BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1050

In the Matter of	)	DIRECT TESTIMONY OF
Application of Duke Energy Carolinas, LLC	)	ROSHENA M. HAM
for Approval of New Cost Recovery Mechanism	)	FOR
and Portfolio of Demand-Side Management and	)	DUKE ENERGY CAROLINAS, LLC
Energy Efficiency Programs	)	

I. INTRODUCTION AND PURPOSE

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Roshena M. Ham and my business address is 550 South Tryon Street, Charlotte, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed as Manager, Measurement and Verification for Duke Energy Carolinas, LLC ("Duke Energy Carolinas" or the "Company").

Q. PLEASE SUMMARIZE YOUR EDUCATION AND PROFESSIONAL QUALIFICATIONS.

A. I have a Bachelor's degree in engineering from Vanderbilt University and a Masters of Business Administration from Georgetown University.

From 1999-2001, I was in the management associate rotation program at Enron. From 2001-2004, I was co-founder and partner of Liberty Power Corporation, a retail electric provider in deregulated markets. From 2004-2008, I was a consultant on various energy projects including energy efficiency, renewable energy and energy procurement, and also during that time I taught business courses at Central Piedmont Community College. From 2006-2009, I worked for Duke University Nicholas School of the Environment as the Energy and Environment program manager. In 2009, I began working for Duke Energy Business Services LLC, a wholly-owned service company subsidiary of Duke Energy Corporation ("Duke Energy"), as an energy efficiency program manager, managing the implementation of Non-Residential Smart $aver

Custom Incentives. In 2013, I assumed my current role as Manager, Measurement and Verification.

Q. PLEASE DESCRIBE YOUR DUTIES AS MANAGER, MEASUREMENT AND VERIFICATION.

A. As Manager, Measurement and Verification, I have responsibilities for a variety of analytical functions in support of product development and operations, including managing impact and process evaluation studies, market research data collection and analysis, marketing design testing, energy load analysis, cost-effectiveness analysis, and product design research. In this role, I provide Evaluation, Measurement and Verification ("EM&V") services for Duke Energy affiliates, including Duke Energy Carolinas.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THIS COMMISSION?

A. No, I have not testified before this Commission.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. My testimony supports Duke Energy Carolinas' Application for approval of its demand-side management ("DSM") and energy efficiency ("EE") cost recovery rider, Rider EE, for 2015 ("Rider 6"). In particular, my testimony: (1) provides an overview of the EM&V process and activities; and (2) details the current findings from the Company's EM&V work.

Q. PLEASE DESCRIBE THE EXHIBITS ATTACHED TO YOUR TESTIMONY.

A. Ham Exhibit 1 provides a summary of the estimated activities and timeframe for completion of EM&V by program. Ham Exhibit 2 provides the actual and expected dates when the EM&V for each program or measure will become effective. Ham Exhibits A through K provide the detailed completed EM&V reports or updates for the following programs:

Ham Exhibit	EM&V Reports	Report Finalization Date	Evaluation Type
A	Smart $aver Residential Energy Efficiency: Property Manager CFLs	February 18, 2013	Process and Impact
B	Residential Energy Assessments (HEHC)	February 19, 2013	Process and Impact
C	Residential Smart $aver: HVAC	February 28, 2013	Impact
D	Power Manager 2012	March 21, 2013	Process
E	Residential Energy Assessments (PER)	March 29, 2013	Process and Impact
F	Non-Res Smart $aver Prescriptive: Linear Fluorescents and Occupancy Sensors	April 5, 2013	Process and Impact
G	Power Manager 2012	June 11, 2013	Impact
H	PowerShare 2012	June 11, 2013	Impact
I	Smart Energy Now	July 31, 2013	Process
J	EE for Schools: NTC	August 21, 2013	Impact
K	Non-Res Smart $aver, Custom	November 20, 2013	Process and Impact

Q. WERE HAM EXHIBITS 1 AND 2 AND A THROUGH K PREPARED BY YOU OR AT YOUR DIRECTION AND SUPERVISION?

A. Yes, they were. However, the EM&V reports were prepared by the Company's independent third party evaluator.

II. RESULTS FROM EM&V

Q. HOW WERE EM&V RESULTS UTILIZED IN DEVELOPING THE PROPOSED RIDER 6?

A. The EM&V process produces two important data sets used in the development of the rider: actual customer participation and evaluated load impacts. As described in Company Witness Kimberly McGee's testimony, the Experience Modification Factor ("EMF"), or true-up, component of Rider 6 incorporates actual customer participation and evaluated load impacts from the EM&V process as agreed upon by the Company, Southern Alliance for Clean Energy ("SACE") and the Public Staff and approved by the Commission in its *Order Approving DSM/EE Rider and Requiring Filing of Proposed Customer Notice* issued November 8, 2011 in Docket No. E-7, Sub 979 ("EM&V Agreement"). In addition, actual participation and evaluated load impacts are used prospectively to update net lost revenues estimated for 2015.

The EM&V Agreement provides that initial EM&V results shall be applied retrospectively to program impacts that were based upon estimated impact assumptions derived from industry standards (rather than EM&V results for the program in the Carolinas), specifically the DSM and EE programs initially approved by the Commission in Docket No. E-7, Sub 831 ("Sub 831 Programs"), with the exception of the Non-Residential Smart $aver Custom Rebate Program and the Low Income Energy Efficiency and Weatherization Assistance Program.

For purposes of the vintage true-ups, initial EM&V results are considered actual results for a program and continue to apply until superseded by new EM&V results, if any. For all new programs and pilots approved after the Sub 831 Programs, the initial estimates of impacts will be used until Duke Energy Carolinas has EM&V results, which will then be applied back retrospectively to the beginning of the offering and will be considered actual results until a second EM&V is performed.

All program impacts from EM&V apply only to the programs for which the analysis was directly performed, though Duke Energy Carolinas' new product development may utilize actual impacts and research about EE and behavior conservation directly attributed to existing Duke Energy Carolinas program offerings not already accounted for.

Since program impacts from EM&V in this Application apply only to the programs for which the analysis was directly performed, there are no costs associated with performing additional EM&V for other measures, other than the original cost for EM&V for these programs. As indicated in previous proceedings, Duke Energy Carolinas estimates that 5% of total portfolio program costs will be required to adequately and efficiently perform EM&V on the portfolio. The level of EM&V required varies by program and depends on that program's contribution to total portfolio, the duration the program has been in the portfolio without material change, and whether the program and administration is new and different in the energy industry. However, Duke Energy Carolinas estimates no additional costs above 5% of total program costs will be associated with performing EM&V for all measures in the portfolio.

Q. HOW WILL EM&V BE APPLIED UNDER THE NEW MECHANISM?

A. Pursuant to the Agreement and Stipulation of Settlement the Company reached with the Public Staff, the North Carolina Sustainable Energy Association, Environmental Defense Fund, SACE, the South Carolina Coastal Conservation League, the National Resource Defense Council and the Sierra Club filed with the Commission in Docket No. E-7, Sub 1032 on August 19, 2013 (the "Stipulation") and approved in the Commission's *Order Approving DSM/EE Programs and Stipulation of Settlement* issued in the same docket on October 29, 2013 ("Sub 1032 Order"), the Company will continue to apply EM&V in accordance with the EM&V Agreement.

For purposes of the annual true-ups, initial results based upon Carolinas EM&V would be considered actual results for a program and would continue to apply until superseded by new EM&V results, if any. For all new programs and pilots that do not have existing Carolinas-based EM&V approved in this portfolio, the initial estimates of impacts will be used until Duke Energy Carolinas has EM&V results, which will then be applied retrospectively to the beginning of the offering and will be considered actual results until a second EM&V is performed, which will then be applied prospectively beginning from the EM&V sample analysis end date. All program impacts from EM&V apply only to the programs for which the analysis was directly performed. As no vintages of the new portfolio of EE/DSM programs approved in the Sub 1032 Order have been completed, there are no true-ups associated with the new mechanism included in Rider 6.

Q. WHICH PROGRAMS CONTAIN IMPACT ESTIMATES BASED ON CAROLINAS-BASED EM&V?

A. The following programs have Carolinas-based EM&V applied and have been provided as Ham Exhibits A through K.

- Smart $aver Residential Energy Efficiency: Property Manager CFLs *(Ham Exhibit A)*
- Residential Energy Assessments (Home Energy House Call ("HEHC")) *(Ham Exhibit B)*
- Residential Smart $aver: HVAC *(Ham Exhibit C)*
- Residential Energy Assessments (Personal Energy Report ("PER")) *(Ham Exhibit E)*
- Non-Residential Smart $aver Prescriptive: Linear Fluorescents and Occupancy Sensors *(Ham Exhibit F)*
- Power Manager 2012 *(Ham Exhibit G)*
- PowerShare 2012 *(Ham Exhibit H)*
- Smart Energy Now *(Ham Exhibit I)*
- EE for Schools: National Theater for Children *(Ham Exhibit J)*
- Non-Residential Smart $aver, Custom *(Ham Exhibit K)*

Q. WHICH PROGRAMS WILL HAVE INITIAL ESTIMATES REPLACED WITH EM&V IN THE FUTURE?

A. The following programs will have Carolinas-based EM&V applied in future annual filings:

- Appliance Recycling Program
- Energy Efficient Appliances and Devices: *Specialty Bulbs, Pool Pumps, Water EE and Heater Products*
- HVAC Energy Efficiency Program: *Tune up, Duct and Attic Insulation and Sealing*
- Income-Qualified Energy Efficiency Program: *Weatherization, Refrigerator Replacement and Neighborhood Initiative*
- Multi-Family Energy Efficiency Program: *Water EE Products*
- Energy Management and Information Services Program Pilot
- Smart Energy Now Pilot

Q. WHICH PROGRAMS OR MEASURES HAVE COMPLETED THEIR EM&V?

A. The completed process evaluation studies for Carolinas-based Smart $aver Residential Energy Efficiency: Property Manager CFLs, Residential Energy Assessments (HEHC), Power Manager 2012, Residential Energy Assessments (PER), Non-Residential Smart $aver Prescriptive: Linear Fluorescents and Occupancy Sensors, Smart Energy Now, and Non-Residential Smart $aver, Custom are included as Ham Exhibits A, B, D, E, F, I and K, respectively. Several of these are combined with an Impact Evaluation.

The completed impact evaluation studies for Smart $aver Residential Energy Efficiency: Property Manager CFLs, Residential Energy Assessments (HEHC), Residential Smart $aver: HVAC, Residential Energy Assessments (PER), Non-Residential Smart $aver Prescriptive: Linear Fluorescents and Occupancy Sensors, Power Manager 2012, PowerShare 2012, EE for Schools: NTC , and Non-Residential Smart $aver, Custom are included as Ham Exhibits A, B, C, E, F, G, H, J and K, respectively.

Q. WHAT WERE THE LOAD IMPACTS FROM THE EM&V AND HOW DO THEY COMPARE TO THE COMPANY'S IMPACT ESTIMATES PRIOR TO EM&V?

A. Gross energy savings[1] from the **Smart $aver Residential Energy Efficiency: Property Manager CFLs Program** were originally estimated to be 39.59 kWh. Based on the most recent EM&V, the gross savings are 40.73 kWh (net energy savings[2] were modified from 36.34 kWh to 37.83 kWh). The coincident kW had an adjustment from 0.0038 kW to 0.0036 kW. These results became effective October 1, 2012 and apply to participants in the Smart $aver Residential Energy Efficiency:

[1] kWh without line losses.
[2] Net adjustments include free ridership, spillover and line losses.

Property Manager CFLs Program. This report has been provided as Ham Exhibit A.

Gross energy savings from the **Residential Energy Assessments (HEHC) Program** were originally estimated to be 901 kWh based on the prior EM&V report. Based on the most recent EM&V, the gross savings are 928 kWh (net energy savings were modified from 690.66 kWh to 1002.24 kWh). The coincident kW had an adjustment from 0.13 kW to 0.19 kW. These results became effective December 1, 2012 and apply to participants in the Residential Energy Assessments (HEHC) Program. This report has been provided as Ham Exhibit B.

Gross energy savings from the **Residential Smart $aver: HVAC Program** were originally estimated to be 830 kWh for air conditioners ("AC") and 997 kwh for heat pumps ("HP"), based on the prior EM&V report. Based on the most recent EM&V, the gross savings are 271 kWh for AC and 637 kWh for HP (net energy savings were modified from 649.9 kWh to 198.4 kWh for AC and from 780.7 kWh to 466.8 kWh for HP). The coincident kW had an adjustment from 0.138 kW to 0.046 kW for AC and from 0.165 kW to 0.099 kW for HP. These results became effective October 1, 2012 and apply to participants in the Residential Smart $aver: HVAC Program. This report has been provided as Ham Exhibit C.

Gross energy savings from the **Residential Energy Assessments (PER) Program** were originally estimated to be 254.57 kWh based on the prior EM&V report[3]. Based on the most recent EM&V, the gross savings are 521 kWh (net energy savings were modified from 237.54 kWh to 562.68 kWh). The coincident kW had an adjustment from 0.026 kW to 0.104 kW. These results became effective September 1, 2012 and apply to participants in the Residential Energy Assessments (PER) Program. This report has been provided as Ham Exhibit E.

Gross energy savings from the **Non-Residential Smart $aver Prescriptive: Linear Fluorescents and Occupancy Sensors Program** were updated. The updates are reported as a single realization rate which is applied to all measures that are in the measure category. Lighting impacts were revised upward as compared to original estimates. Based on the most recent EM&V, the kWh savings increased by a realization rate of 1.73. Occupancy sensor impacts were revised upward; based on the most recent EM&V, the kWh savings increased by a realization rate of 1.19. These results became effective October 1, 2012 and apply to participants in the Non-Residential Smart $aver Prescriptive: Linear Fluorescent and Occupancy Sensor Measures. This report has been provided as Ham Exhibit F.

Gross energy savings from the **EE for Schools: National Theater for Children (NTC) Program** were originally estimated to be 249 kWh based on the prior EM&V report. Based on the most recent EM&V, the

[3] Ex post impacts described in Direct Testimony of Ashlie J. Ossege, Docket No. E-7, Sub 1001 were revised as described in Direct Testimony of Ashlie J. Ossege, Docket No. E-7, Sub 1031.

gross savings are 236 kWh (net energy savings were modified from 221.4 kWh to 254.88 kWh). The coincident kW had an adjustment from 0.0411 kW to 0.0473 kW. These results became effective September 1, 2012 and apply to participants in the EE for Schools: NTC Program. This report has been provided as Ham Exhibit J.

Gross energy savings from the **Non-Residential Smart $aver, Custom Program** were also updated. The updates are reported as a single realization rate which is applied to all measures in the program. Based on the most recent EM&V, the kWh savings decreased by a realization rate of 0.94. These results became effective January 1, 2013 and apply to participants in the Non-Residential Smart $aver, Custom Program. This report has been provided as Ham Exhibit K.

Q. WHAT IS THE PROJECTED ACTIVITIES SCHEDULE FOR EM&V AND ESTIMATED EFFECTIVE DATES OF IMPACTS?

A. The projected activities schedules for EM&V can be found in Ham Exhibit 1. The effective dates can be found in Ham Exhibit 2.

Q. PLEASE EXPLAIN ANY ADDITIONS OR CHANGES TO THESE SCHEDULES FROM THE PRIOR PROCEEDING?

A. There were a few additions and changes made from the previous EM&V Schedule filed as Ossege Exhibit 2 in the Rider 5 Filing, which are reflected in Ham Exhibit 2. In addition, the format of Ham Exhibit 1 has been changed to reflect a color-coded chart format along with a narrative on EM&V activities.

Ham Exhibit 2 shows that the MyHER evaluation report will be delivered in the first quarter of 2014 (instead of the fourth quarter of 2013, as shown in Rider 5 Filing Ossege Exhibit 2). This change was to ensure that a full year of billing data for North Carolina customers was available for the analysis. The effective date of the impacts will be November 2013.

Ham Exhibit 2 also shows the current projected schedule for impact evaluation reports in 2014-2017. Actual report dates may vary depending on program participation to provide a significant sample and the time needed to collect adequate data.

Q. DO THE COMPANY'S CURRENT AND FUTURE EM&V REPORTS EVALUATE SNAPBACK AND PERSISTENCE?

A. Yes. Snapback can be thought of as the additional energy and capacity used by customers who feel they can consume more because they have implemented an energy-efficient product. For example, snapback occurs when a customer decides not to turn off a newly-installed CFL when he leaves the room, because he figures that his energy consumption does not matter as the CFL is more efficient than his previously-installed incandescent light bulb.

Persistence is the measurement of how long an energy-efficient product remains installed and utilized after its initial acquisition. For example, persistence measures if a customer decides to remove a CFL after it has been installed because they do not like the quality of light produced. Both snapback and short-term persistence are measured and included (though not explicitly) in the EM&V reports, as they apply to EE programs.

Billing analysis and on-site metering capture the short-term effects of snapback and persistence, because they capture the impacts that occur soon after an EE action is taken. Because metering and utility bill analyses often examine electric consumption records before and after an action is taken, the effects of snapback and persistence are embedded in the analysis results.

The long-term effects of persistence, however, cannot be directly measured during the current 12- to 18-month cycle for each EM&V report. Long-term analysis of persistence requires regular, cyclical studies with the same respondents over the life of each measure. Such long-term evaluations would increase the cost of EM&V reporting significantly but would provide little, if any, increased accuracy in the analysis.

The EM&V reports for the Company's programs include an explicit paragraph explaining the evaluation of snapback and persistence, as described above.

III. <u>LOST REVENUES</u>

Q. PLEASE EXPLAIN HOW THE ENERGY AND CAPACITY REDUCTIONS FOR THE NET LOST REVENUE CALCULATIONS FOR THE PROSPECTIVE COMPONENTS OF RIDER 6 WERE CALCULATED.

A. Based on the available EM&V analysis, the Company ran the DSMore model in order to calculate the kWh and kW reductions associated with net lost revenues. These results were then provided to Witness McGee in order for her to determine the Company's net lost revenues. Energy and capacity associated with net lost revenues for year three of Vintage 4, year two of Vintage 2014 and year one of Vintage 2015 were calculated beginning January 1, 2015 and ending December 31, 2015 using rates in effect as of September 25, 2013.

IV. CONCLUSION

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.

March 2014

Planned Evaluation, Measurement and Verification (EMV) Activities through the rate period (Dec. 31, 2015)

Evaluation is a term adopted by Duke Energy Carolinas, DEC, and refers generally to the systematic process of gathering information on program activities, quantifying energy and demand impacts, and reporting overall effectiveness of program work. Within evaluation, the activity of measurement and verification (M&V) refers to the collection and analysis of data at a participating facility/project. Together this is referred "EM&V."

Refer to the accompanying Exhibit 1 chart for a schedule of process and impact evaluation analysis and reports that are scheduled.

Energy Efficiency Portfolio Evaluation

DEC has contracted with an independent, third-party evaluation consultant to provide the appropriate EM&V support, including the development and implementation of an evaluation plan designed to measure the energy and demand impacts of the residential and non-residential energy efficiency programs.

Typical EM&V activities:

- Develop evaluation action plan
- Process evaluation interviews
- Collect program data
- Verify measure installation and performance through surveys and/or on-site visits
- Program database review
- Impact data analysis
- Reporting

The process evaluation provides unbiased information on past program performance, current implementation strategies and opportunities for future improvements. Typically, the data collection for process evaluation consists of surveys with program management, implementation vendor(s), program partner(s), and participants; and, in some cases, non-participants. A statistically representative sample of participants will be selected for the analysis.

The impact evaluation provides energy and demand savings resulting from the program. Impact analysis may involve engineering analysis (formulas/algorithms), billing analysis, statistically adjusted engineering method, and/or building simulation models, depending on the program and the nature of the impacts. Data collection may involve surveys and/or site visits. A statistically representative sample of participants is selected for the analysis. The Company intends to follow industry-accepted methodologies for all measurement and verification activities, consistent with International Performance Measurement Verification Protocol (IPMVP) Options A, C or D depending on the measure.

The field of evaluation is constantly learning from ongoing data collection and analysis, and the best practices for evaluation, measurement and verification continually evolve. As updated best practices are identified in the industry, DEC will consider these and revise evaluation plans as appropriate to provide accurate and cost-effective evaluation.

Demand Response Program Evaluation

DEC has contracted with an independent, third-party evaluation consultant to provide an independent review of the evaluation plan designed to measure the demand impacts of the residential and non-residential demand response programs and the final results of that evaluation.

Typical EM&V activities:

- Collect program data
- Process evaluation interviews
- Verify operability and performance through on-site visits
- Collect interval data
- Program database review
- Benchmarking research
- Dispatch optimization modeling
- Impact data analysis
- Reporting

The process evaluation provides unbiased information on past program performance, current implementation strategies and opportunities for future improvements. Typically, the data collection for process evaluation consists of surveys with program management, implementation vendor(s), program partner(s), and participants; and, in some cases, non-participants. A statistically representative sample of participants will be selected for the analysis.

The impact evaluation provides demand savings resulting from the program. Impact analysis for Power Manager involves a simulation model to calculate the duty cycle reduction, and then an overall load reduction. Impact analysis for PowerShare involves statistical modeling of an M&V baseline load shape for a customer, then modeling the event period baseline load shape and comparing to the actual load curve of the customer during the event period.

The field of evaluation is constantly learning from ongoing data collection and analysis, and the best practices for evaluation, measurement and verification continually evolve. As updated best practices are identified in the industry, DEC will consider these and revise evaluation plans as appropriate to provide accurate and cost-effective evaluation.

Ham Exhibit 1 - March 2014
Planned Evaluation, Measurement and Verification (EMV) Activities through the rate period (Dec. 31, 2015)

		Evaluation Activities 2014-2015 [1]							
Residential Program	**Program/Measure**	**Q1 2014**	**Q2 2014**	**Q3 2014**	**Q4 2014**	**Q1 2015**	**Q2 2015**	**Q3 2015**	**Q4 2015**
Appliance Recycling Program	Refrigerator, Freezer	Process Evaluation Report							
		Impact Evaluation Report				Impact Analysis	Impact Analysis	Impact Evaluation Report	
Energy Education Program for Schools	K12 Curriculum					Process Analysis	Process Analysis	Process Evaluation Report	
						Impact Analysis	Impact Analysis	Impact Evaluation Report	
Energy Efficient Appliances & Devices	Residential CFL					Process Analysis	Process Analysis	Process Evaluation Report	
						Impact Analysis	Impact Analysis	Impact Evaluation Report	
Energy Efficient Appliances & Devices	Specialty Bulbs	Process Analysis	Process Analysis	Process Evaluation Report					
		Impact Analysis	Impact Analysis	Impact Evaluation Report					
Energy Efficient Appliances & Devices	Water Heater; Water EE Products				Process Analysis	Process Analysis	Process Evaluation Report		
					Impact Analysis	Impact Analysis	Impact Evaluation Report		
Energy Efficient Appliances & Devices	Pool Pumps			Process Analysis	Process Analysis	Process Evaluation Report			
				Impact Analysis	Impact Analysis	Impact Evaluation Report			
HVAC EE Products & Services [2]	Duct Insulation, Sealing, Tune Up; Attic Sealing, Insulation		Process Analysis	Process Analysis	Process Evaluation Report				
			Impact Analysis	Impact Analysis	Impact Evaluation Report				
Income-Qualified EE Products & Services	Weatheriziation; Refrigerator Replacement					Process Analysis	Process Analysis	Process Evaluation Report	
							Impact Analysis	Impact Analysis	Impact Evaluation Report
Income-Qualified EE Products & Services	Neighborhood Initiative	Process Analysis	Process Evaluation Report						
			Impact Analysis	Impact Analysis	Impact Evaluation Report				
Multi-Family Energy Efficiency	Water EE Products					Process Analysis	Process Analysis	Process Evaluation Report	
							Impact Analysis	Impact Analysis	Impact Evaluation Report
My Home Energy Report	My Home Energy Report	Process Evaluation Report							
		Impact Evaluation Report							
Power Manager	Power Manager	Process Evaluation Report			Process Analysis	Process Evaluation Report			
		Impact Analysis	Impact Evaluation Report			Impact Analysis	Impact Evaluation Report		

The following Residential programs do not have evaluation reports scheduled for delivery in 2014-2015: HVAC Residential Smart $aver AC and HP; Multi-Family Energy Efficiency Lighting (CFL Property Manager); Residential Energy Assessments

		Evaluation Activities 2014-2015 [1]							
Non-Residential Program	**Description**	**Q1 2014**	**Q2 2014**	**Q3 2014**	**Q4 2014**	**Q1 2015**	**Q2 2015**	**Q3 2015**	**Q4 2015**
Custom Assessment	Custom Assessment	*Schedule TBD based on participation*							
		Schedule TBD based on participation							
Non-Residential Smart $aver Custom Incentive [3]	Custom Rebate		Process Analysis			Process Analysis	Process Analysis		
				Impact Analysis	Impact Analysis			Impact Analysis	Impact Analysis
Energy Management and Information Services	Energy Management and Information Services	*Schedule TBD based on participation*							
		Schedule TBD based on participation							
Non-Residential Smart $aver Energy Star Food Service Products [3]	Energy Star Food Service Products			Process Analysis	Process Analysis		Process Analysis	Process Analysis	Process Evaluation Report
				Impact Analysis	Impact Analysis			Impact Analysis	Impact Analysis
Non-Residential Smart $aver HVAC [3]	HVAC			Process Analysis	Process Analysis		Process Analysis	Process Analysis	Process Evaluation Report
				Impact Analysis	Impact Analysis			Impact Analysis	Impact Analysis
Non-Residential Smart $aver Lighting [3]	Lighting			Process Analysis	Process Analysis			Process Analysis	Process Analysis
				Impact Analysis	Impact Analysis				Impact Analysis
Non-Residential Smart $aver Motors, Pumps & VFDs [3]	Motors, Pumps & VFDs			Process Analysis	Process Analysis		Process Analysis	Process Analysis	Process Evaluation Report
				Impact Analysis	Impact Analysis			Impact Analysis	Impact Analysis
Non Res Information Technology	Non Res Information Technology	*Schedule TBD based on participation*							
		Schedule TBD based on participation							
Process Equipment [3]	Process Equipment			Process Analysis	Process Analysis		Process Analysis	Process Analysis	Process Evaluation Report
				Impact Analysis	Impact Analysis			Impact Analysis	Impact Analysis
PowerShare Call Option	PowerShare Call Option	Process Analysis	Process Evaluation Report						
		Impact Evaluation Report			Impact Analysis	Impact Evaluation Report			
PowerShare	PowerShare	Process Analysis	Process Evaluation Report						
		Impact Evaluation Report			Impact Analysis	Impact Evaluation Report			
Smart Energy Now	Smart Energy Now								
		Impact Evaluation Report							

[1] Future Process and Impact Evaluation Report dates are projections only. Actual report dates will vary depending on program participation to provide a significant sample and the time needed to collect adequate data.
[2] Evaluation work for HVAC (Duct Insulation, Sealing, Tune Up; Attic Sealing, Insulation) will be delayed if participation remains low.
[3] Evaluation work for the following programs will be done in batches, with some data collected each year to contribute to the final analysis: Custom Incentive, Energy Star Food Service Products, HVAC, Lighting, Motors, Pumps & VFDs, and Process Equipment.

LEGEND	
Process Analysis	Process surveys/interviews (customers or other) for purposes of report that follows
Impact Analysis	Impact data collection (onsites, billing data) and analysis for purposes of report that follows
Evaluation Report	EM&V Report

Ham Exhibit 2 - March 2014

EM&V EFFECTIVE DATE TIMELINE

This chart contains the expected timeline with end of customer data sample period for impact evaluation and when the impact evaluation report is expected to be completed.

Unless otherwise noted, original impact estimates are replaced with the first impact evaluation results, after which time subsequent impact evaluation results are applied prospectively.

Program	Program/Measure	2014				2015				2016				2017			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Appliance Recycling	Refrigerator, Freezer	Report						2nd EM&V	Report								
Energy Efficiency Education (K12 Curriculum)	Energy Efficiency Education (K12 Curriculum)							3rd EM&V	Report								
Energy Efficient Appliance and Devices	Lighting - Smart Saver RCFL						3rd EM&V	Report							4th EM&V	Report	
	Lighting - Specialty Bulbs		1st EM&V	Report											2nd EM&V	Report	
	HP Water Heater					1st EM&V	Report										
	Pool Pumps				1st EM&V	Report											
	SF Water EE Products					1st EM&V	Report										
HVAC Energy Efficiency	Residential Smart $aver AC and HP															3rd EM&V	Report
	Duct Insulation and Sealing			1st EM&V	Report												
	Tune Up			1st EM&V	Report												
	Attic Sealing and Insulation			1st EM&V	Report												
Income-Qualified Energy Efficiency	Weatherization							1st EM&V	Report							2nd EM&V	Report
	Refrigerator Replacement							1st EM&V	Report								
	Low Income Neighborhood			1st EM&V	Report							2nd EM&V	Report				
Multi-Family Energy Efficiency	MF Water EE Products							1st EM&V	Report								
	Lighting (CFL Property Manager)										2nd EM&V	Report					
My Home Energy Report [1]	MyHER	Report										3rd EM&V	Report				
Residential Energy Assessments	Home Energy House Call														3rd EM&V	Report	
Non-Residential Smart $aver Energy Efficiency Custom	Non-Res Smart$aver Custom Rebate													2nd EM&V	Report		
Non-Residential Smart $aver Energy Effiency Food Service	Non-Res Smart $aver Energy Effiency Food Service								2nd EM&V	Report							
Non-Residential Smart $aver Energy Effiency HVAC Products	Non-Res Smart $aver Energy Effiency HVAC Products								2nd EM&V	Report							
Non-Residential Smart $aver Energy Effiency Lighting	Non Re Smart $aver Prescriptive Lighting									2nd EM&V	Report						
	Non Res Smart $aver Prescriptive Other									3rd EM&V	Report						
Non-Residential Smart $aver Energy Effiency Motors Pumps Drives	Non-Res Smart$aver Prescriptive (VFDs or other)								2nd EM&V	Report							
Non-Residential Smart $aver Energy Effiency Process Equipment	Non-Res Smart $aver Energy Effiency Process Equip								2nd EM&V	Report							
Smart Energy Now	Smart Energy Now	Report															

[1] EM&V schedule for MyHER has been adjusted to evaluate the impact of the planned addition of electronic delivery channel.

- Original Estimate
- 1st EM&V
- 2nd EM&V
- 3rd EM&V
- 4th EM&V

Final Report

Process and Impact Evaluation of Duke Energy's Residential Smart $aver: Property Manager CFLs in the Carolinas

Prepared for

Duke Energy

139 East Fourth Street
Cincinnati, OH 45201

February 18, 2013

Submitted by

Nick Hall and Brian Evans
TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

Subcontractor:

Pete Jacobs
BuildingMetrics, Inc.

Matthew Joyce

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Executive Summary

At the time of the Residential Smart $aver Energy Efficiency: CFL evaluation, the data collection and analysis was still underway for the Property Manager CFL outreach (program). This is an addendum as part of the overall Residential Lighting program evaluation.

Key Findings

This section presents the key findings and recommendations identified through the evaluation of the North and South Carolina Residential Smart$aver CFL Program: Property Managers CFLs. Table 1 presents the estimated overall impacts from the engineering analysis.

Table 1. Estimated Overall Impacts

	Gross Savings	Net Savings
Annual Savings Per Bulb Distributed		
kWh	40.7	35.0
kW	0.0038	0.0033

The impacts in this table were calculated using engineering algorithms from Appendix D: Impact Algorithms. These estimates use the actual average daily hours of use as measured through a lighting logger study. The net-to-gross ratio used to calculate net savings is 86%. Freeridership and spillover, the two components of the net-to-gross ratio, are calculated in their respective sections: Freeridership Levels and Spillover Levels.

Significant Impact Evaluation Findings

- Mean wattage of a replaced bulb is 55 watts.
    - See Impact Analysis on page 17.
- An ISR of 94.7% was reported.
    - See In-Service Rate on page 16.
- Daylength-adjusted average daily hours of use from the lighting logger study is 2.89
    - See Table 12 on page 23.
- Living or family room, bathroom, kitchen, and master bedroom, in that order, are the four most popular room types for bulb replacements; together they make up 78% of all bulb installations.
    - See Figure 1 on page 19.

Significant Process Evaluation Findings

From the Management Interviews

- The program did not meet its goal for CFL installs in the first year. In North Carolina it installed 171,673 CFLs against an initial goal of 779,812, which was 22% of goal. In South Carolina it installed 57,968 CFLs against an initial goal of 288,424, which was 20% of goal.

- As of September 4, 2012, performance in North Carolina is 296,054 CFLs against an annual goal of 324,850, which is currently 91% of goal. In South Carolina, year to date performance is 39,816 CFLs against a goal of 120,150, which is 33% of goal.
- Low performance against goals in 2011 is attributed to the following reasons: The program was rolled out with insufficient Honeywell staffing, and management and marketing processes to support the roll-out were slow to start.
- While bulb installs in South Carolina continue to lag in 2012, overall program administration and daily operations are running smoothly.
- Program managers and property managers concur that participation rates would likely increase if Duke Energy offered CFLs for common areas and administrative spaces. If these areas are not covered under residential rates and are thus ineligible for this program, then interested property managers might be referred to an alternative program offering CFLs to business customers.

From the Property Manager Interviews

- Customer satisfaction with the program is high, with a mean satisfaction score of 8.7 in North Carolina and 8.8 in South Carolina. The biggest complaint hindering satisfaction is too much labor involved.
- Customer satisfaction with Duke Energy is fairly high, with a mean satisfaction score of 8.0 in North Carolina and 7.7 in South Carolina. High electric rates were the most frequent reason given for lower satisfaction scores.
- A strong majority (89%) of property managers surveyed felt that programs such as this were necessary to get properties to begin using CFLs, reinforcing the program theory and approach for achieving net new savings.
- More than half of property managers interviewed said they participated in the program at the direction of their corporate offices. This is a direct reflection of the success of the top down approach to recruiting property manager participation for this program.
- Three quarters of property managers cite indirect benefits to their businesses such as happier tenants or temporary savings on bills for vacant units as program benefits. However, many property managers consider the program to be one of high effort with little direct reward to the property owners or managers since the energy savings accrue to the tenants.
- The largest barrier to participation and the most frequent complaint has to do with the extensive labor involved in replacing large quantities of bulbs.
- 82% of property managers surveyed indicated that if not for the program they would not have replaced their existing incandescent bulbs with CFL bulbs, compared to 4% of respondents who said they would have done so regardless of program participation. The program is changing how bulbs are replaced and the use of incandescents as the primary type of bulb used prior to the program.
- 65% of property managers plan to continue providing CFLs in the future, while 20% will go back to incandescents indicating strong long-term market effect savings above the savings achieved directly via the program-provided bulbs.
- In terms of the wattage of the old bulbs that were removed, 60 watt incandescents were the overwhelming majority with 94% of respondents reporting that bulb type.

- Eighty nine percent of property managers interviewed reported that their tenants responded favorably overall to the installation process.
- The single most requested type of specialty bulb was the Hollywood (globe) bulb for use in bathroom vanities featuring rows of exposed bulbs, with 45% of all respondents making this request.
- Property managers praised their communications with Honeywell, the program implementer.

From the Tenant Surveys

- Tenant satisfaction is very high. Their ratings (using a 10-point scale) were: light quality (8.9) and bulb quality (9.2), overall program satisfaction (9.2), and overall satisfaction with Duke Energy (9.0).
- Incandescent bulbs were far and away the most frequently mentioned type of bulb to be replaced with 76% of respondents mentioning this bulb type. The most popular wattage replaced was 60 watt bulbs.
- Fifty seven percent of respondents said that prior to participation in this program they had no CFLs previously installed; 38% indicted that they had already installed CFLs.
- Likewise, more than half (53%) of survey respondents indicated that they had never purchased CFLs before.
- When asked to estimate the number of remaining bulbs in their homes that were not CFLs, 28% reported zero, indicating that all the bulbs in their homes were CFLs. Forty one percent reported one to five bulbs as non-CFLs, while another 16% indicated that six to ten bulbs were non-CFLs.
- When asked to rate the likelihood of buying and using CFLs in the future on a 10 point scale, 57% rated their likelihood as a 10. The average likelihood was 8.5.
- The most important factor influencing future CFL buying decisions is their cost savings on utility bills, followed closely by energy savings. Factors such as mercury, appearance, and ability to dim the light scored as the least important.
- Direct mail is the preferred distribution method for receiving discounted bulbs.
- 23% of respondents reported changing their energy behaviors after participating in the program, and 18% reported making energy efficiency improvements to their homes. To boost these numbers, program managers will need to step up the educational aspects of the program.

Introduction and Purpose of Study

Summary Overview

This document presents the impact evaluation report for Duke Energy's Residential Smart $aver Energy Efficiency: Property Manager CFLs as it was administered in the Carolina System. The evaluation was conducted by TecMarket Works, BuildingMetrics, and Matthew Joyce, subcontractors to TecMarket Works.

Summary of the Evaluation

TecMarket Works performed a process evaluation comprised of management interviews, property manager interviews, and a survey of tenants to identify program implementation issues and satisfaction levels.

Table 2. Evaluation Date Ranges

Evaluation Component	Dates of Analysis
Tenant Surveys	Surveys conducted from 4/17/12 through 5/23/12
Property Manager Interviews	Interviews conducted from 5/1/12 through 6/11/12
Logger Study	Loggers installed from 7/16/12 through 9/17/12
Engineering Estimates	10/16/2012 through 11/6/2012

TecMarket Works conducted tenant phone surveys between April 17 and May 23, 2012 with 85 randomly selected tenants who received CFLs in the Carolina System.

Surveyed tenants were asked how many CFLs that were currently installed in light fixtures and specific information was collected for a maximum of three bulbs. This information included the location of the installed CFL, the type and wattage of the bulb that it replaced, and the average hours per day that it is in use. The information gathered about the three CFLs is sufficient and provides statistically significant data. The actual hours of use were measured through the use of a lighting logger study and used in the place of the self-reported values for the engineering savings estimates.

An impact analysis was performed for all CFLs by room type and can be seen in Table 12. However, it should be noted that individual room type samples are of insignificant size to achieve statistical relevance and are presented as anecdotal evidence. The impacts are based on an engineering analysis of the impacts associated with the self-reported installs identified through the tenant surveys.

Evaluation Objectives

The objective of the process evaluation is to determine the effectiveness of and customer satisfaction with Duke Energy's Smart $aver Residential Energy Efficiency CFLs: Property

Manager channel as it was administered in the Carolina System. The objective of this impact evaluation is to determine the energy impacts.

Program Description

As part of the Residential CFL program Duke Energy targeted and worked with property managers of multi-family communities within Duke Energy service territory to provide and install 13-watt energy efficient CFLs in permanent fixtures of the residential units on their respective properties.

The first objective of the program is to replace as many incandescent bulbs as possible with energy-efficient 13-watt bulbs. The second objective is to stimulate long-term behavior change by educating tenants and property managers about similarities and differences between incandescent bulbs and energy-efficient bulbs, and helping them understand how to properly shop for and recycle energy-efficient bulbs. The intention is to saturate as many multi-family communities as possible with energy-efficient bulbs so that tenants become familiar with using CFLs and start noticing impacts on their electric bills.

To achieve these objectives Duke Energy's third-party agent Honeywell identifies and approaches property management companies and individual property managers to inform them about the program and to encourage enrollment. Upon signing up, property managers calculate the number of eligible sockets (up to 12 per apartment) on their properties and place their orders. The bulbs are then shipped to the properties, which also receive digital copies of tenant notification letters, packets of information for residents about the bulbs and recycling, and installation worksheets for maintenance crews to track bulbs installations. Properties are given up to 90 days to install the bulbs and complete the documentation paperwork. The cost of the bulbs is covered by Duke Energy, while shipping costs are paid by the properties.

Program Goals and Participation

The program began with an initial goal of 779,812 CFLs to be installed in North Carolina and 288,424 CFLs South Carolina by the end of 2011. Those goals were not reached by year end. Actual installs totaled 171,673 bulbs (22% of goal) in North Carolina, and 57,968 CFLs (20% of goal) in South Carolina.

The 2012 program goals are 324,850 CFLs in North Carolina and 120,150 in South Carolina. As of September 4, 2012 the program had installed 296,054 CFLs in North Carolina (91% of goal), and 39,816 CFLs in South Carolina (33% of goal).

Since its inception, the program has enrolled a combined total of 369 properties in North Carolina with 56,968 units and installed a combined total of 467,028 CFLs. Since inception, numbers for South Carolina are 111 properties with 13,526 units and a total of 98,484 installed CFLs. The combined totals for the Carolina System are 480 properties, 70,494 residential units, and 565,512 CFLs installed.

According to the Duke Energy program manager, the program's inability to reach its initial goals was primarily due to insufficient Honeywell resources devoted to the effort. As seen in the numbers cited above, goals for 2012 were lower than 2011 and performance improved during the second year. Progress is strong in North Carolina, but still lags in South Carolina.

Table 3 summarizes the program's performance to date. Note that when an overage in bulbs occurs, rather than return the extra bulbs to Niagara/AM Conservation, the extra bulbs are held in Honeywell's inventory and distributed to other properties that need them. As a result, the bulb order quantities and bulb install quantities do not necessarily align as shown in the table below.

Table 3. Program Performance through September 4, 2012

State	Time Period	Goal # of Installed Bulbs	Property Count	Sum Bulb Order Qty	Unit Count	Sum of Bulbs Installed/ Uploaded to EE Database	% of Goal	Avg. Bulbs Per Unit
NC	2011	779,812	135	178,296	21,423	171,673	22%	8
NC	2012	324,850	234	307,346	35,545	296,054	91%	8
NC	2011-2012	1,104,662	369	485,642	56,968	467,028	42%	8
SC	2011	288,424	64	60,103	8,948	57,968	20%	7
SC	2012	120,150	47	37,839	4,578	39,816	33%	9
SC	2011-2012	408,574	111	97,942	13,526	98,483	24%	7
Total	2011	1,068,236	199	238,399	30,371	229,641	21%	8
Total	2012	445,000	281	345,185	40,123	335,870	75%	8
Total	2011-2012	1,513,236	480	583,584	70,494	565,511	37%	8

Methodology

Overview of the Evaluation Approach

The impact evaluation studies the responses of a series of questions posed to tenants residing in participating properties. These questions include the location of the CFL, the type and wattage of the bulb that it replaced, and the average hours per day that it is in use. TecMarket Works conducted the phone surveys with a random sample of 85 tenants[1] from the Carolinas between April 17, 2012 and May 23, 2012. The compilation of this data is presented in Table 8 in its unadjusted form; that is before the self-reporting bias is applied to the hours of use. The adjusted values appear in Table 9. The actual hours of use were measured through the use of a lighting logger study and used in the place of the self-reported values for the engineering savings estimates. The unadjusted results from the lighting logger study are shown in Table 10. The values that have been adjusted for day length appear in Table 12.

The process evaluation consisted of three primary components: management interviews, property manager interview surveys, and tenant surveys.

Study Methodology

Management Interviews

TecMarket Works held interviews with three members of Duke Energy's program management, two managers from Honeywell, which is the partnering vendor, and one manager at Niagara, the program's original fulfillment contractor. The interviews considered program design, execution, operations, interactions, data transfer methods, and personal experiences in order to identify any implementation issues and discuss opportunities for improvement.

Property Manager Interview Surveys

TecMarket Works conducted phone interviews with randomly selected property managers, maintenance supervisors, and regional managers to assess program design and implementation and to determine satisfaction levels.

Tenant Surveys

TecMarket Works fielded a phone survey with randomly selected tenants who received CFLs in their residential units as part of this program in order to measure satisfaction and to identify areas for program improvement.

Engineering Estimates

Engineering algorithms can be seen in Appendix D: Impact Algorithms. These algorithms were enhanced beyond those in the Draft Ohio Technical Resource Manual (TRM)[2] to take advantage of additional primary data collected relevant to the Carolina System. These unit energy savings algorithms were applied to customers in the engineering analysis sample.

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[1] For the process evaluation, responses from 82 of the surveys were used, since 3 responders did not complete the full survey. The impact evaluation was able to utilize the responses from all 85 tenants surveyed.
[2] PUCO Case No. 09-512-GE-UNC

Data collection methods, sample sizes, and sampling methodology

Management Interviews

Management interviews and follow-up phone calls for questions and answers were conducted with staff members from Duke Energy, Honeywell, and Niagara. The interview instrument can be found in Appendix A: Management Interview Instrument.

Property Manager Interview Surveys

Phone interviews were conducted with 69 randomly selected property managers, maintenance supervisors, and regional managers. The interview instrument can be found in Appendix B: Property Manager Survey Instrument.

Tenant Surveys

A tenant phone survey was conducted between April 17 and May 23, 2012 with 85[3] randomly selected tenants who received CFLs in the Carolina System. The phone survey instrument can be found in Appendix C: Tenant Survey Instrument.

Engineering Estimates

A tenant phone survey was conducted between April 17 and May 23, 2012 with 85 randomly selected tenants who received CFLs in in the Carolina System. Additionally, 149 loggers were installed in a total of 40 tenants' homes.

Number of completes and sample disposition for each data collection effort

Management Evaluation

Between December 2011 and July 2012, TecMarket Works interviewed six program managers and vendors for this evaluation. This represents a completion rate of 100%.

Property Manager Evaluation

Between May 1 and June 11, 2012, TecMarket Works completed 64 Carolina System property manager phone interviews out of a population of 480 participating properties for a sample rate of 13%. Property managers were contacted a maximum of four times or until the contact resulted in a completed interview or a refusal to participate.

Note that between May 1 and June 11, 2012 TecMarket Works conducted a parallel survey of property managers in the Ohio service territory. That effort completed interviews with five property managers out of a total of seven qualifying properties in Ohio. However, in two cases one property manager ran two properties, which reduced the pool of potential interviews to five. Thus with the five interviews we achieved a 100% sample rate for the interview process. [Since the time the interview call list was generated new properties have been added to the roster.] Because the Ohio sample size is small, we combined the information collected from the Ohio interviews with that from North Carolina and South Carolina to increase the size of data pool for our recommendations. We believe this methodology is warranted since Duke Energy, Honeywell, and the fulfillment contractors operate similarly in all three service territories, and

[3] For the process evaluation, responses from 82 of the surveys were used, since 3 responders did not complete the full survey. The impact evaluation was able to utilize the responses from all 85 tenants surveyed.

recommendations that benefit the program overall will also benefit the efforts in an individual state.

Tenant Evaluation
Surveys of tenants who received the CFLs achieved sufficient completion rates to be statistically sound and thus do not reflect data collected from Ohio.

More specifically, between April 17 and May 23, 2012, TecMarket Works called 1,232 tenants from a pool of 38,412 program participants in the Carolina system and completed 85 phone surveys. The effort had a 6.9% completion rate and an overall sample rate of .02%. Tenants were contacted a maximum of four times or until the contact resulted in a completed survey or refusal to complete the survey.

Table 4. Summary of Data Collection Efforts

Smart $aver Residential Energy Efficiency: Property Manager CFLs				
Data Collection Effort	**State**	**Size of Population**	**# of Successful Contacts**	**Sample Rate**
Management Interviews	NC, SC	6	6	100%
Property Manager Interviews	NC	369	42	11%
	SC	111	22	20%
Tenant Phone Survey	NC	30191	40	0.13%
	SC	8221	45	0.55%
Logger Study[4]	NC	30191	58	0.19%
	SC	8221	42	0.51%

Engineering Estimates
Engineering estimates rely on participant survey responses conducted between April 17 and May 23, 2012. TecMarket Works called 1,232 tenants from a pool of 38,412 program participants in the Carolina system and completed 85 phone surveys. Additionally, 149 loggers were installed in a total of 40 tenants' homes. After removal of faulty or corrupted logger data, 115 remained for analysis.

Description of baseline assumptions, methods and data sources

Baseline assumptions were determined through phone surveys with customers providing self-reported values of baseline lamp watts and room-type distribution. Hours of use are the result of the lighting logger study. Robust data concerning HVAC system fuel and type was available from Duke Energy's Home Profile Database (appliance saturation survey type data) in the Carolinas. Interaction factors derived from this data were used in favor of deemed values from secondary sources as they recognize only Duke Energy customers and, therefore, more accurately represent the participant population. A breakdown of these factors by system and fuel type can be seen in Appendix D: Impact Algorithms.

[4] While 100 customers agreed to take part in the logger study, further communication with these customers resulted in 40 homes agreeing to and being available for the study.

Description of measures and selection of methods by measure(s) or market(s)

The program distributed CFLs exclusively. The Draft Ohio TRM's impact algorithms were enhanced with primary data, specifically appropriate waste heat factors were used that are indicative of climate characteristics similar to those observed in North Carolina and its various climates and used to calculate energy savings. All customers are in the residential market.

Expected and achieved precision

Sampling procedures for the tenant survey had an expected precision of 90% ± 10% and an achieved precision of 90% ± 7.2%.

Threats to validity, sources of bias and how those were addressed

CFL installations were tracked through the use of the Property Manager CFL Campaign Tracker. Hours of use were collected with lighting loggers installed in participants' homes. There is a potential for bias in the engineering algorithms' parameters, such as replaced wattages, which are self-reported by the surveyed participants.

The baseline wattage data that feeds the engineering analysis was obtained from the tenants through the tenant phone surveys. Since the property managers, not the tenants, were the ones that physically removed the old incandescent bulbs from their fixtures in order to install the CFLs, the tenants' recollection of replaced wattage is potentially distorted. TecMarket Works nonetheless believes that this is a valid estimate of baseline wattage. As seen in Table 8, the average baseline wattage reported by the tenants is 55.33 watts. This compares very favorably with the Draft Ohio TRM, where, by means of the deemed calculation for delta watts (CFL watts * 3.25), we can determine that the average wattage of an incandescent bulb that is replaced by a 13-watt CFL is 55.25 watts (13 * 3.25 + 13).

Net to Gross Analysis

Freeridership Levels

The property managers receiving the Duke Energy bulbs were instructed to install the CFLs in tenant's units so that each installation removed an incandescent bulb from a fixture that was being used by the occupants of that unit. This approach was taken because Duke Energy wanted to design a program with a low freerider rate reducing the risk that the bulbs would be used by people who were already using CFLs in those fixtures. Duke Energy theorized that if the fixture contained an incandescent bulb and was in use, then the conversion of that fixture to a CFL would acquire higher net savings than a typical CFL rebate program in which the customer installed the bulb where they wanted or placed part of the bulbs into storage.

The evaluation results support Duke Energy's theory. According to surveyed occupants, 86 percent of the property-manager-installed CFLs went into fixtures in which the tenant reported having an incandescent light bulb prior to the conversion. Only 14 percent of the property-manager-installed CFLs were reported to have had a CFL in that fixture prior to the installation of the new bulb. From this perspective, 86 percent of the CFLs installed by the property managers provided net new energy savings.

Table 5. Net to Gross Analysis

CFL replaced:	Bulb1	Bulb2	Bulb3	Total	
An Incandescent	63	64	60	187	86%
A CFL	11	9	11	31	14%
Don't know	10	9	9	28	-
Missing	1	2	5	8	-

However, even though the property manager-installed CFLs went into incandescent fixtures, this does not mean that all fixtures in the apartments, including the program-targeted fixtures, had incandescent light bulbs.

When we asked if the tenants had already used CFLs in their units prior to the program-installed CFLs, 43 percent of the tenants reported having at least one CFL in their units prior to the program installed units. Five percent of the tenants indicated that the CFLs in their units were installed prior to their taking possession of their units and an additional 37 percent of tenants indicated that they had installed one or more CFLs in their units. Fifty-seven (57%) of the tenants indicated that there were no CFLs installed in their units prior to the program-installed CFLs.

Of the 31 tenants who reported having already used CFLs in their units and could also estimate the number of CFLs that were already in use, the typical unit had 3.9 CFLs prior to the program-installed CFLs. Without the program, there is a possibility that some of the tenants who had incandescent bulbs in the fixtures that were replaced by CFLs via the program may have replaced that incandescent with a CFL when the incandescent burnt-out.

With the majority of tenants (57%) having not already used CFLs in the past, and the average tenant having only 3.9 CFLs in their units there is not a strong indication that these tenants are committed CFL users. In addition, because 86% of the program installed CFLs went into incandescent fixtures, these tenants had not yet made the switch to energy efficient lighting in all of their primary fixtures. The program is reaching its intended market and getting CFLs placed in fixtures that used standard bulbs prior to the replacement.

Because the program is a direct install program in which the program installs CFLs in fixtures that are lit with incandescents, the level of freeridership is set at the level at which the tenants report having the property owners change their fixture from an incandescent to a CFL. As a result, the level of freeridership for this program is assessed to be 14 percent. We are not crediting Duke Energy with a net CFL installation if the tenant indicated that they had already been using a CFL in the fixture before the Duke Energy CFLs were installed. These tenants report that they had already converted their fixtures to CFLs. However, this reporting is suspect and may not be accurate. It is unlikely that a property manager would take out a CFL only to install another CFL. However, we take the tenant's response seriously and discount net savings by the level at which the tenant reports already using a CFL in the fixture targeted by the property owner.

There will also be times when the participant will remove a CFL installed by the property manager and replace them with an incandescent. In this study we incorporate this adjustment into the ISR (in service rate). The ISR is the rate at which the program-installed CFLs are still installed at the time of the survey, and are still providing savings. The ISR adjustment subtracts out savings that no longer are being achieved because the program-installed CFLs have been removed and replaced with incandescent bulbs.

As a result of these conditions, we expect that the savings reported in this study are lower than what is actually being achieved.

Spillover Levels

The experience tenants gained with the Duke Energy program-installed CFLs did not produce a large amount of spillover of additional CFL bulb purchases, but it did induce some tenants to buy and use more CFLs. This is because most of the tenants had, to a limited degree, already experimented with CFLs on their own. However, for a few of the tenants, the Duke Energy CFLs did increase their likelihood to try CFLs on their own. A few tenants did buy and install more CFLs and attribute the cause of their purchase to the experience they obtained via the program-installed CFLs. In all cases, the surveyed tenants reported that their program experience made it more likely that they would have purchased additional CFLs (N=3). They purchased more CFLs (purchased 13 bulbs), and they installed those bulbs in fixtures they are using (installed 8 of the 13 bulbs). Again, this is a small amount of spillover, but worth noting and documenting.

When tenants were asked to score the level at which the program installed bulbs caused them to buy and use more CFLs, a 1 to 10 scale was used to score that effect. To allocate program-induced spillover causal effect, a score of 1 was counted as zero spillover allocation. The rest of the scores were directly converted to a percent allocation score (5=.5, 7=.7, 9=.9, 10=1.0). These allocation scores were then multiplied by the number of additional bulbs that the participants indicated that they had both purchased and installed. Thus, for this set of respondents, we are adding one bulb to the 691 distributed by the program to survey respondents. This provides a level of spillover of 0.001 percent (1/691=.001). We did not count any spillover for any respondent who said that the program did not change their demand for CFLs or if they said that the program's bulbs made it less likely that they would acquire CFLs in the future. The 0.001 percent spillover is conservative, as it only counts the Duke Energy motivated purchases that were installed and which occurred between the period of time of the installation and the survey.

We also note that this is short-term spillover. Additional bulbs may have been purchased after the evaluation effort was completed, however these are excluded from this assessment.

Table 6. Spillover Numbers

Experience with the program CFLs on future purchase and use	How many did you buy	How many are being used	Attribution score (1-10 scale)
More likely (N=3)	6 – 6 – 1	5 – 2 – 1	1 – DK – 10

Net Energy Savings Adjustment Factor[5]

The combination of the reduction in energy savings attributed to freeriders plus the adjustment attributed to spillover provides a net adjustment factor of 86% [(1 - 14% freerider) * (1 + 0.001% spillover) = .86]. Accounting for freeriders, those that already indicated that they had installed a CFL, and for spillover, those indicated that the Duke Energy program caused them to buy and install more CFLs provides a net energy savings of 86% of the gross savings.

In-Service Rate

The in-service rate (ISR) for the CFLs shipped to North and South Carolina property owners is calculated using Honeywell's program records for the quantity of bulbs shipped to property owners and the property manager-reported installation counts for bulbs they received. Of the 280 total property owners that received CFLs in the Carolinas, 241 reported the number of bulbs they had installed, totaling 256,161 bulbs. Honeywell's delivery records indicate that those 241 owners received a total of 270,356 bulbs from the Duke Energy via the Property Owners CFL program. These records indicate that the ISR for the Carolina's component of this program is 94.7 percent (256,161/270,356=0.947).

[5] Subsequent to the drafting of the survey instruments an agreement was reached by the Commission's evaluation oversight contractor to increase the number and type of questions used to estimate freeridership and spillover. These changes will be incorporated into future studies.

Impact Analysis

Table 7 shows the estimated energy savings per bulb distributed adjusted downward for the ISR of 94.7% and incorporating the hours of use from the lighting logger study as well as the freeridership and spillover percentages computed from participants' survey responses. The program distributed 13-watt CFLs exclusively. The average wattage of a replaced bulb was 55 watts.

Table 7. Adjusted Impact: kWh and Coincident kW per Bulb Distributed

Metric	Result
In Service Rate	94.7%
Gross kW per bulb	0.0038
Gross kWh per bulb	40.7
Freeridership rate	14.00%
Spillover rate	0.001%
Total Discounting to be applied to Gross values	14%
Net kW per bulb	0.0033
Net kWh per bulb	35.0
Measure Life[6]	5 years
Effective useful life net kWh per bulb	175

Methodology

Primary data collected from survey participants was used to determine room-type distribution of CFL installations and mean wattage of bulb removed seen in Table 8. Average daily hours of use from the lighting logger study, seen in Table 10, were used in place of the self-reported values for impact calculation purposes.

From the CFL installation data, the in service rate (ISR) was calculated using the algorithm in the In-Service Rate section on page 16. Next, the unadjusted daily hours of use from the lighting loggers were adjusted for daylength in the Daylength Adjustment section on page 22. Finally, this data was combined as per Appendix D: Impact Algorithms on page 124 to calculate gross savings per bulb.

Survey Data

Property managers were asked how many CFLs distributed through Duke Energy's Property Manager CFL program they had installed in light fixtures. Additional, more specific information was collected through a phone survey of their tenants for a maximum of three bulbs, including the location of the CFL, the type and wattage of the bulb that it replaced, and the average hours per day that it is in use. TecMarket Works conducted the phone survey with a random sample of 85 tenants from the Carolinas between April 17, 2012 and May 23, 2012. The compilation of this data is presented in Table 8 in its unadjusted form; that is before the self-reporting bias is applied to the hours of use. The adjusted values appear in Table 9. The self-reported hours of use before and after the adjustment are used for comparison purposes only. Impact is driven by the actual hours of use determined by the lighting logger study.

[6] Consistent with prior evaluations of CFL programs for Duke Energy, a measure life of five years was used for installed CFLs. No derate was performed for post-EISA years.

Table 8. Unadjusted CFL Survey Data

Room Type	Number of Installations	Average Wattage of Bulb Removed	Average Daily Hours of Use (Old)	Average Daily Hours of Use (New)
Basement	1	60.00	3.50	3.50
Other bedroom	4	36.50	11.63	10.25
Dining room	18	59.15	3.36	3.42
Garage	1	13.00	11.50	11.50
Hall	19	55.32	3.74	3.79
Kitchen	46	51.02	4.66	4.72
Living/family room	57	54.61	4.96	4.90
Master bedroom	38	61.03	2.88	2.72
Bathroom	52	52.63	2.90	3.04
Closet	1	55.25	1.00	1.00
Other	9	78.39	4.83	4.83
AVERAGE/TOTAL	**246**	**55.33**[7]	**4.04**	**4.03**

Figure 1 graphically shows the prevalence of CFL installations in each room type in ascending order. Living or family room, bathroom, kitchen, and master bedroom, in that order, are the four most popular room types for bulb replacements; together they make up 78% of all bulb installations.

[7] The overall average wattage of the bulb removed is a weighted average that uses CFL installation distribution data from the entire survey population to assign weights. As this data was collected from the tenants, and not the property managers that did the installations, there is the potential for distorted results. However, TecMarket Works believes this to be a valid estimate of baseline wattage. This compares very favorably with the Draft Ohio TRM, where, by means of the deemed calculation for delta watts (CFL watts * 3.25), we can determine that the average wattage of an incandescent bulb that is replaced by a 13-watt CFL is 55.25 watts (13 * 3.25 + 13).

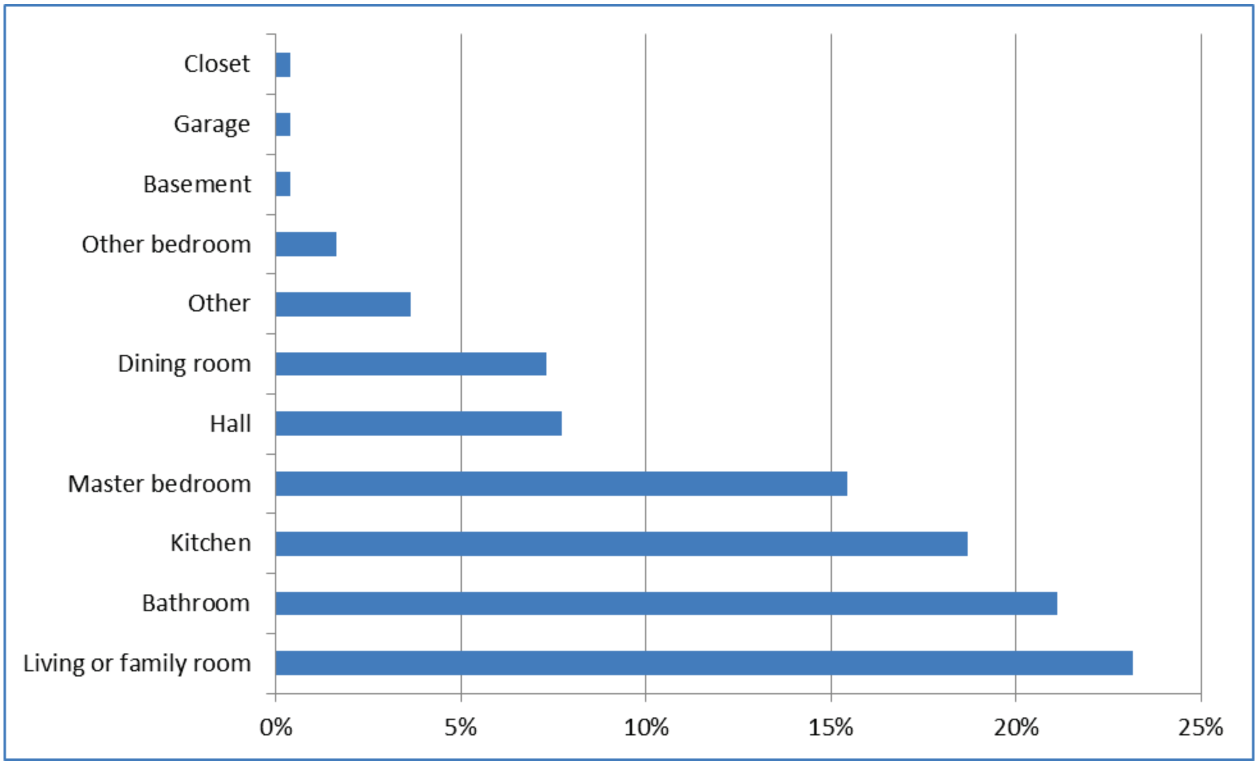

Figure 1. Percent of CFL Installations by Room Type

Self-Reporting Bias

Previous studies that have included both customer surveys and lighting loggers have shown that, comparing customers' self-reported hours of operation to the actual hours of operation, customers responding to the survey overestimated their lighting usage by about 27%[8]. Consequently, the self-reported hours of use obtained from the survey were reduced by the 27% established through the collection of data from previous programs.

Customers were asked if they had increased or decreased their lighting usage since installing the CFLs they received through the program. The weighted average of self reported hours of use going from an incandescent bulb to a CFL were nearly identical. Table 9 shows the weighted average of the unadjusted hours of use values along with the updated weighted average values after the self-reporting bias is applied. The final value for average daily hours of use is 2.95 and 2.94 for incandescent bulbs and CFLs respectively. Again, this information is presented for comparison purposes only. Impact is driven by the actual hours of use determined by the lighting logger study. However, these data do document that the hours of use adjustments that were developed by TecMarket Works in previous Duke Energy program evaluation studies are exceptionally accurate and in this case the difference between the estimation approach and the logger study approach in the per-bulb energy impacts is 1 kWh per bulb. That is, the use of actual logged hours of use only adjusted the estimated hours developed by TecMarket Works by 0.05 hours for the sampled customers. This level of accuracy is well within the margin of error

[8] TecMarket Works and Building Metrics. "Duke Energy Residential Smart $aver® CFL Program in North Carolina and South Carolina". February 15, 2011. Pg. 35.

estimated by the logger study. That is, both approaches (TecMarket Works' estimated hours and logged hours) provide the same level of accuracy and reliability in the impact savings estimates. We find that there is little to no added reliability achieved via the use of logger studies when best practice estimation approaches are employed within the analysis effort.

Table 9. Adjusted Average Daily Hours of Use

Adjustment	Magnitude of Adjustment	Average Daily Hours of Use (Incandescent)	Average Daily Hours of Use (CFL)
Unadjusted	N/A	4.04	4.03
Self-Reporting Bias	27%	2.95	2.94

Lighting Logger CFL Data

In conjunction with the phone surveys, a lighting logger study was performed with a subset of phone survey participants. The purpose of this logger study was to determine how tenants residing in participating buildings are using CFLs and how the building managers have distributed them (i.e., what room or fixture the bulbs are installed in), as well as to determine the actual hours of use of these CFLs. Unadjusted hours of use by room type are shown in Table 10. The average daily hours of use after day length has been accounted for are shown in Table 12.

Table 10. Unadjusted Lighting Logger Hours of Use by Room Type of Logged Bulbs

Room Type	Number of Valid Logger Installations	Percent of Installations	Average Daily Hours of Use
Bathroom	18	21.14%	1.56
Closet	2	0.41%	0.09
Dining room	6	7.32%	1.95
Hall	13	7.72%	0.85
Kitchen	13	18.70%	5.40
Living/Family Room	15	23.17%	2.62
Bedroom	32	17.07%	2.46
Other	16	4.47%	1.63
TOTAL/AVERAGE	115		2.65[9]

Note: The overall average daily hours of use is a weighted average that uses CFL installation distribution data from the entire survey population, rather than the subset of lighting logger participants, to assign weights. The "Master Bedroom" and "Other Bedroom" categories present in the phone survey data were collapsed into a single "Bedroom" category as the logger data was not always clear as to which was which. Similarly, the "Garage" and "Basement" categories, which were unrepresented in the logger study, had their weights added to the "Other" category.

Not all fixture types were described. Those that were appear in Table 11. Approximately 65% of all CFL installations were ceiling or table lamp fixtures. The remaining 12 categories each make up a far smaller fraction of the total installations, ranging from one to seven percent.

[9] Weighted by number of installations from Table 8.

Table 11. Lighting Logger Fixture Types of Logged Bulbs

Fixture Type	Number of Logger Installations
Ceiling	45
Table lamp	21
Floor Lamp	7
Wall light	7
Vanity light	5
Ceiling fan	3
Pendant	3
Bar	2
Bedside	2
Dome light	2
Torchiere	2
Chandelier	1
Lamp	1
Hood light	1
TOTAL	102

The participants' loadshape is shown in Figure 2. As the shape demonstrates, lighting usage is at its peak around 9PM. The coincident load from 3-4PM, Duke Energy's peak time, is 8.1%.

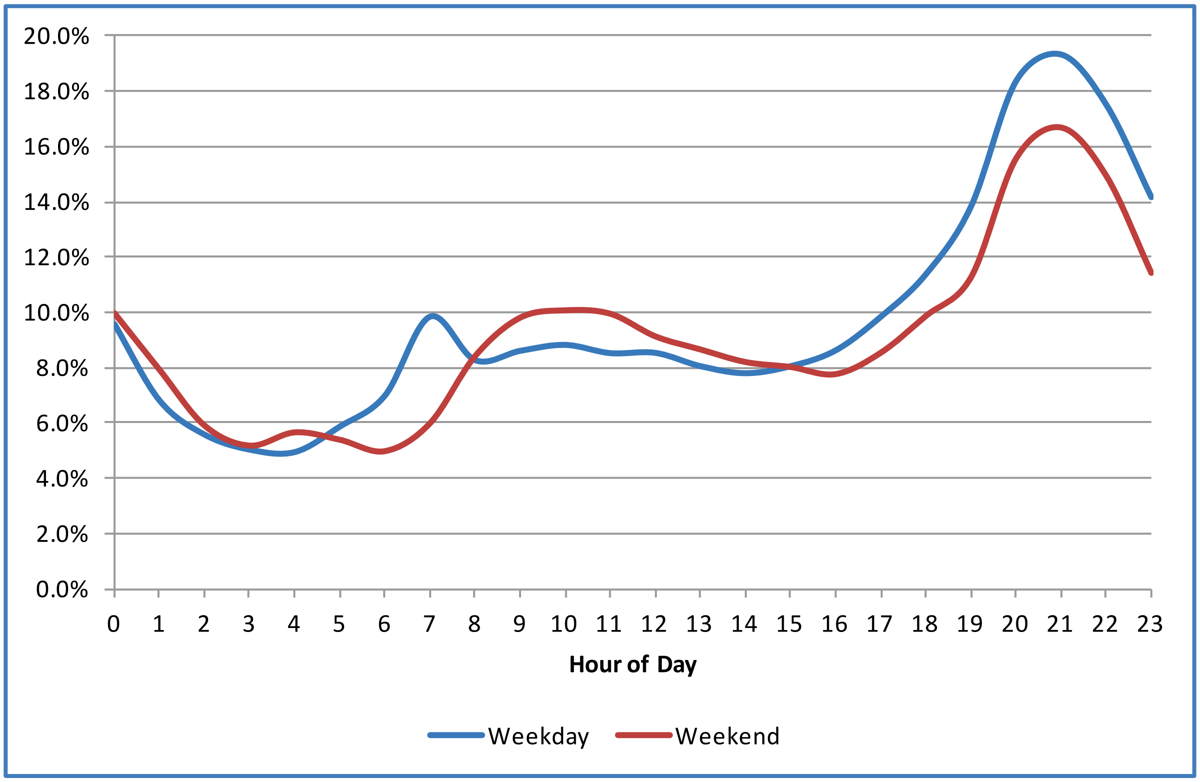

Figure 2. Weekend and Weekday Loadshapes

Daylength Adjustment

The frequency and length of time customers use their CFLs is affected by daylength. As days become longer and shorter throughout the year, the length of time a bulb needs to be used increases and decreases in rooms where natural lighting is used to offset CFL use. Depending on which time of the year lighting usage is measured, the amount of use recorded by the lighting loggers may over- or under-predict a customer's overall usage for the year. The amount of daylight during any given season is a factor of the position of the sun which determines the sunrise and sunset time and the number of hours of daylight. The increase and decrease in hours of daylight experienced throughout the year can be expressed as a sine function, and the average over- or under-prediction in hours of use as a result of increased or decreased daylight can be calculated using the following equation[10]:

Equation 1: Hours/day = hours/day average * [1 + Max deviation * sin(θd)]

This approach was used by the Cadmus Group to analyze seasonal light logger data in a large residential CFL study in California. To calculate the impact of daylight on daily use, a regression analysis was used to estimate the average hours per day and maximum deviation variables in Equation 1 from observed light logger data. The right side of the function represents a progression through the year where the right hand term goes to zero on the spring and fall equinox, and is a maximum value at the winter solstice and a minimum value at the summer solstice.

[10] The Cadmus Group. "Upstream Lighting Program Evaluation Report. Prepared for CPUC". November 16th, 2009. Pg. 16.

Equation 2: $\theta d = 2\pi * (284 + n) / 365$
Where n = Julian date (1 = Jan 1; 365 = Dec 31)

The Cadmus regression model predicted the annual average hours of use and the maximum deviation. The ratio of the maximum deviation to the annual average represents the maximum percent difference in the daily hours of use relative to the annual average. Equation 2 above can be used to predict the percent over- or under-estimation of lighting hours on any particular day of the year. This is the daylength adjustment factor. The predicted maximum deviation from the annual average hours of use from the Cadmus study is on the order of ±16%.

To calculate the daylength adjustment factor for this study, Equation 2 was evaluated at the median date of the survey period (August 15th):

$$\theta d = 2\pi * (284 + n) / 365 = \mathbf{2\pi * (284 + 228) / 365 = 8.81}$$

Equation 1 is evaluated using the average hours per day determined through the lighting loggers to determine the daylength-adjusted actual average hours of use per day:

$$\text{Hours/day} = \text{hours/day average} * [1 + \text{Max deviation} * \sin(\theta d)]$$

$$= \mathbf{2.65 * [1 + 16\% * \sin(8.81)] = 2.89}$$

Daylength-adjusted hours of use by room type can be seen in Table 12.

Impact Estimates

Applying the daylength adjustment to each individual room type allows a look at hours of use and bulb savings by room type. However, savings estimates at the room type level are unreliable and should not be used in any calculations. The room-level impacts do not contain an adjustment for the ISR, as an ISR was not calculated for each room type. The "Total/Average" row represents the weighted average savings per bulb before the ISR is applied. The values in the bottom "In Service Rate" row are the ones that should be used. These are the only values that have had the ISR factored in.

Table 12. Adjusted Hours of Use With Gross Impacts by Room Type.

Room Type	Number of Valid Logger Installations	Percent of Installations	Average Wattage of Bulb Removed	Adjusted Average Daily Hours of Use	kWh per Bulb	kW per Bulb
Bathroom	18	21.14%	52.63	1.71	23.8	0.0038
Closet	2	0.41%	55.25	0.10	1.4	0.0040
Dining room	6	7.32%	59.15	2.12	34.5	0.0044
Hall	13	7.72%	55.32	0.93	13.8	0.0040
Kitchen	13	18.70%	51.02	5.89	78.7	0.0036

Living/Family Room	15	23.17%	54.61	2.86	41.8	0.0039
Bedroom	32	17.07%	58.71	2.68	43.1	0.0043
Other	16	4.47%	70.77	1.78	36.1	0.0055
Total/Average	**115**		**55.33**	**2.89**[11]	**43.0**	**0.0040**
In Service Rate = 94.7%					**40.7**	**0.0038**

[11] Weighted by number of installations from Table 7. Unadjusted CFL Survey Data.

Management Interview Results

Program Operations and Oversight

Duke Energy oversees the overall administration of the Property Manager CFL Program, including contractor oversight, eligibility confirmation, and creation of marketing materials online and overview of marketing material created by Honeywell, website administration, inventory reconciliation, and overall quality assurance.

Day-to-day implementation is contracted to Honeywell, which handles marketing, enrollment, contract management, client relations, installation oversight, follow up inspections, data collection and database management, reporting, forecasting, inventory control, and quality assurance.

Duke Energy switched fulfillment vendors in April of 2012. From program inception until April 2012, Niagara of Cedar Knolls, NJ was the third-party fulfillment center for Duke Energy's non-residential and residential Smart $aver programs, of which this program is a component. Niagara received CFL orders and packaged and shipped bulb kits to participating properties. It also tracked data regarding participants, deliveries, and errors. Those functions were assumed by AM Conservation in April 2012. Operations under the new fulfillment contractor were deemed too recent for review within this report, but program managers at Duke Energy and Honeywell report that functionality of packaging, shipping and tracking has been maintained without interruption.

Program History and Timeline

Duke Energy's Smart $aver Residential Energy Efficiency: Property Manager CFLs Program began in early 2010 when Duke Energy recognized the potential for energy savings programs targeted to non-homeowners in the residential rental markets of its service territories. A pilot effort was launched to initially assess market size, audience interest, and viability, and later to determine timing, bulb types and maximum number of bulbs per unit, necessary marketing materials, and other attributes of program design. An RFP process was initiated May of 2010 and Honeywell was signed as the implementation contractor on November 24, 2010. Niagara had a pre-existing agreement with Duke Energy and was assigned as the fulfillment vendor to supply and ship the CFLs. Coordinated start up efforts between Duke Energy and Honeywell began in December 2010. Marketing of the full program began in January of 2011 using outbound calling to contact targets and solicit the initial orders of bulbs. The first CFLs were shipped on February 15, 2011. AM Conservation replaced Niagara as the fulfillment vendor in April of 2012.

Marketing to and Recruiting of Property Managers

While Duke Energy is responsible for the development of online marketing materials, Honeywell is responsible for the execution of marketing efforts. Other marketing efforts created by Honeywell are approved by Duke Energy before execution. Honeywell deploys a range of marketing strategies in order to attract properties into the program. Early efforts focused on onsite visits to properties, but marketing efforts now use a variety of channels including email, fax, direct mail, and a number of types of in-person marketing methods.

During onsite visits the Honeywell representative gives a 15 to 20-minute presentation about the program, explaining how to utilize the web site and program, answering questions, and helping customers to fill out enrollment paperwork. One of the most frequently used marketing methods is outbound calling to property management firms found through free local rental property magazines, property management organizations, and research into corporate management firms. This approach has proven to be particularly effective when targeting senior executives and regional managers of large property management companies, since a "yes" from someone in such a position generally results in multiple properties enrolling at one time. These one-to-one marketing methods are supplemented by several types of one-to-many marketing efforts, including email and fax message blasts and industry advertising.

In particular, Honeywell targets franchises, trade associations, chambers of commerce, and other groups that provide access to large memberships through association meetings, newsletters, and other forms of marketing. Other effective marketing vehicles have been trade shows, association meetings, and other types of industry gatherings, at which a Honeywell representative staffs a booth using a bowl to collect business cards and Duke Energy's marketing materials to describe the program. These high traffic events provide an opportunity for face-to-face communications with a high volume of prospects.

Word of mouth efforts also appear to be an important part of this program's marketing efforts, so to encourage future conversations Honeywell provides stacks of business cards and flyers in both English and Spanish to anyone who will accept them: be that apartment association directors, individual property managers willing to speak with colleagues, or organizations such as the Housing Authority in South Carolina, which eventually ordered more than 9,000 bulbs. Along these same lines, Honeywell is also collecting photographs and testimonials from property managers who have completed the program to help overcome barriers and market resistance among those who are unfamiliar the program.

Aside from normal barriers arising from awareness, one market barrier to this program appears to be confusion and competition with other Duke Energy efficiency programs. When property managers initially learn of the program they sometimes think they are already participating because their tenants have ordered CFLs through the residential Smart $aver program. Duke Energy and Honeywell have addressed this issue by revising the marketing flier to provide clarification. While this has reportedly helped, a number of enrolled property managers interviewed indicated that they still had some initial confusion prior to a complete explanation by Honeywell. Thus further clarification of printed marketing materials and persistent explanation during follow up contacts throughout the marketing process may be warranted.

Eligibility

Any property with multiple housing units ranging from fewer than 5 to more than 500 apartments is potentially eligible. To qualify, the properties must be comprised of multi-family units with single meters and individual residential accounts. Those units must have permanent traditional screw-in light fixtures (i.e. when the tenant moves out the bulbs remain in the ceiling, rather than departing along with the tenant's floor lamp). Only fixtures inside residences are considered eligible for this program. Lighting for common rooms, property management offices, work and storage areas, hallways, breezeways and other outdoor situations is covered by separate Duke Energy programs.

Although these eligibility requirements are clearly defined, they often represent a somewhat illogical set of boundaries in the minds of the property managers, who do not appreciate why the light fixtures in business offices, common areas, and outside situations are not included within this program as well. Once property managers become aware of the energy savings potential and are interested in the possibility of receiving free CFLs, they feel disappointed that bulbs will not also be provided for areas in which savings are realized to the owners of the facilities. They question why only the occupants are eligible for savings when they are also Duke Energy customers capable of providing additional savings.

Although this situation arises in part because property managers do not understand the distinction between residential and business rate programs, it represents a lost opportunity for Duke Energy to garner additional energy savings, particularly considering the fact that lighting in business offices, common areas, and outdoor situations is often used between 8-24 hours per day. Customer satisfaction may be improved and energy savings may be increased if Duke Energy establishes a companion effort that enables the Honeywell representatives to offer property managers free CFLs for their non-residential areas during the same conversation. Such an offer would also provide the added benefit of enabling property managers to justify the shipping costs of the bulbs, by explaining to their senior managers that the shipping costs of all bulbs delivered to the property will be paid back through energy savings on bills accruing to the corporate office rather than to the tenants. Enabling such an arrangement could help overcome one of the property managers' largest objections: the energy/cost savings only accrues to the tenant and not the business itself.

Enrollment Process

The application process uses an Excel spreadsheet to collect customer information, which speeds verification. Upon sign up, all account information is verified prior to enrollment. This verification process takes time because unlike some of Duke Energy's direct-to-customer programs that are focused directly on the account holder, this program's marketing efforts are targeted at property managers who represent large numbers of accounts in multiple names, and those properties are often scattered across multiple addresses.

Once an account has been verified, the Honeywell representative ensures that a contract is signed. At that point, the property can request the appropriate number of CFLs.

The management and property manager interviews indicate that a small number of participants have found the enrollment process onerous. To respond to this concern and to make the process easier, Honeywell now offers prospective properties the opportunity to enroll by phone (or even onsite if a Honeywell representative is in the area), whereby a trained representative collects the customers' information, qualifies them, and emails out the contract. This option was well-received by the few property managers that we interviewed who had availed themselves of it.

Ordering Process

Property managers calculate the number of bulbs they'll need by multiplying the number of bulbs (up to 12) needed for each unit model by the number of units of that type. They then place their orders through Honeywell, which collects payment for the shipping costs in advance. Orders are sent to Niagara/AM Conservation for fulfillment.

According to Honeywell, bulb installation tracking has revealed that properties in all states reviewed install an average of 85% of the bulbs that they order. This results in the need for Honeywell to pick up the extra bulbs and deploy them elsewhere. Unused bulbs arise from a number of factors including ordering errors on the part of the property manager, tenant refusal to install the bulbs, or prior installation of CFL bulbs by the tenant. The most common reason for prior CFL installation is because individual tenants have taken advantage of Duke Energy's other CFL programs and unbeknownst to the property manager they have already ordered and installed Duke Energy's free bulbs for their apartments. To diminish the likelihood of unused bulbs, Honeywell reduces the final order by 15%. If extra bulbs are needed, they are ordered and shipped to the property at a later time or inventoried bulbs from Honeywell are utilized. This scenario has occurred only a handful of times. Honeywell continues to revise this percentage as more installation data is obtained.

The only ordering difficulty uncovered arose early in the program when Honeywell first began holding back a percentage of bulbs ordered. This change took place before the practice for informing customers about the "hold back" had been clarified. The result was temporary confusion among property managers about the amounts of bulbs shipped. The error was identified in weekly meetings between Duke Energy and Honeywell and was rectified by Honeywell. No further problems have been reported by participants who joined the program after that point.

In the time period between when the bulb order is placed and shipped, Honeywell emails the property manager a spreadsheet checklist with general instructions for what to do once the order arrives. The email message also directs property managers to Duke Energy's website where they can download a generic tenant notification letter that can be customized and sent to the tenants. Fifty eight percent of property managers we interviewed indicated that they used the letter. Of those who used it, everyone indicated that it worked well and no one suggested any improvements.

Fulfillment, Shipping, and Delivery

Fulfillment Process

Niagara/AM Conservation received and processed the bulb orders, bundling and shipping the bulbs to the designated property. A unique program ID number is used to track and report data regarding customer information, shipment sizes and delivery dates. This information is sent to Duke Energy for billing and bulb reconciliation purposes.

Fulfillment Numbers

During 2011, Carolina system customers ordered 238,399 CFLs. At the time of this process evaluation at the end July of 2012, the shipment numbers for 2012 were 345,185 in North Carolina and South Carolina.

Change of Fulfillment Vendor

The volume of CFLs shipped to property managers under this program represents a fraction of the total number of CFLs shipped for all of Duke Energy's Residential Smart $aver CFL programs. However, because the overall shipping volume of all programs is high, Duke Energy cited concerns with Niagara involving reporting, inadequate inventory levels, and Niagara's increasing of prices to a noncompetitive level. This ultimately led Duke Energy to cancel its contract with Niagara in April of 2012.

Fulfillment operations continued under AM Conservation, which offered Duke Energy better pricing, increased delivery volumes, and the same service standards. Duke Energy program managers report that the transition went well and fulfillment efforts are going smoothly. Because the transition occurred only a short time before this report, no process evaluation interview with AM Conservation was conducted.

Shipping Charges

Although CFLs are given away free to property managers under this program, Duke Energy decided to charge for the costs of shipping the bulbs so that "the properties have some skin in the game" to better ensure that the bulbs will actually be installed. While this incentive structure may indeed be effective for encouraging compliance with deadlines, it has nonetheless met with some resistance from the property managers. Based upon those property managers surveyed, an estimated 20% of property managers we interviewed mentioned shipping costs as a potential barrier to entry, even though the average shipping cost for 4,000 bulbs is $150-$250. Property managers see this aspect of the program essentially amounting to the property owners needing to pay part of the program's operational costs in order for their tenants to save energy. That is, participation in the program is not saving them money, but instead is costing money for them to provide a bill savings to their tenants, thereby lowering the return on their property management investment by increasing costs. Honeywell managers also noted a reticence among property managers to pay for shipping.

Although TecMarket Works is unaware of any organized effort to document the opportunities lost due to concerns over shipping costs, Honeywell was sufficiently concerned about the property manager reluctance that it began formulating proposals for alternative means of incenting the properties to finish their install processes in a timely manner. One such proposal is to return the full monies paid for shipping to the property if the bulbs are installed within 30 days, and to provide 50% of the monies if the install process is finished between 31– 60 days after receipt. Properties requiring 61-90 days would be ineligible for the incentive. As of the time of this writing, no formal decision had been made about this or other proposals, but we deem the ideas worthy of consideration pending a cost-benefit analysis.

Extra Bulbs

Another area for potential improvement involves the number of bulbs permitted to be placed in storage at the property. Current program rules require all extra bulbs to be returned and accounted for. While this makes sense from the perspective of estimating energy impacts and bulb cost recovery, it makes less sense from a customer service point of view. Because the bulbs are warrantied, property managers can request replacements should the bulbs burn out during the warranty period. But bulb replacement takes time and in the meanwhile the tenants must have bulbs. As a result, property managers either draw from their existing stock of bulbs or purchase new bulbs, many of which may be incandescent bulbs. A small amount of bulbs held in reserve at the property to account for breakage and burn out issues would be one way to ensure replacements with CFLs. While other factors must be considered prior to implementing such a change, the advantages of such a practice should be weighed against relative merits of current practices for collecting extra bulbs.

Bulb Installation and Documentation

As mentioned earlier in this evaluation, under the terms of the contract, properties have up to 90 days to install all bulbs and return the extras along with the tracking worksheet to Honeywell.

While the bulb installation process is the responsibility of the property management company and not the responsibility of Duke Energy or Honeywell, the installation process has proven to be one of the more challenging areas of the program due to differing imperatives among the various parties involved. On one hand, Duke Energy needs to see documented results within a reasonably short time period. On the other hand, the manpower and labor time required on the part of the property to install large quantities of bulbs is sometimes considered burdensome and conflicting maintenance requests take priority, which can result in missed deadlines.

Tracking, Reporting, and Quality Assurance

Bulb Tracking and Quality Assurance

During the 90 days that properties have to complete installation, Honeywell conducts follow up calls to ensure bulb delivery and again at 30, 45, and 60 days to ensure progress is being made. The dates of the calls and status of the install process are noted in the program database. When a property completes the bulb installation process it sends the completed worksheets to Honeywell, which imports the worksheet data into the database to track the quantity of installed bulbs. Honeywell also reconciles the number of bulbs ordered and shipped with those actually installed, including accounting for damaged and defective bulbs. If a property doesn't use all of the bulbs, Honeywell picks them up for redistribution to other properties.

For quality assurance, post-install inspections are conducted on completed properties. Honeywell gives the properties a list of randomly selected units that it plans to inspect. In compliance with state law, Honeywell provides two-week notice prior to the inspections. The quality assurance target is 5% of units, but the list contains more units than will actually be inspected. This overage helps to ensure that a sufficient number of units can actually be inspected, since access may occasionally be denied by the tenant due to sickness, etc. Inspections compare the claimed number of installed bulbs with the actual number in each unit. Inspections also note any defective, missing, or moved bulbs. All information is recorded and uploaded to the program database. Once all information is uploaded into the database, Honeywell generates monthly reports that Duke Energy can review as needed.

By all accounts from the management interviews, the tracking, reporting, and quality assurance processes are working effectively and Duke Energy will continue to review and improve processes for the program. However, no changes are suggested.

Bulb Tracking and Quality Assurance

As staffing for the administering and running the program has increased, so has the importance of establishing protocols and systems to 1) reduce the likelihood of duplicate outbound calls or emails; 2) to ensure that performance metrics (e.g. number of outbound calls per week and apartment association events per year) are reached, and that 3) each step in the process is followed every time. To this end, Duke Energy and Honeywell have established regularly scheduled meetings, agreed on a call and email tracking system, and standardized metrics. This appears to have helped considerably, but continued diligence is warranted since the property management industry has a high degree of employee turnover. Thus we recommend that steps continue to be taken in order to ensure that contact information remains current and that new property managers and maintenance supervisors are kept apprised of the program and the terms of existing contracts.

Management Communication and Coordination

Communication and coordination between Duke Energy, Honeywell, and the new fulfillment contractors occurs on a monthly, weekly, and as needed basis. All communications appear to be clear, timely, appropriate, and smooth.

Customer Communication

Because property managers are very busy, they tend to favor email as their primary means of communication. The program has adapted to this both in terms of marketing and for ongoing interactions. According to Honeywell, at least 50% of the properties enrolled in the program to date initially responded to an email message. As such, outbound email is frequently the first step in marketing the program, and this mode of communication persists as the sales process turns into the client support process. Honeywell supplements its email communication with inbound and outbound phone calls as it works with properties to discuss more detailed aspects of the program. Niagara and AM Conservation primarily use email to properties for delivery confirmation.

Property managers almost unanimously praised the quality of communication that they experienced with Honeywell. Communication was clear, timely, and thorough throughout the entire process.

Reasons for Lower than Anticipated Participation in the Program

We asked interviewees why they thought they had not reached the originally anticipated enrollment numbers for the Property Manager CFL Program. We received a number of responses including:

- Honeywell points out that part of the challenge for meeting goals comes from the requirement that properties handle the installation of the bulbs. As a result, property managers and maintenance supervisors are reluctant to sign up for activities that will make further demands on their time, such as doing mass installs of bulbs in all of their units.

- Another challenge has been finding the right levels of staffing for promoting the program. With too few staff the territory has proven to be difficult to service effectively. To this end, Honeywell has hired region specific coordinators for North Carolina and South Carolina, which is anticipated to help increase enrollment numbers.

Program Changes Interviewees Would Like to See

We asked managers to suggest the changes that they would like to see made to the program. While managers are generally satisfied with the program, they are continually looking for opportunities for improvement. Their suggestions are noted below.

- “The objective of program is focused on residents, but the program would be more popular if the property could actually benefit since they're paying shipping costs and allocating manpower. Including bulbs for office and common areas would make it seem more advantageous.”

- “I would originally offer fewer bulbs. Even two bulbs per unit could probably get more customer satisfaction from tenants. They'd be happy with the program and get the same exposure without such high shipping costs and labor expense for the properties, although the energy savings would be less.”

- “I'd like to have a method for mailing or shipping expired bulbs to a recycling center. People need an easy way for people to deal with the mercury disposal.”

- “I would like to find a way to help maintenance people with installations. That seems to be one of the biggest challenges we face.”

- “We only offer a 13-watt bulb equivalent to 60-watt incandescent. I would expand that to also include higher wattage bulbs, such as 100 watt equivalents. This would help with energy impacts and brightness considerations, particularly for elderly people.”

Property Manager Interview Results

This section presents the results from interviews with property managers in Ohio, South Carolina and North Carolina. The instrument can be found in Appendix B: Property Manager Survey Instrument.

Introduction

TecMarket Works conducted telephone interview surveys with 69 randomly selected property managers from May 1, 2012 through June 11, 2012. At the time of this evaluation there were only seven participating properties in the state of Ohio, of which two property management companies ran two properties apiece, thus resulting in a total pool of five potential interviews. We contacted all five property managers (a 100% completion rate) in Ohio and combined those results with those from North Carolina and South Carolina to provide greater statistical and analytical confidence. We believe this methodology is warranted since Duke Energy, Honeywell, and the fulfillment contractors operate similarly in all three service territories, and recommendations that benefit the program overall will also benefit the efforts in an individual state.

When a property management firm was successfully contacted, the interviewer asked if the property manager was familiar with the program. In instances when the property manager was unfamiliar, such as being hired after the install process had been completed, the interviewer attempted to speak with someone else who was on staff at the time, such as the regional manager, maintenance supervisor, or assistant manager. Due to varying levels of participation in the ordering, install, and tracking processes, and because of the long lag time between some installs and the follow up interviews, not every interviewee could speak to every question. Thus respective sample sizes are noted for each question.

Program Involvement

Of the property managers we spoke with, the majority (51%) indicated that they had been participating in the program for between 6 and 12 months. One quarter (25%) had been in the program for between 12 and 18 months, while 6% had been involved for more than 18 months and 10% had joined less than six months ago. Eight percent did not know or could not recall when they joined the program.

When we asked about the primary reasons for participating in the program, more than half of the 69 property managers (52%) answered “Because my company told me to”. This notable response rate reflects the top-down sales approach taken by Honeywell as it focused on corporate offices and regional property managers, which in turn directed individual properties to participate in the program. Other frequently cited reasons for becoming involved in the program include: “It saves money” (46%), “It provides a service to the tenants” (43%), and “It’s a wise business move” (33%). Figure 3 below displays the percent of respondents for the most common reasons cited.

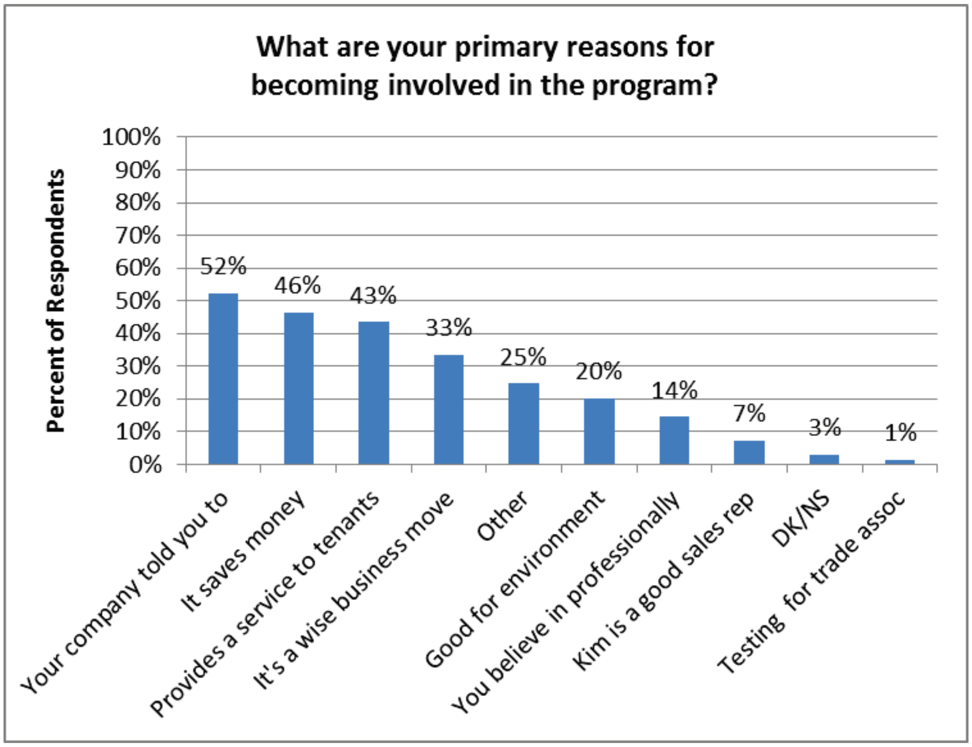

Figure 3. Reasons for Program Involvement

We followed up this line of questioning by asking if the program had made any noticable difference in their businesses. The most frequently given response was “I can’t say or I don’t know” (25%). This kind of response was typically followed by comments such as: “We don’t see the savings directly, the tenants see the savings on their bills, ” and “Tenants rarely tell us anything positive,” and “Since they didn’t complain I guess they’re OK with it.”

Positive comments regarding the impacts from the program include: “The tenants are happy” (17%), “Our vacant unit bills are lower” (16%), and “It saved us money on buying bulbs” (9%). However, not every property felt the changes had been for the better. A small number of managers indicated that tenants did not like the bulbs, that the bulbs burned out quickly. Figure 4 documents the property manager impressions about the impact the program made upon their businesses.

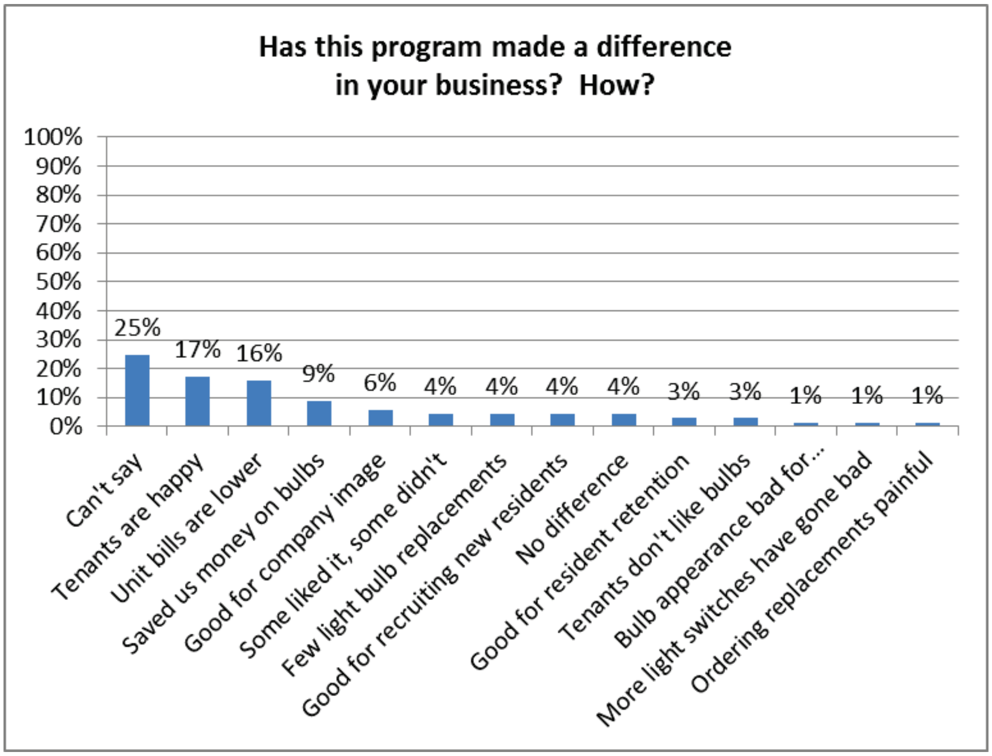

Figure 4. Program Impacts on Their Businesses

How to Increase Program Enrollment

To find ways for Duke Energy to increase program enrollments we asked current program participants for suggestions. Twenty six percent of respondents indicated "better marketing" as a general response, but their specific replies were more illuminating. Their verbatim suggestions[12] include:

- "As a rule, properties are always short staffed by nature so giving them a longer time to do the installs could make it more attractive."
- "Hire someone to do the bulb installations for the properties. Then they won't worry about the staff time involved."
- "Allow bulb replacements as units become vacant instead of [requiring that they be done] all at once."
- "For many properties free bulbs are not enough of an incentive since the energy savings go to the residents. But you can entice properties to join by saying "If you do it for your residents, then you get X number of free bulbs for your common areas." Otherwise property managers will be less likely to join since they'll be thinking about the labor costs to install the bulbs and the lost opportunities for making other repairs."
- "Work with new construction teams. If Duke would give us bulbs for new properties we could install them at the beginning instead of as a retrofit."

[12] All customer comments are included verbatim for completeness of reporting. However, in some cases customer statements may be less than accurate.

- "Mercury in the bulbs is a concern. You give instructions for cleaning up broken bulbs, but who is legally liable? The resident, the property, Duke, or the bulb manufacturer? You'll get more people to participate if you address the legal liabilities of broken bulbs and their mercury content."
- "Create a referral program."
- "Find a champion and get them to work within their organization."
- "Use more case studies and testimonials from both properties and tenants to help overcome property manager concerns."
- "Focus on lighting for outside and common areas that property managers pay for. If you give them free bulbs and the benefit goes to them, as well as to the tenants then they'll want to get involved."
- "Use the try-before-you-buy method. Give away free bulbs for offices and club houses to let property managers try out the bulbs first to see the lighting quality and savings. Plus this lets them be a role model for their residents."
- "Free shipping would help reduce cost concerns, especially for Section 8 properties since either they have small profit margins or they are actually losing money. If not free shipping, at least let them pay for it over time."
- "The easiest properties to sell the program to are those that include utilities as part of the rent. They'd be an easy sale."
- "Property managers are too busy to think about the benefits of a program like this. Start with corporate offices and work your way down. Then they'll have to participate and maintenance can't complain."
- "Join property management and apartment associations as an affiliate organization and then ask them to endorse the program and reach out to all their members."
- "Have you tried going to all the high rise residential units? They are easy to spot and have a lot of units all in one place."
- "Don't limit the number of bulbs to 12. We could have used more per unit. So we either had to buy more bulbs on our own or end up with a mix of CFLs and regular bulbs."

Bulb Ordering, Shipping, Lead Time, and Communications

Sixty one percent of the 57 property managers who answered this question felt that the ordering and shipping processes worked well. Another 23% indicated that they were not involved in that aspect of the program. Only 16% indicated that there was room for improvement in this area. Other than the confusion during the early implementation of the automatic reductions on bulb orders described in the management interview section above (7% of respondents), their suggestions for improvement included: reducing or eliminating the costs for shipping the bulbs. (4%), less paperwork (2%), and unclear directions (2%).

Shipping Costs

While only 7% of property managers actually suggested that Duke Energy reduce or eliminate charges for shipping, a sizeable number of additional property managers grumbled about shipping costs, anecdotally indicating that they were unhappy with the fees, even if they grudgingly accepted the program rule about paying shipping costs as a necessary requirement in order to receive the free bulbs.

In an effort to reduce shipping costs, numerous property managers told us that their firms placed one large bulb order for all the properties that they manage and then shipped the bulbs to a central location. This saved money on shipping costs, but in turn caused difficulties for individual property managers, who told us that they then needed to borrow pickup trucks and vans or make countless trips in private cars to transfer the cartons of bulbs to their specific properties. While the property managers placed the "blame" for the extra time commitment on their own companies' decisions to reduce shipping costs, the extra hassle seemed to predispose them to later complaints about the time required to complete the installs. While this was not a major concern among those we spoke with, the general consensus was that the issue could have been eliminated with offers for free shipping.

If free shipping is not offered, one property manager provided a potentially useful insight: "Why don't you just change the name of the fee from a shipping cost to an administrative fee? If you're giving away the bulbs for free, they'll have a harder time arguing about paying to offset the cost of administering the program."

Another potentially useful idea was: "Everyone wants to get the shipping for free, but if you give away free bulbs for common areas and administrative offices, then you can argue that the shipping costs will be offset by the energy savings generated by the bulbs used in areas where property managers pay the bill. That way they'll be paying themselves back for the shipping costs out of their own bill reductions."

Packing Slips
One other recommendation for fulfillment improvement arises from confusion about the amount of bulbs shipped versus the amount ordered. In a corollary to the issue with the automatic 15% bulb order reductions described in the management section above, one property manager explained how he was confused about the actual amount of bulbs shipped versus the amount initially ordered. The issue was made more difficult to rectify because the bulbs were shipped from Niagara without a packing slip to document the actual delivery amounts. Thus, in addition to better upfront communication regarding the automatic bulb count reduction (as now corrected by Honeywell), this property manager suggests that the fulfillment company include a packing slip with each order shipped.

Lead Time
Sixty one percent of the 46 property managers who answered this question felt that the lead time and training process worked well. Another 22% indicated that they were not involved in that aspect of the program. Just 17% indicated that there was room for improvement in this area. When describing problem areas, they mentioned unclear directions/insufficient training (4%), poor communication within their own companies (4%), need more information on mercury for residents and office staff (4%), need containers for broken bulb disposal (4%), shipping time took too long (4%).

Communications
Seventy eight percent of those surveyed reported that communications with Honeywell and Duke Energy were fine as is. Only three people (5%) were unhappy with the level of communication, two of which indicated that they wanted more direct contact with Honeywell, rather than

receiving communications second-hand from their corporate offices. The third person declined to provide a reason.

Tenant Notification and Program Materials

As shown in Figure 5 below, 59% of property managers interviewed indicated that they used the tenant notification form letter provided by Duke Energy, while another 29% used their own letters, often with information cut and pasted from the form letter. Other methods of communication saw only single digit participation rates.

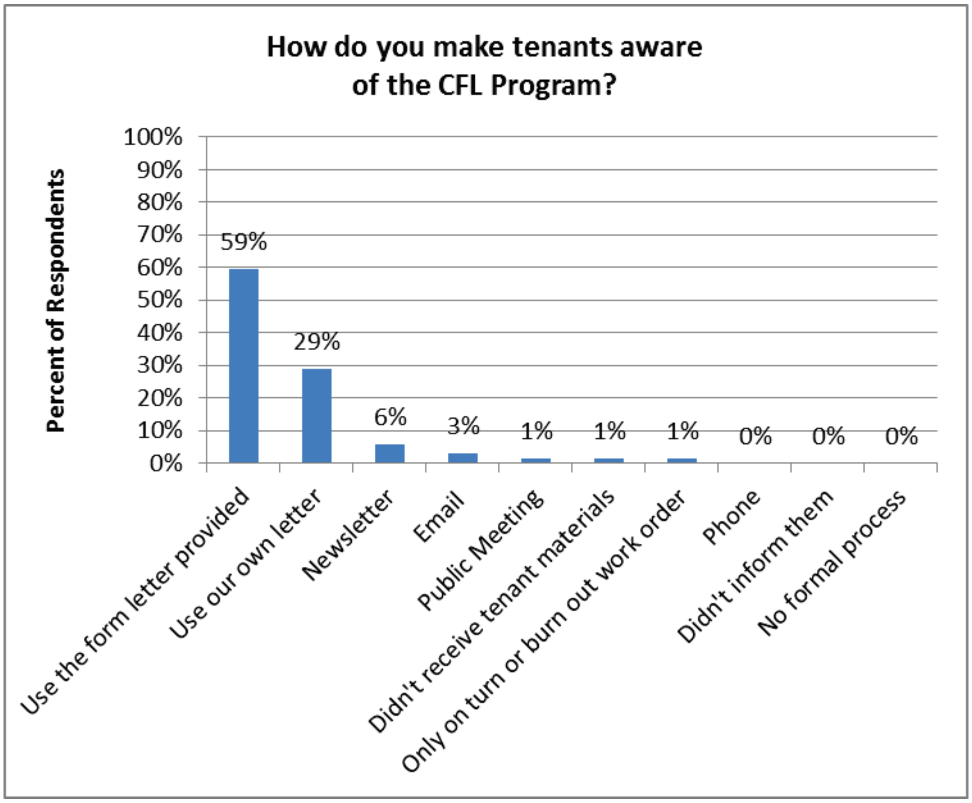

Figure 5. Tenant Notification Methods

Eighty two percent of respondents indicated that the support materials that they received were sufficient for understanding the benefits of the bulbs. Eleven percent found them less than helpful, and 7% said that they did not use them. From the six people who found the materials wanting we garnered the following feedback:

- “We would have liked more info on mercury for residents and for the office in case people call in.”
- “The pamphlet was not very informative so I was not well versed enough to explain it to my tenants.”
- “The pamphlets didn’t explain very much.”
- “Provide electronic copies.”
- “They are just light bulbs.”
- “People didn't read them.”

Bulb Replacement

Replacement Policies

To determine if the program had any impact on property managers' bulb replacement practices we first ascertained what their bulb replacment policies were prior to participation in the CFL program. Of the 63 property managers who respondend to this question, 89% indicated that it was their policy to replace bulbs after tenants move out, 56% reported doing so upon tenant request, while 24% indicated that standard light bulb replacment was a tenant responsibility.

Table 13. Bulb Replacement Policies

Policy for Bulb Replacement	Number of Responses *	Percent Responding
After tenants moved out	56	89%
As needed/upon request	35	56%
Standard bulbs are tenant responsibility. Only replace specialty bulbs like kitchen lights and appliance bulbs	10	16%
Didn't replace bulbs / Tenant responsibility	5	8%
According to maintenance schedule	2	3%
No standard practice	1	2%
DK/NS	0	0%

** Some respondents gave more than one answer*

We next asked if property managers had changed their bulb replacement policies after participating in the program. One third (33%) indicated that they had changed their policies, while two thirds (66%) said they had not. However, the findings for this question must be taken with a grain of salt since the survey question was worded in such a way that we believe some property managers were responding to changes in the above noted policies, while other were refering to changing from standard to CFL bulbs.

However, when we asked the question in a different way we learned that 65% of property managers plan to continue providing CFLs in the future, while 20% will go back to incandescents, and another 15% indicated "Other." The table below lists property manager reasons for not continuing to provide CFLs, as well as explanations for "Other" responses.

Reasons for not continuing to provide CFLs	Frequency of Response
We have gone back to incandescents	8
Incandescents are cheaper	4
People don't like the CFLs	2
CFLs don't last long	1
Reasons for "Other" response	
We will use up existing incandescent bulbs first	5

Depends on bulb cost and our budget	5
Will use CFLs, except for bathroom vanities since people don't like swirly bulbs	1
We hope to go to LEDs instead	1

Furthermore, 82% of property managers surveyed indicated that if not for the program they would not have replaced their existing incandescent bulbs with CFL bulbs, compared to 4% of respondents who said they would have done so regardless of program participation. Thus the program is getting CFLs installed in sockets that would have been filled with energy inefficient incandescent bulbs. An addttional 12% of respondents selected the "Other" response. Their verbatim answers are noted below.

- "Maybe someday, but not now."
- "We were looking into it but the price quote was too high."
- "Program helped, but we would have done it eventually, although not at this scale."
- "Eventually but this did it sooner."
- "Wanted to but budget didn't allow it."
- "No policy yet, but had started to try CFLs [on a limited basis]."
- "Eventually but this did it sooner."
- "No, but did some replacements as one offs. We try to replace bulbs with similar types."

A strong majority (89%) of property managers surveyed also felt that programs such as this were necessary to get properties to begin using CFLs. When asked why, the high cost of mass bulb replacement was the most common answer, while the next most common answer was people's tendency to continue doing what they have always done. Table 14 shows the range and frequency of responses.

Table 14. Reasons Why CFL Program Is Necessary

Reason	Frequency of Response
Otherwise it is cost prohibitive	22
It overcomes inertia. Otherwise people do what they normally would do.	11
It exposes people to the benefits of the bulbs	9
It depends on the age of the property	2
Some people already had bulbs from other Duke programs	2
it depends on their business decisions	1
It depends on people's tastes	1

Type of Bulbs Replaced

In terms of the wattage of the old bulbs that were removed, 60 watt incandescents were the overwhelming majority with 94% of respondents reporting that bulb type. A mere 5% reported replacing 40 watt bulbs, and one property manager (1%) indicated that 100 watt bulbs were replaced. No other bulb types were mentioned by those we surveyed.

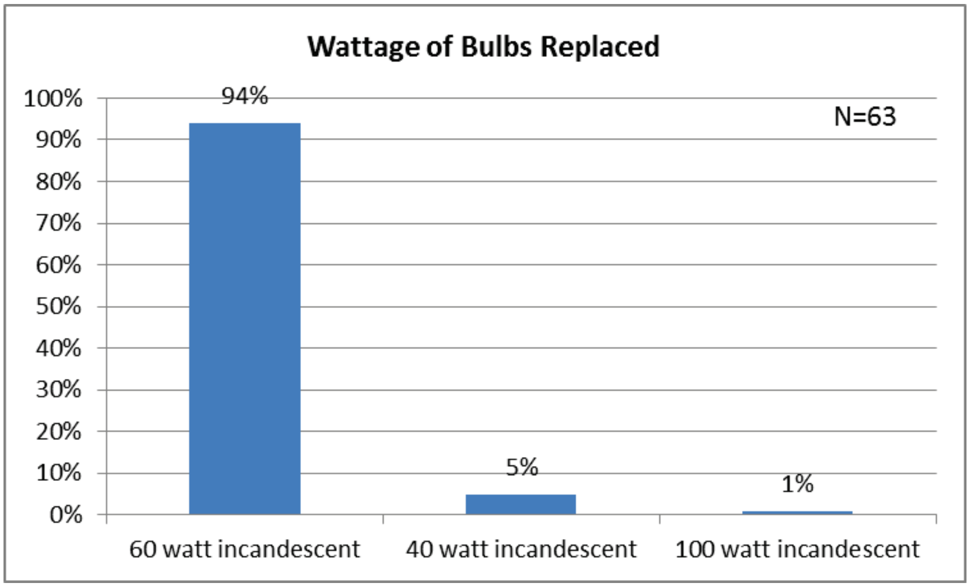

Figure 6. Wattage of Bulbs Replaced

Bulb Installation and Documentation

Number of Bulbs Installed

As shown in Figure 7, nearly three quarters (74%) of respondents indicated that they installed the full amount of bulbs ordered in each unit. Eight percent indicated that in accordance with program rules, they did not replace existing CFLs, while 18% reported that they did not install the full amount of bulbs for other reasons. Reasons given for not installing the full complement of bulbs are shown in Table 15.

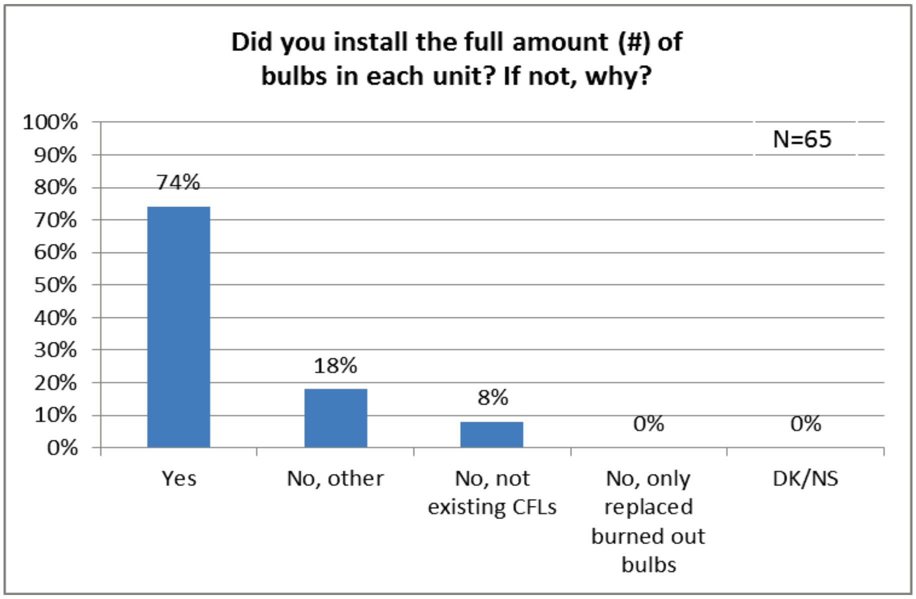

Figure 7. Amount of Bulbs Installed

Table 15. Reasons for Not Installing All Bulbs Ordered

Reason	Frequency of Response
Estimate was off	5
Insufficient manpower to finish installs	1
Tenants didn't want them	1
Some people already had CFLs	1
Some bulbs arrived broken	1
Skipped the vanities	1
Some didn't fit	1

Of the bulbs that were left over, 48% of interviewees indicated that they returned the extra bulbs, while 15% kept the bulbs in storage, 8% installed them in common areas, and 1% said their extra bulbs were never picked up.

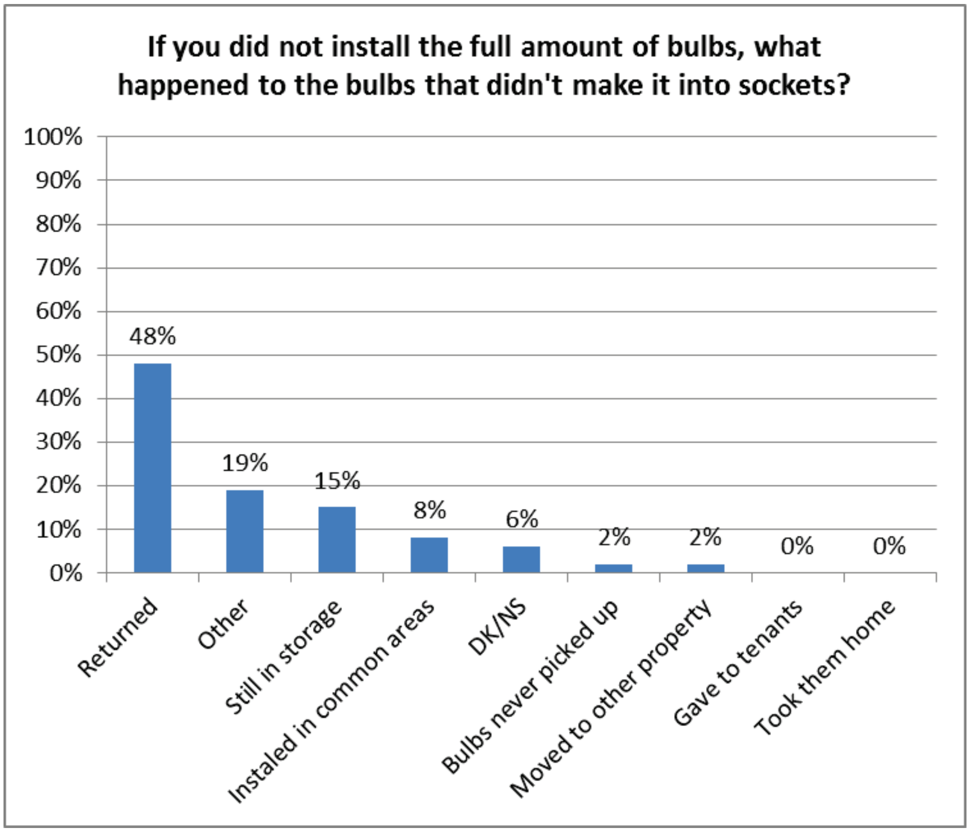

Figure 8. What Happened to Left Over Bulbs?

Tenant Response

Eighty nine percent of property managers interviewed reported that their tenants responded favorably overall to the installation process, with 3% indicating an overall negative response, and 8% unsure. When asked more specifically about the feedback that they heard from tenants, 25% of respondents reported that the tenants liked the bulbs, compared to 10% who said that overall their tenants did not like the bulbs. In a similar comparison, 16% of property managers indicated that their tenants liked the light quality, compared to 22% who said their tenants did not like it. Table 16 shows a full comparison of the tenant feedback received by tenants.

Table 16. Tenant Feedback as Reported by Property Managers

Tenant Feedback	Number of Respondents	Percent of Respondents
Like the bulbs	17	25%
Don't like the bulbs	7	10%
Like the lighting quality	11	16%
Don't like the lighting quality	15	22%
Like the program	10	14%
Don't like the program	1	1%
Positive impression of Duke Energy	3	4%
Negative Impression of Duke	0	0%

Energy		
Liked the installation process	5	7%
Didn't like the install process	0	0%
Lower monthly bills	11	16%
Appreciate free bulbs	7	10%
Nobody said anything	3	4%
Other	12	17%
DK/NS	13	19%

Install Process Improvements

Since the program is designed in such a way that the install process is the responsibility of the property managers, we have no specific recommendations for program improvements in this regard. However, future program participants may benefit if Duke Energy managers pass on the advice that we collected from current program participants.

- "For bigger properties tell them to order the bulbs in waves. That way they get multiple deadlines with less to do before each deadline."
- "If you calculate how long it will actually take to install the bulbs, then getting free bulbs doesn't seem such a great deal. You need to really think about the return on investment compared to the effort. It may be fine during slow periods, but not when tenants need repair, units need to be flipped, etc."
- "Don't plan your installs for first of the month, on Mondays, or during summer. There are too many other things that can come up during those times to mess up your schedule."
- "Have people tell tenants that the installs will be done during a given week, but don't be more specific or set appointments. You just can't tell when you'll be there."
- "In your notification letters try to ensure that people clear a way to access the bulbs. We told them that if we can't get to the bulbs we will charge them $20 (we wouldn't but the threat helps) so their doors were unlocked and we didn't need to move things to change bulbs."
- "Visiting units just to replace bulbs wastes an opportunity. Tell people to combine the installs with regular maintenance tasks or inspections so overall the crew is more efficient and the residents have fewer interruptions."
- "Do other efficiency upgrades at the same time, like faucet aerators, shower heads, etc."
- "The install timeline was tight so we brought in more staff to get the job done. We hired some college kids, but people can team up and work with other properties too."
- "It will be easier to get maintenance to buy in if you emphasize the benefit to them. They'll have fewer bulb replacement orders in the future."
- "The 60-90 day install window seems rigid. Why not automatically give people an extra 15 days during known busy periods like the summer."
- "The install process will go faster if you team up and give each person a specific task. For instance, one guy replaces bulbs, while another does the paperwork."
- "It took longer to unwrap the bulbs than it did to screw them in. One of the biggest wastes of time was opening all of the individual boxes. If you know you are going to be shipping them in batches, can't you pack them egg-crate style instead?"

- "Why don't you get residents to do it on their own? That way no one has to do more than 12 bulbs. You can go in and verify the installs, or better yet just up set things up so that Duke ships to each unit directly with a letter."
- "When we found a socket with a tenant-owned CFL already in it, we put the new CFLs where we needed it to go, and put the tenant bulbs in other fixtures."
- "Some residents took out bulbs after we put them in."
- "We have a policy that says residents must leave their units in their original condition when they move out, but tenants are balking at paying for replacement CFLs since they cost more than regular light bulbs."
- "We didn't have a logo for the notification form letter so we scanned the property manager business card onto the flier and then copies of that so that our info on the copy."

Editing and passing advice such as this to new program participants may help to improve customer satisfaction in the future.

Number and Type of Bulbs Ordered

Among those interviewed, 65% felt that the number of bulbs they ordered was appropriate, compared to 35% who felt they had ordered an inappropriate amount. Among those who ordered an inappropriate number of bulbs, 70% felt they had ordered too many, while 30 percent felt they had ordered too few. (Hence Honeywell's automatic 15% bulb reduction efforts.)

When asked how many bulbs they ordered per unit, nearly half (48%) reported ordering 12 bulbs per unit (the maximum allowed) for both one- and two-bedroom units. Only 37% of respondents indicated that they ordered the maximum number of bulbs for a three-bedroom unit, but this percentage is offset by the 15% who indicated that they did not have three-bedroom units on their properties. Table 17 shows a full breakdown of the number of bulbs ordered by size of unit. Figure 9 presents this information visually.

Table 17. Number of Bulbs Ordered by Type of Unit

Number of Bulbs Installed	One Bedroom Unit		Two Bedroom Unit		Three Bedroom Unit	
	N	Percent Respondents	N	Percent Respondents	N	Percent Respondents
12	16	32%	24	48%	18	37%
11	0	0%	2	4%	1	2%
10	3	6%	1	2%	2	4%
9	3	6%	4	8%	1	2%
8	5	10%	4	8%	3	6%
7	1	2%	5	10%	2	4%
6	5	10%	4	8%	3	6%
5	6	12%	4	8%	4	8%
4	1	2%	1	2%	0	0%
3	2	4%	0	0%	0	0%
2	1	2%	0	0%	0	0%
1	0	0%	0	0%	0	0%

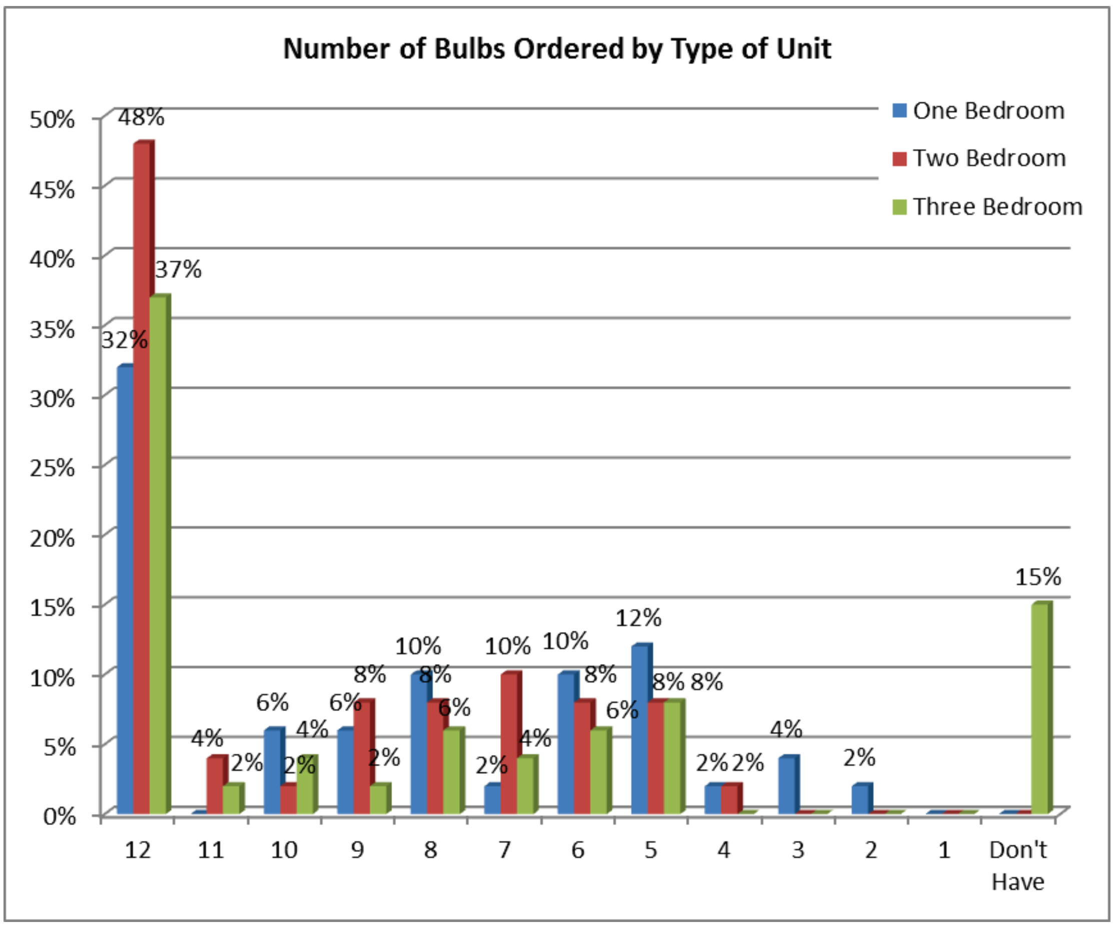

Figure 9. Number of Bulbs Ordered by Type of Unit

When we asked how many of the bulbs ordered were actually installed per unit, 81% reported installing all that were ordered, while 6% averaged one bulb left over, and 8% were not sure.

Table 18. Number of Bulbs Actually Installed (N=62)

Number of Bulbs Eventually Installed	Number of Respondents	Percent Responding
All that were ordered for that unit	50	81%
One less than ordered for that unit	4	6%
Two less than ordered for that unit	2	3%
More than three less than ordered for that unit	1	2%
Don't know / Not sure	5	8%

In terms of the type of bulbs (wattage, size, etc.) provided by the program, three quarters (74%) of property managers felt the bulbs were appropriate, compared to one quarter (25%) that did not. Among those who didn't find the bulbs appropriate, bulb fit was the primary complaint. Comments regarding inappropriate bulbs are noted in the table below.

Table 19. Reasons Bulbs Were Considered Inappropriate

Reason	Number of Comments
Bulbs did not fit	5
Burned out quickly	2
Not bright enough	2
Too bright	1
Wanted more variety	1
Afriad they will break (mercury)	1

Additional Bulb Types and Other Efficiency Products Desired

We asked about other bulb types that should be provided by the program and a majority of property managers interviewed indicated that they desired Hollywood (globe) bulbs for bathroom vanities where bulbs are left exposed for constant viewing. Of those who wanted the Hollywood bulbs, all but one property manager told us that they did not install CFLs in their vanities because tenants did not like the look of the bulbs. As a result, it appears that bathroom vanities with multiple bulbs in each went unchanged in apartments across Duke Energy service territory.

Table 20 shows the types of bulbs requested by property managers during that specific interview question. However, additional requests for Hollywood bulbs also came up at other times during the interview processes. Those unofficial responses are not reflected in the official tally below, but they were frequent and add weight to the importance of providing this particular bulb type.

Table 20. Additional Types of Bulbs Desired

Other Type of Bulb	Number of Requests	Percent of Respondents
Hollywood (globe) for bathroom vanties	31	45%
Outdoor floods	12	17%

Candelabra	10	15%
Higher watt equivalent	4	6%
Track light bulbs	2	3%
Recessed bulbs	1	1%
Bulbs that brighten quicker	1	1%
Shorter bulbs	1	1%
Long thin kitchen lights	1	1%
LEDs to replace HIDs	1	1%

Other Energy Efficiency Products Desired

In addition to asking about other types of bulbs that the program might provide, we also inquired about other energy efficient products that property managers would like to have for the units that they manage. Among the products suggested, 29% requested weather stripping (20 requests), 19% wanted programmable thermostats (13), and 16% asked for water heater blankets (11). A full listing is included in theTable 21.

Table 21. Additional Energy Efficient Products to Consider Providing

Desired Product	Number of Requests	Percent of Respondents
Weather stripping	20	29%
Programmable thermostats	13	19%
Water heater blankets	11	16%
DK/NS	10	14%
No	10	14%
Door sweeps	9	13%
Powerstrips	4	6%
Low flow toilets	3	4%
Low flow shower heads	2	3%
Faucet aerators	2	3%
Motion detection lights	2	3%
Energy Star appliances	2	3%
Window replacement incentives	2	3%
HVAC	2	3%
Digital, not programmable thermostats	2	3%
Lighting timers	1	1%
Tinted window films	1	1%
Rebates for wall mounted heat pumps	1	1%
Additional attic insulation	1	1%
Common area bulbs	1	1%
Window strips	1	1%
Water heater timers	1	1%
Furnace filters	1	1%
Foam insultators for wall sockets	1	1%
Pilot for peak monitoring units	1	1%

Benefits of Participation

This program is specifically designed to benefit residential tenants by providing them with energy efficient light bulbs and resulting savings on their energy bills. The benefits to property managers are less immediate, so we asked them to help us identify those benefits that they found to be most direct.

Among those we spoke with, 42% felt that the program helped to improve their tenant relations, 39% felt that it improved their image by helping tenants to save money, and 33% felt it helped the company image by doing something positive for the environment. Only 14% felt that installing the CFLs actually helped them to attract new tenants, but those that did used the program to their advantage by advertising their energy efficiency efforts. One property used the bulb installs to help with LEED certification, and another used its participation to garner extra credibility with HUD and investors. Some used the installs as an opportunity to increase resident engagement with contests and parties, while others were simply pleased with reduced costs on bulb purchases and decreased requests for bulb replacement.

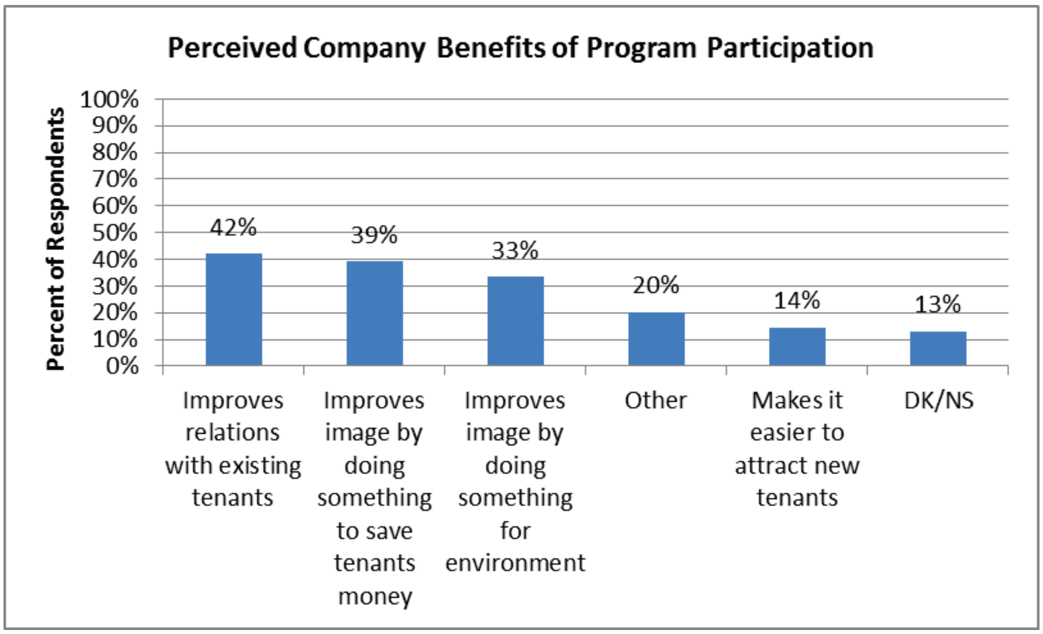

Figure 10. Perceived Benefits to Properties from Program Participation

When asked about their perceptions of tenant benefits (see Figure 11), 64% of respondents cited lower monthly bills, while 28% indicated that tenants saved money by not needing to purchase bulbs, this later percentage likely being reported by properties with policies requiring tenants to supply their own light bulbs. An additional three people (4%) gave other responses to this question. While not necessarily in context to the question, they are noted here for completeness.

- Good for the environment
- Less maintenance for light bulb replacement
- Some people say the lights too bright

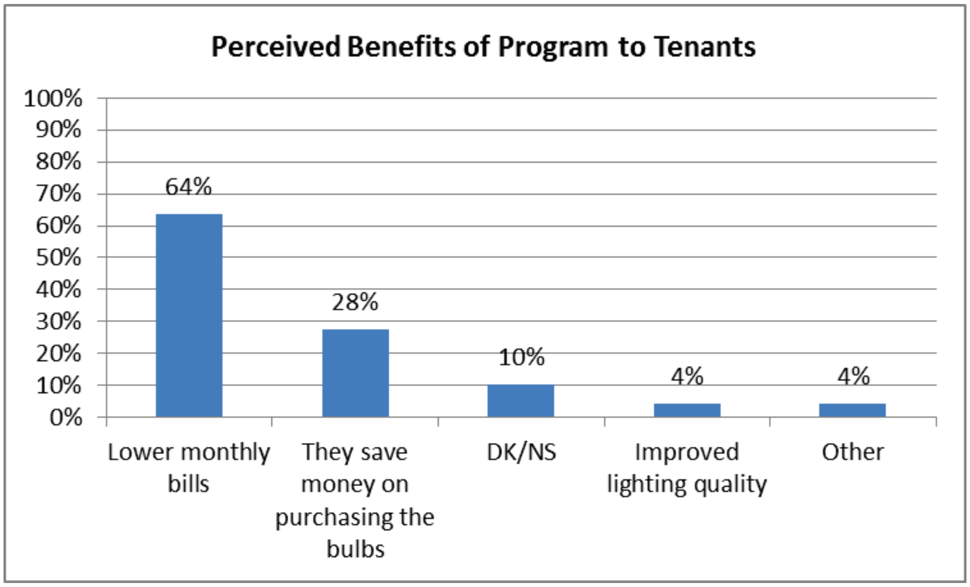

Figure 11. Perceived Benefits to Tenants from Program Participation

Customer Satisfaction with the Program

Property managers indicated a high level of satisfaction with the program. Among all program participants the mean satisfaction score was 8.7 on a scale of 1 to 10 with 1 meaning they were very unsatisfied and 10 meaning they were very satisfied. Seventy two percent of property managers rated the program as a 9 or 10.

When analyzed by state, Ohio participants reported a mean satisfaction score of 8.6 on the same scale with 62% rating the program a 9 or 10. North Carolina property managers reported a mean satisfaction score of 8.7 with 74% rating the program a 9 or 10. South Carolina participants reported a mean satisfaction score of 8.8 with 72% rating it a 9 or 10. Overall and state-by-state satisfaction scores are shown in the figures below.

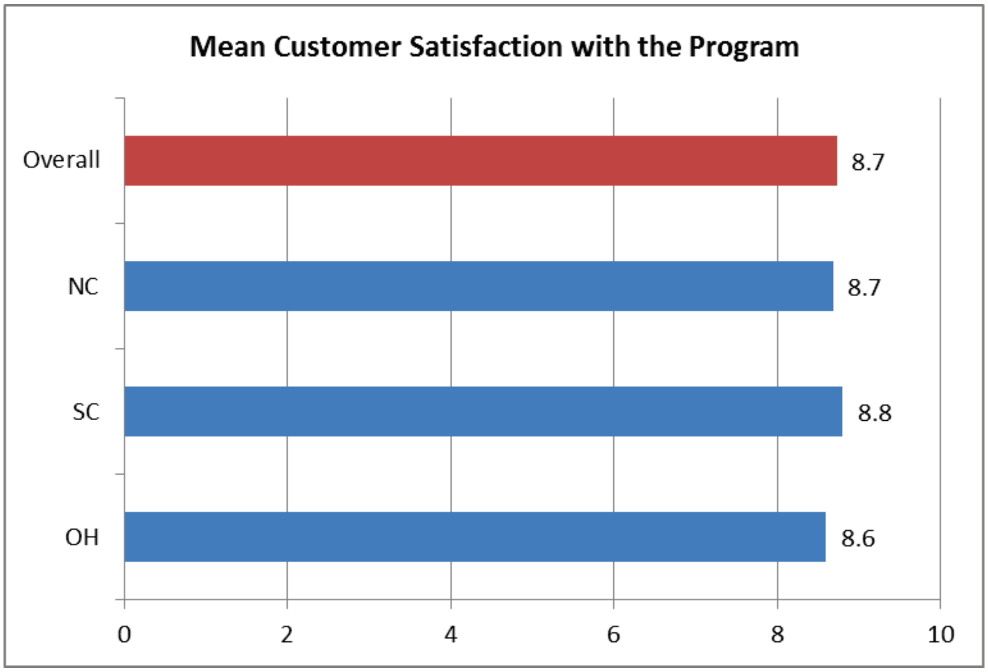

Figure 12. Overall Property Manager Satisfaction with Program

The following are the reasons given by participants for program satisfaction scores of 8 or less.

Table 22. Reasons for Satisfaction Ratings of 8 or Less

Reason for Score of 8 or Less	Frequency of Response
Too much labor involved	7
Need better communication	3
Tenants don't like bulbs	3
Bulbs burn out too quickly	2
Have not seen cost savings	2
Wanted more flexibility for the install time	1
Where do you put the 2400 light bulbs you take out?	1

Verbatim responses are shown below:

- "It was a pain due to communication, but it did positively introduce CFLs to people. Have not seen savings in bills."
- "Need better communication."
- "Bulbs are not energy efficient if off and on. Not everyone likes that kind of bulb."
- "Because of the high labor involvement."
- "Took too long, tenants didn't like the bulbs. Bulbs burn out very fast."
- "It took too much time to do the installs."
- "Wanted more flexibility for the install time."
- "Took too long to do bulbs installs, shape and light quality is a question."

- "It was too inconvenient. Why don't you put in the bulbs yourself? Where do you put the 2400 light bulbs you take out?"
- "Bulbs don't last. Took too much time and effort for too little return."

For the state of Ohio we also used a second approach for ascertaining customer satisfaction by asking the following question: If you were rating your overall satisfaction with the CFL Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied? Of the five survey respondents, three people (60%) were very satisfied, one person was somewhat satisfied (20%), and one respondent declined to state (20%). The distribution of scores is shown in the figure below.

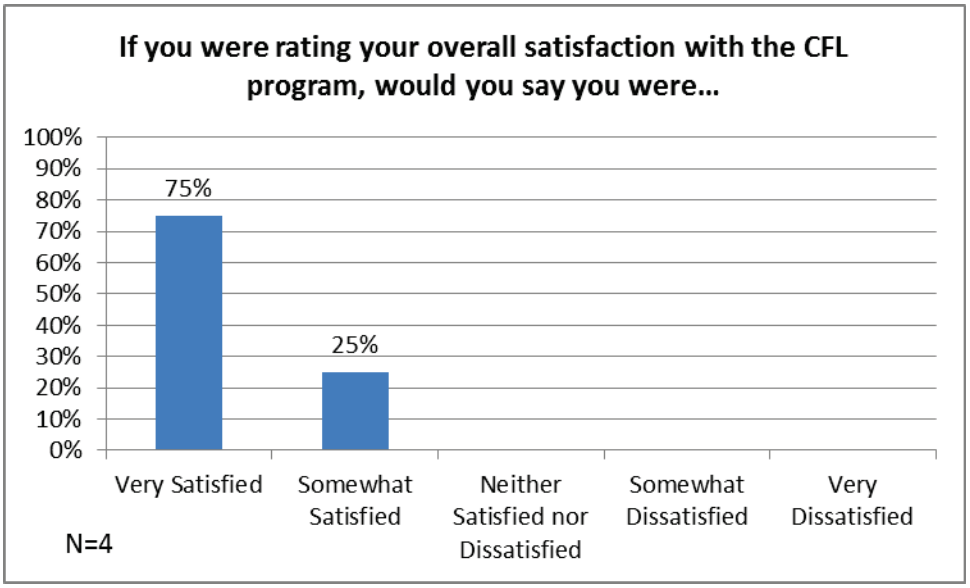

Figure 13. Ohio-Specific Satisfaction with the Property Manager CFL Program Using Verbal Scale

The following are the verbatim responses from the four Ohio participants who answered this survey question.

Rating	Verbatim Response
Very Satisfied	Free bulbs!
Very Satisfied	It's easy to do and a no brainer. 1500 bulbs for $130 is a great deal. Plus it lets us show people we are going green.
Very Satisfied	Going through the program was a bit of a pain. We tried to be accurate on paperwork. The return for us was minor. The residents gave us five minutes good will and then asked for other things.
Somewhat Satisfied	I had a few questions that never got answered. A few extra bulbs would be nice. I wanted more time to do the installs.

Customer Satisfaction with Duke Energy

To assess participants' satisfaction with Duke Energy, respondents were asked to rate their satisfaction with Duke Energy on a 1-to-10 scale with 1 being very dissatisfied and 10 being very satisfied. Their combined scores generated an average satisfaction of 7.8, with half (50%) of respondents rating Duke Energy with a 9 or 10.

When considered state by state, Ohio participants reported a mean satisfaction score of 8.6 on the same scale with 60% rating their satisfaction with Duke Energy a 9 or 10. North Carolina property managers reported a mean satisfaction score of 8.0 with 49% rating Duke Energy a 9 or 10. South Carolina participants reported a mean satisfaction score of 7.7 with 58% rating Duke Energy overall a 9 or 10. Overall satisfaction and state-by-state satisfaction scores are presented in the figures below.

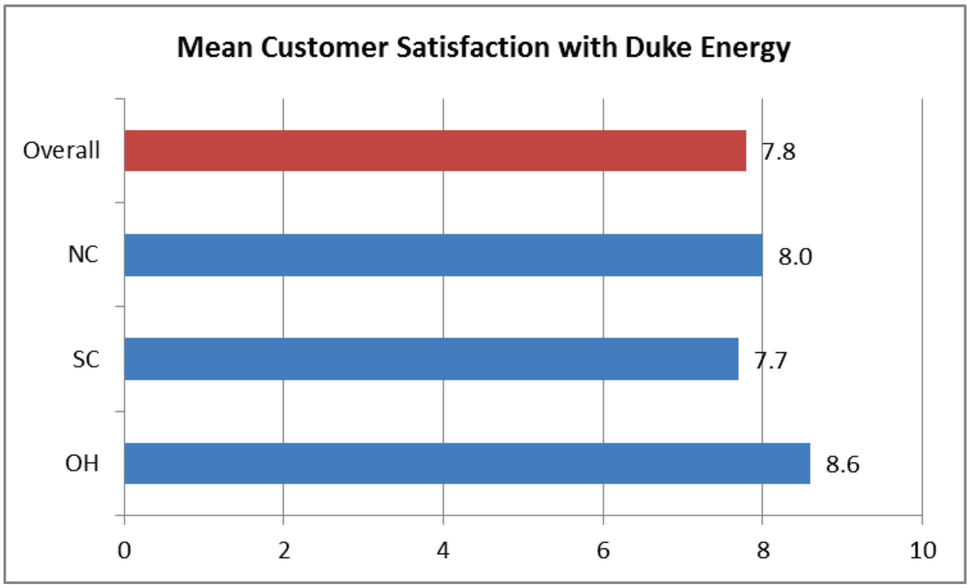

Figure 14. Overall Property Manager Satisfaction with Duke Energy

The following are the reasons for participants reporting lower (score of 8 or less) satisfaction scores with the program.

Table 23. Reasons for Satisfaction Ratings of 8 or Less

Reason for Score of 8 or Less	Frequency of Response
High rates	7
Overall customer service (not this CFL program)	6
Poor support for property managers such as power off/on, account changes, timely meter reading, tax id changes, etc. (not specifically this CFL program)	6
Credit requirements for tenants	2
Poor property manager web interface	1
Power reliability	1

Property Manager Suggestions for Improvement

Throughout the interview process the property managers that we spoke with offered suggestions for changes to program. In addition to the recommendations noted earlier in this report, we have cataloged the following additional suggestions.

Checklists and Documentation

- “I didn’t know about the checklist spreadsheet until later. So we had to go back and fill it out. That was a pain. Make sure everyone knows about in advance.”
- “The check sheets did not include a spot for closets.”
- “I don’t quite know how to say this, but maintenance guys are not very good at counting bulbs and filling out paperwork. At least not accurately. So it took a lot of my time to repeatedly count the bulbs during ordering, shipping, installing, inspecting, and returning them. Anything to cut down on that would be a big help.”
- “The spreadsheets are painful. The less we need to fill out the better, but if you want us to fill something out, then explain why you need to know the number of bulbs in each area. Better explanations will make people more apt to take the forms seriously.”
- “Skip all the spreadsheet forms and create an app for the iPad. Then we can enter the data and send it directly to you.”

Bulbs

- “Give us bulbs for common areas, our offices, etc. The lights stay on longer in those areas so they’ll accrue more energy savings.”
- “Provide a greater variety of bulbs types and wattages, such as candelabra bulbs for ceiling fans, outdoor bulbs, shorter bulbs, Hollywood bulbs, etc.”
- “People don't want bulbs made in China because they are worried about risk of mercury from faulty bulbs. Stay away from Chinese bulbs.”
- “Make it standard practice to provide a small percentage of extra bulbs in case some blow out.”
- “You need to provide bags or kits for broken bulbs. Getting rid of them may be no problem in Charlotte, but for those of us in remote areas the nearest recycling point is 40 miles away. So all broken bulbs go into the trash and landfill.”

Other

- “Send a Duke representative to do the installs. We can send one too and they can work together.”
- “Bigger boxes with more bulbs per box, so there is less individual light bulb packaging overall.”
- “Faster shipping.”
- “Free shipping.”
- “Better communication from Duke and Honeywell.”
- “Look at turnover ratio and if it’s high enough allow them to do the installs when units change.”

- “You might have better luck targeting newer properties since the maintenance teams will be less busy than at older properties.”
- “We would like to have a display from Duke that explains the benefits of the bulbs in our office.”
- “Keep providing participation certificates. Our owner uses the one we received in presentations. It’s helped us during presentations at HUD and with investors for new properties.”

Tenant Survey Results

Between April 17 and May 23, 2012, TecMarket Works called 1,232 tenants from a pool of 38,412 program participants in the Carolina system and completed 82 phone surveys[13]. The effort had a 6.9% completion rate and an overall sample rate of .02%. Tenants were contacted a maximum of four times or until the contact resulted in a completed survey or refusal to complete the survey. The survey instrument can be found in Appendix C: Tenant Survey Instrument.

Eighty five participants started the survey but full completions were obtained from 82 of the participants. The others had to drop off the phone call and could not complete the survey. For purposes of consistency, this analysis only uses the data collected from completed surveys.

CFL Installs

Number of CFLs Now Installed

As seen in Figure 15 below, tenants reported that they now have between two and 14 CFLs installed in the permanent fixtures of their homes for an average of 4.5 bulbs per household. However, the biggest category of responses was “Don’t Know” with 24 respondents (29%) indicating they were unsure of how many bulbs they had installed.

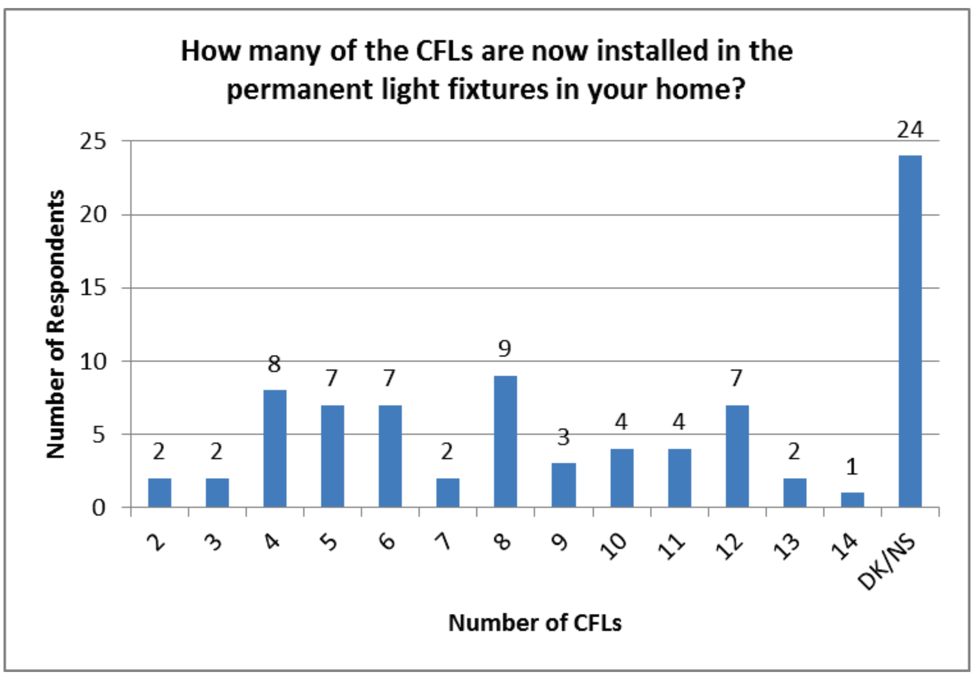

Figure 15. Number of CFLs Installed in Permanent Fixtures

Location of New CFLs

When asked in what rooms the first three bulbs were replaced, respondents indicated that living/family rooms were the most common with 52 responses, and bathrooms the second most popular with 50. [Note that this finding about bathroom lighting appears to be incongruent with

[13] The process evaluation utilizes 82 out of 85 completed surveys, as not all questions were answered by all 85 respondents.

property manager interviews in which a sizeable number of respondents reported NOT installing CFLs in bathroom vanities.] Kitchens were the next most frequently mentioned room with 43 responses, while master bedrooms rounded out the top 4 most common rooms mentioned. Figure 16 shows the full range of responses.

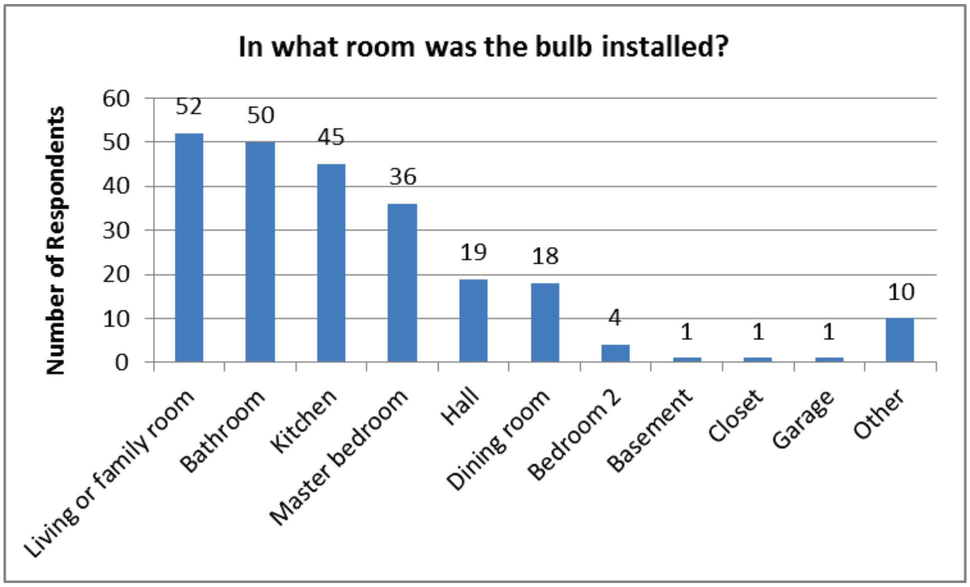

Figure 16. Location of Bulb Replaced

Estimated Hours of Bulb Use

CFL Estimates

In order to determine the average hours of use per bulb per day, tenants were asked to estimate the typical hours of use for the first three CFLs that were directly installed in their homes. Their estimates generated an average of 4.1 hours per day (See Figure 17). Moreover, 76% percent of respondents said that the hours of bulb usage remained the same after the installs were complete. Four percent of respondents felt that they were leaving the new CFLs were on longer than the old bulbs at an average of 2.3 hours more usage each day. A similar 4% felt that their bulb usage had gone down to an average of 3.6 hours of use per day.

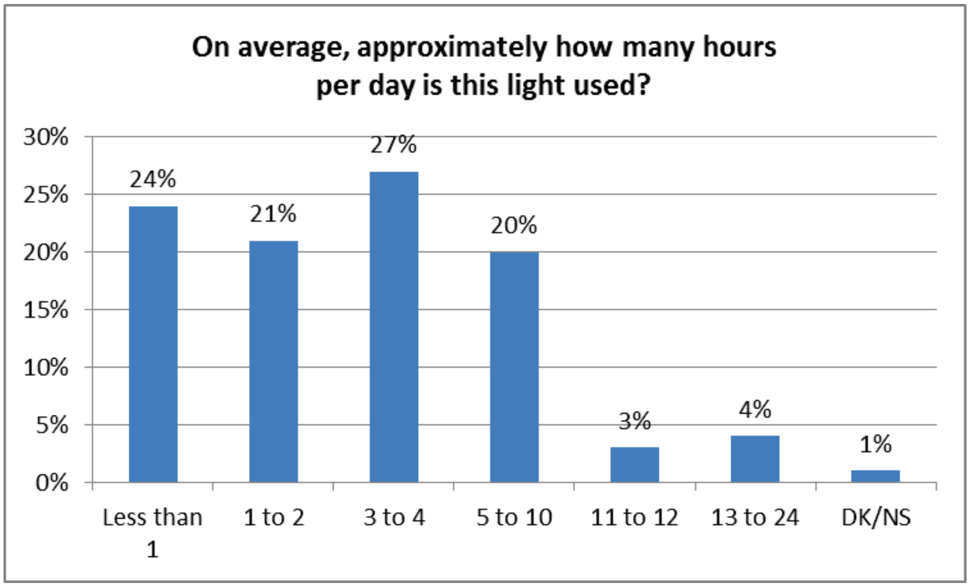

Figure 17. Estimated Hours of Bulb Use per Day

Non-CFL Estimates

When asked how many non-CFL bulbs in their households were used more than two hours per day, 57% of tenants surveyed said that zero bulbs were used for more than two hours per day. An additional 11% said their non-CFL bulbs were used for just one hour per day. Figure 18 shows the full range of responses respective to estimated hours of use.

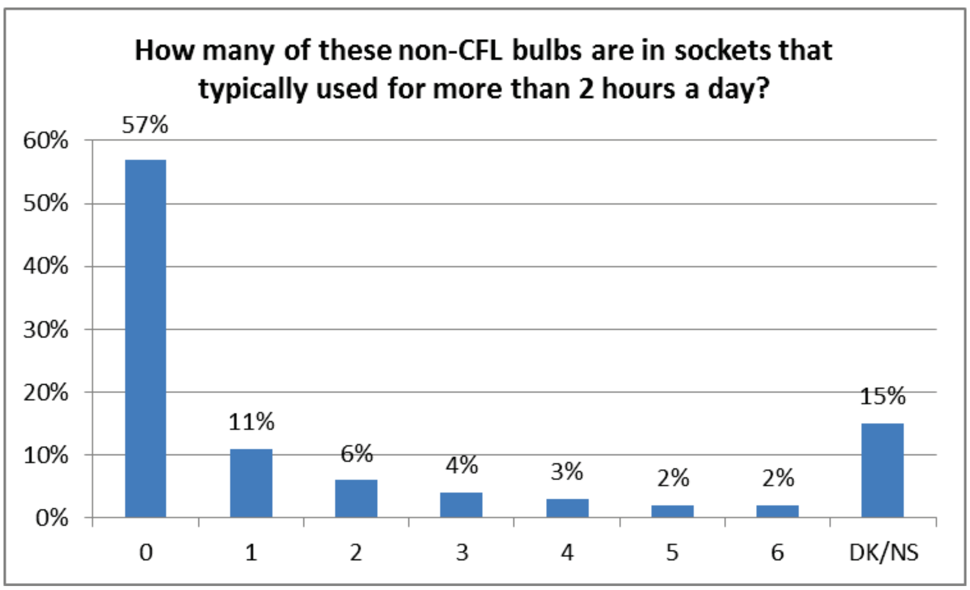

Figure 18. Estimated Hours of Non-CFL Bulb Use

Disposition of Replaced Bulbs

When asked what happened to the bulbs that were removed, 51% of respondents indicated that the installer removed them, 20% placed the old bulbs in storage, and 23% threw away their old bulbs.

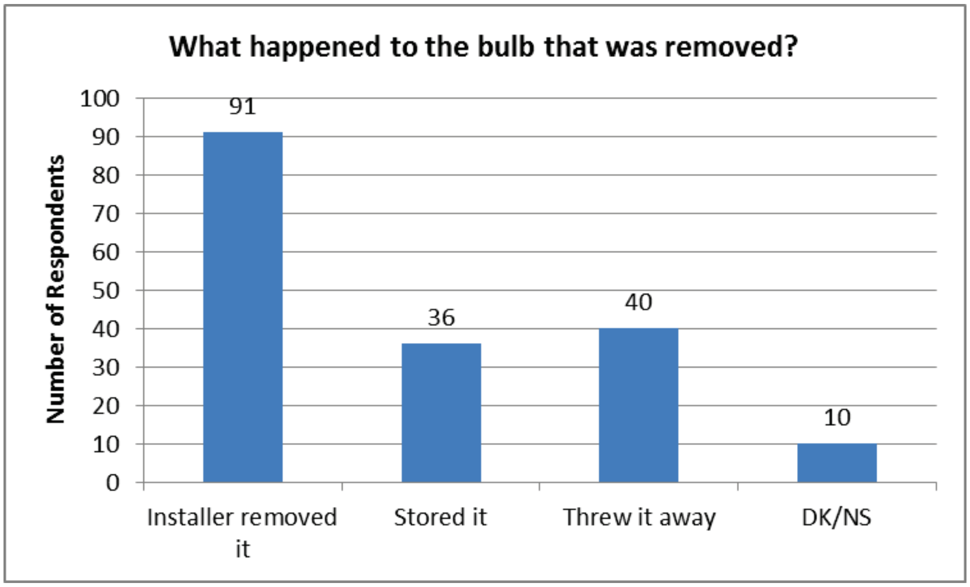

Figure 19. Disposition of Old Bulb after Removal

Types of Non-CFLs Remaining in Tenant Homes

Incandescent bulbs were far and away the most frequently mentioned type of bulb to be replaced with 76% of respondents mentioning this bulb type. More specifically, 28% of respondents reported that 45-70 watt bulbs had been replaced. Thirteen percent indicated that 71-99 watt bulbs had been replaced, and 5 percent reported replacing bulbs of 100 watts or more. Figure 20 shows the full distribution of responses.

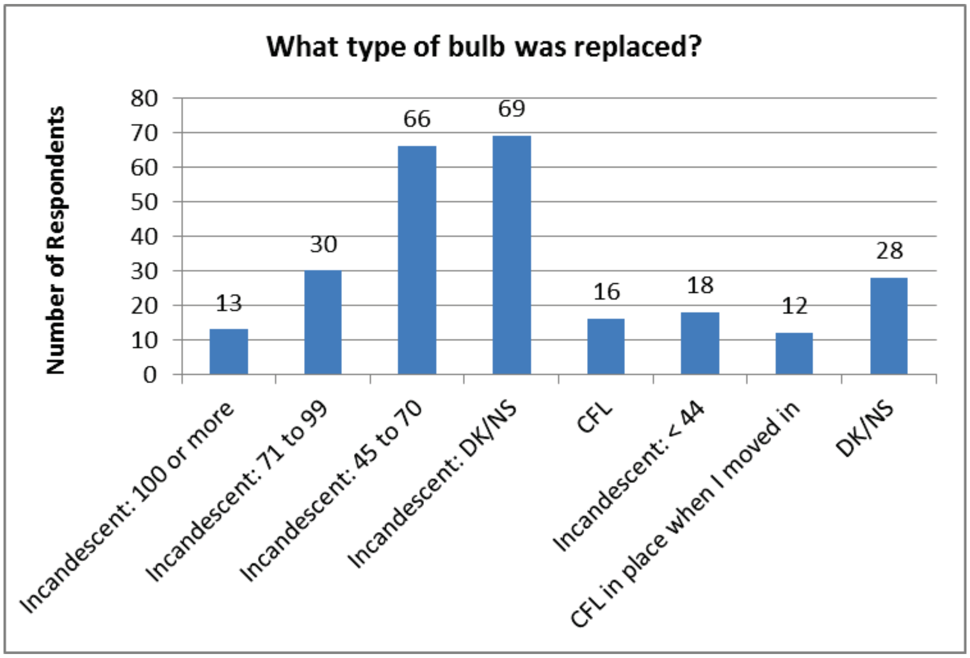

Figure 20. Type of Bulb Replaced

Specialty Bulbs

In terms of the most popular specialty bulbs in tentant homes, candelabra bulbs ranked first on the non-CFL list with 15 people reporting a total of 139 bulbs. The most popular specialty CFL was outdoor flood lights with 3 people reporting a total of 20 bulbs. Table 24 shows the number of people reporting specialty bulbs and the number of bulbs of that type.

Table 24. Specialty Bulb Types

Specialty Bulb Type	# Respondents	# Bulbs
Dimmable CFLs	1	1
Dimmable Incandescents	5	6
Outdoor flood CFLs	3	20
Outdoor flood Incandescent	5	13
Three way CFLs	2	4
Three way Incandescents	7	14
Spotlight CFLs	0	0
Spotlight Incandescents	2	5
Recessed CFLs	0	0
Recessed Incandescents	0	0
Candelabra CFLs	1	6
Candelabra Incandescents	15	139
Other CFLs	1	8
Other Incandescents	11	41
Other: Vanity Globe	10	NA

Other: Tube Florescent	9	NA
Other Night light	2	NA
Other: Mercury Vapor	1	NA

Number of Bulbs in Use

Because this program involved direct installs, it was important to determine how many tenants were already using CFLs in their homes. Fifty seven percent of respondents said that they had no CFLs previously installed, while 38% indicted that they had already installed CFLs, and an additional 5% reported that CFLs were installed before they moved in. When asked how many CFLs were already in the use 68% of respondents reported having between one and four bulbs installed. As seen in Table 25 the most popular number of previously installed CFLs was two, with 23% of respondents.

Table 25. Number of Previously Installed CFLs

Number of CFLs Previously Installed	Number of Respondents	Percent of Those With Previously Installed CFLS
1	3	10%
2	7	23%
3	6	19%
4	5	16%
5	1	3%
6	2	6%
9	2	6%
10	1	3%
12	2	6%
All	1	3%
Some	1	3%

Number of Non-CFLs Remaining in Tenant Homes

When asked to estimate the number of remaining bulbs in their homes that were not CFLs, 28% reported zero, indicating that all the bulbs in their homes were CFLs. Forty one percent reported one to five bulbs as non-CFLs, while another 16% indicated that six to ten bulbs were non-CFLs. Seven percent were unsure.

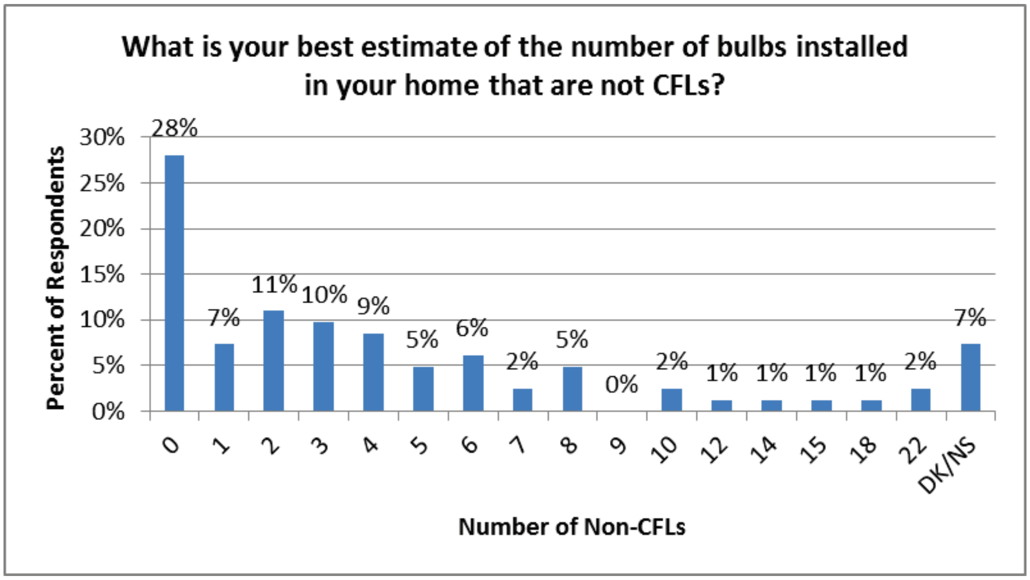

Figure 21. Number of Non-CFL Bulbs Remaining in Tenant Homes

CFL Usage

In addition to the energy savings generated via the direct installs, one of Duke Energy's primary goals was to encourage the use of CFLs in the future. To evaluate the effectiveness of the program in this regard, tenants were asked a series of questions to explore their propensity to purchase and install CFLs after participating in the program.

Previous CFL Usage

As shown in Figure 22, 16% of those surveyed reported that they had made their first CFL purchase within the past year, while 29% had been using CFLs for two or more years. But more importantly, more than half (53%) of survey respondents indicated that they had never purchased CFLs before. This indicates that the direct install program has been successful in reaching a majority of tenants who would otherwise not have been likely to begin using CFLs

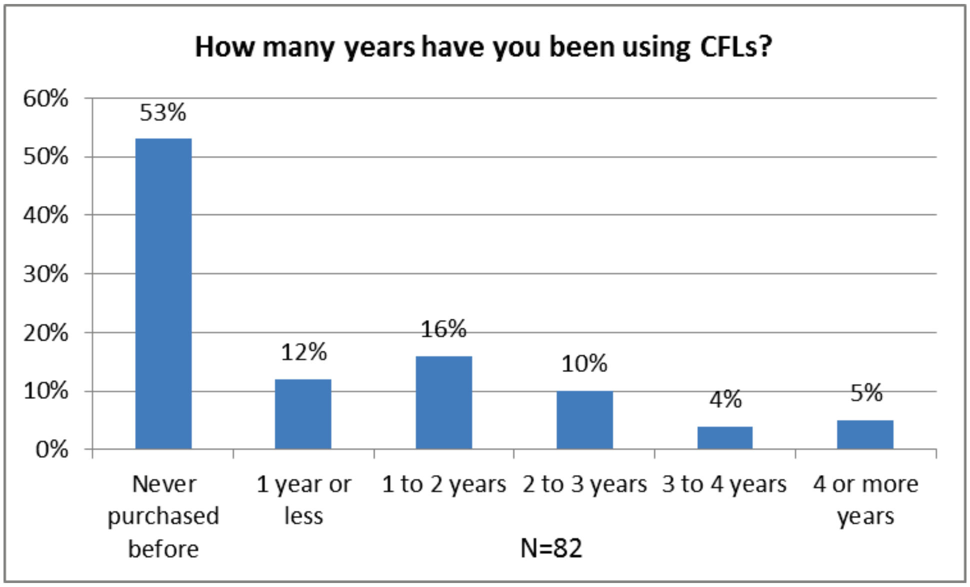

Figure 22. Years of CFL Usage Prior to the Program

Propensity for Future CFL Usage

When asked about the likelihood of buying and using CFLs in the future using a scale of 1 to 10 where 1 means not at all likely and 10 means very likely, respondents returned an average likelihood of 8.5. Fifty seven percent rated their likelihood as a 10, as shown in Figure 23.

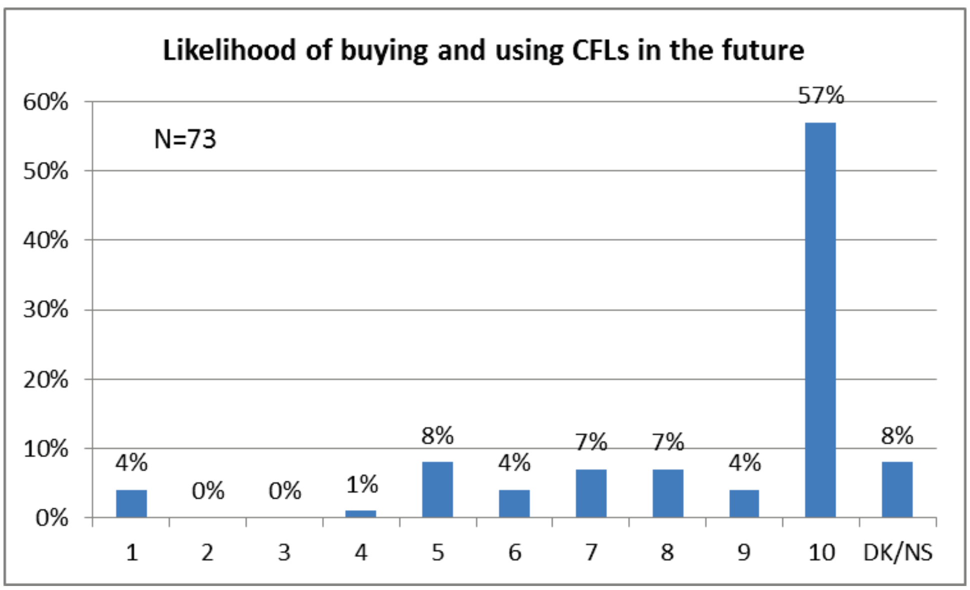

Figure 23. Likelihood of Buy and Using CFLs in the Future on 1-10 Scale

The positive response rate for future usage was even higher when tenants were asked to rate their likelihood of purchasing and installing CFLs using a verbal rather than numeric scale. Seventy three percent of respondents felt that they were more likely to do so, compared to 6% who were less likely and 21% who were neither more nor less likely. When asked why they were more likely to do so, 37% answered because CFLs save money. 17% said because they save energy, and 15% felt they would buy CFLs because they like the brightness. Table 26 presents all of their reasons.

Table 26. Reasons for Being More Likely to Purchase CFLS in Future

Reason for being more likely to buy CFLs	N Responses	% of Respondents
Save money/lower bills	26	37%
Save energy	12	17%
Brightness	11	15%
Light quality	7	10%
Last longer	7	10%
Not as hot	4	6%
Better for environment	4	6%
Total Respondents	71	100%

Just five people felt they would be less likely to purchase CFLs in the future. Their responses are show below.

Table 27. Reasons for Being Less Likely to Purchase CFLS in Future

Reason for being more likely to buy CFLs	Frequency of Response
I do not like the light quality	1
I don't like the light, they glare if they are not under a shade.	1
I hate the light from CFLs	1
I will buy the incandescent in the future because that's what I'm used to. They've always worked, I always like the light quality, and they look nice.	1
They are too dark. I can't read with that light.	1

Because intended future behavior is not the same as present behavior we also asked about any CFL purchases already completed since participating in the program. Only 4% of respondents reported purchasing additional CFLs, compared to the 96% who said that they had not purchased CFLs. While this 4% positive response rate is low, the result is not surprising given that the currently installed bulbs have a projected life span that is longer than the interval between their installation and the date of the survey.

Factors Influencing the Purchase of CFLs

When making a light bulb purchase a number of different factors can influence a buyer's decision. To help determine which factors have a greater influence we asked customers to rate importance on a scale of 1 to 10 with 1 being not at all important and 10 being very important. When the responses are ranked according to mean importance scores "cost savings on utility bill" tops the list as the most important factor at 9.7, followed immediately by "energy savings" with a score of 9.6. Availability of bulbs in stores where you shop rounded out the top three with a score of 9.2. The full distribution of scores is presented in Table 28 below.

Table 28. Importance of Bulb Characteristics in Purchasing Bulbs

Bulb Characteristic	Mean Importance
Cost savings on utility bill	9.7
Energy savings	9.6
Availability in stores you normally shop	9.2
Purchase price	8.9
Availability of utility programs	8.6
Selection of wattage and light output	8.4
Recommendations from utility company	7.8
Recommendations from family and friends	7.7
Ease of bulb disposal	6.7
Speed to full lighting level	6.6
Mercury Content	6.3
Ability to dim the lighting level	5.8
Appearance of bulb	3.7

As seen in the table above, factors often perceived as barriers to CFL adoption, such as appearance (3.7), ability to dim bulbs (5.8) and ease of disposal (6.3) were rated as the least important characteristics. Overall, this suggests that an effective way to increase CFL adoption and installation by tenants of multi-family properties is to focus messaging on cost and energy savings and to make the bulbs available in stores where tenants normally shop.

Preferred Channels for CFL Distribution

TecMarket Works asked approximately half[14] (n=44, 54%) of the surveyed tenants to rate their likelihood of participation, on a 1-to-10 scale, in six hypothetical CFL distribution programs that offered **discount** CFLs, and then asked the other half (n=38, 46%) of surveyed tenants to rate their likelihood of participation, on a 1-to-10 scale, in six hypothetical CFL distribution programs that offered **free** CFLs. The mean ratings and program types are shown in Figure 24.

Likely participation is rated highest for programs that use direct mail (4.4 for discount, 3.7 for free), while manufacturer coupons, retailer store coupons, and stands in parking lots follow close behind. All scores within groups (free and discount) were clustered closely, and all scores for the distribution methods (direct mail, coupon, etc.) were clustered within one half point of the others, indicating that upon comparison there were relatively small differences between findings.

When ranked in order of preference, both groups scored the distribution methods in the same order. This suggests that tenant preferences for various distribution methods remain constant despite the differing financial incentives offered.

[14] The survey data collection tool used has a function which assigns “free” or “discount” at random.

For all hypothetical distribution methods, tenants rated their likelihood of participating higher for programs that offer discount bulbs rather than programs that offer free bulbs. This seemingly incongruous finding may be an artifact of the small sample sizes involved, but it does suggest that price may not be the dominant factor driving bulb purchasing decisions.

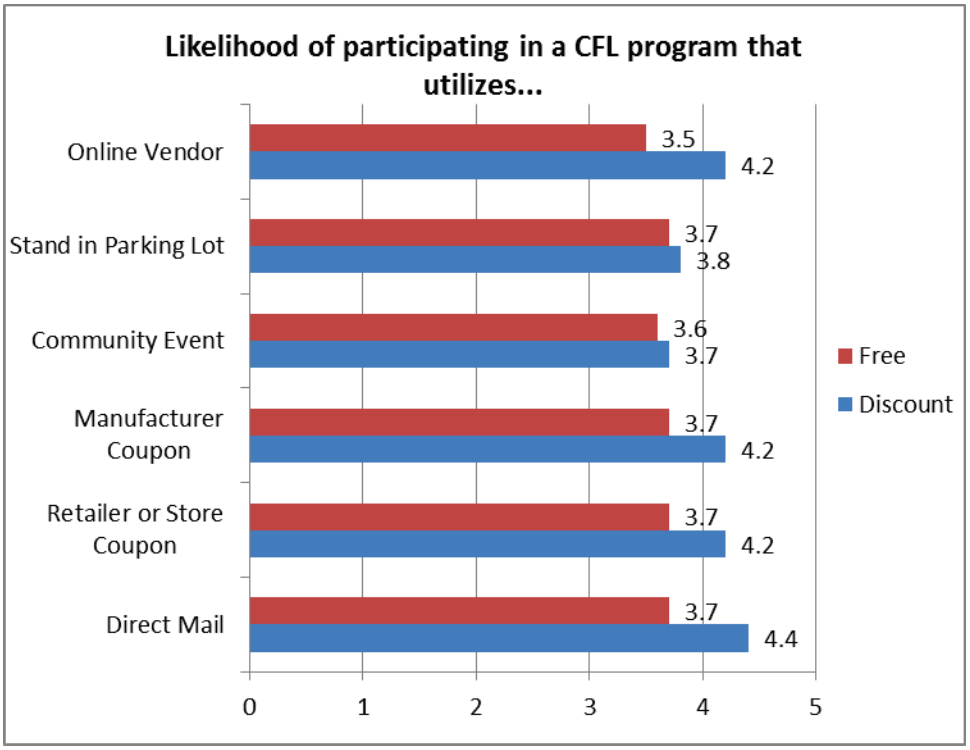

Figure 24. Mean Ratings of Likelihood of Participation in CFL Programs Among Tenants

We also delved a bit deeper into the direct mail distribution method to ask respondents to rate their interest in participating in a CFL program that uses direct mail to ship specialty bulbs. Their ratings averaged 8.8 on the 10 point scale (See Figure 25). In fact, more than two thirds (68%) of respondents rated their level of interest in participating a 10. This suggests a strong interest in this type of program among tenants of multi-family properties.

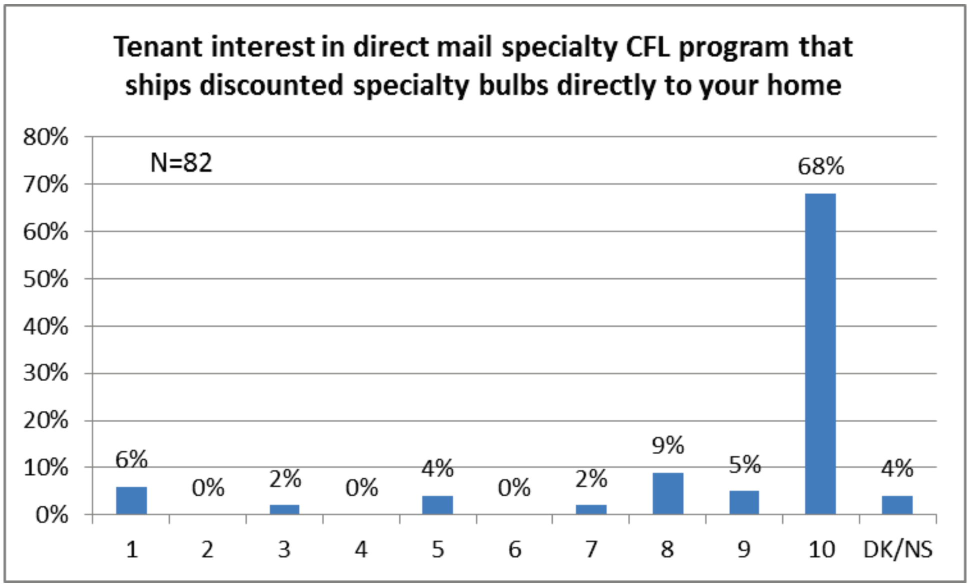

Figure 25. Tenant Interest in Direct Mail Specialty CFL Program

Behavior Change

To determine if participation in the program had impacts on tenant behavior, we asked tenants if they had changed any habits related to energy use. Among those surveyed, 77% (65 tenants) indicated no change, but 23% (19 people) did report changing their behavior. In a follow up question to the 19 tenants who did change their behavior, we found that among this group 47% reported turning off lights, 16% unplugged items when not in use,11% added timers or sensors, 26% used less HVAC, 16% reduced water usage, and 5% ran full loads when washing dishes or laundry. Responses are shown below.

Table 29. Tenant Changes in Energy Habits

Behavior Change	Frequency of Response	Percentage Responding
Turn off lights	9	47%
Unplug or turn off when not in use	3	16%
Added timers or sensors	2	11%
Use less HVAC	5	26%
Use less water	3	16%
Full loads in dishwasher, washer, drier	1	5%

We also surveyed tenants to learn if they had made any energy efficiency improvements to their homes after participating in the direct install CFL program. As may be expected among those who rent rather than own their homes, the number of people who reported making energy efficiency improvements was low. Eighty four percent reported taking no action, compared to 16% who did. Of those who took action, the most common improvement was adding weather stripping with six people doing so. Installing low flow showerheads was next, with five respondents indicating that they had done so. All improvements are shown in the below. Note that some respondents reported taking more than one action.

Table 30. Tenant Energy Efficiency Improvements

Improvement	Frequency of Response	Percentage Responding
Weather stripping	6	7%
Low flow showerhead	5	6%
Programmable thermostat	2	2%
Wall or ceiling insulation	1	1%
Caulking	1	1%
Faucet aerators	0	0%
Outlet or switch gaskets	0	0%
None of these	69	84%

From these relatively low numbers of energy efficiency improvements and personal behavior changes we conclude that while the program was effective at placing energy efficient bulbs in tenant residences, as currently administered, the educational aspects of the program are insufficient for driving widespread behavior change or efficiency improvements within this audience. If energy savings deriving from these sources should become an increasingly important goal of the program in the future, then additional steps toward energy efficiency awareness and education may need to be added.

Attitudes and Awareness

Because tenants were informed about the program by their property managers and not by Duke Energy directly, we sought to ascertain why customers thought that Duke Energy was providing free CFLs through the direct install program. The highest scoring reason on the multiple choice response was "Duke Energy wants to save energy for economic reasons;" followed closely by "Duke Energy wants to save energy for environmental reasons". The distribution of scores is presented in Figure 26 below. Reasons for respondents selecting the Other category follow Table 31 immediately after the figure.

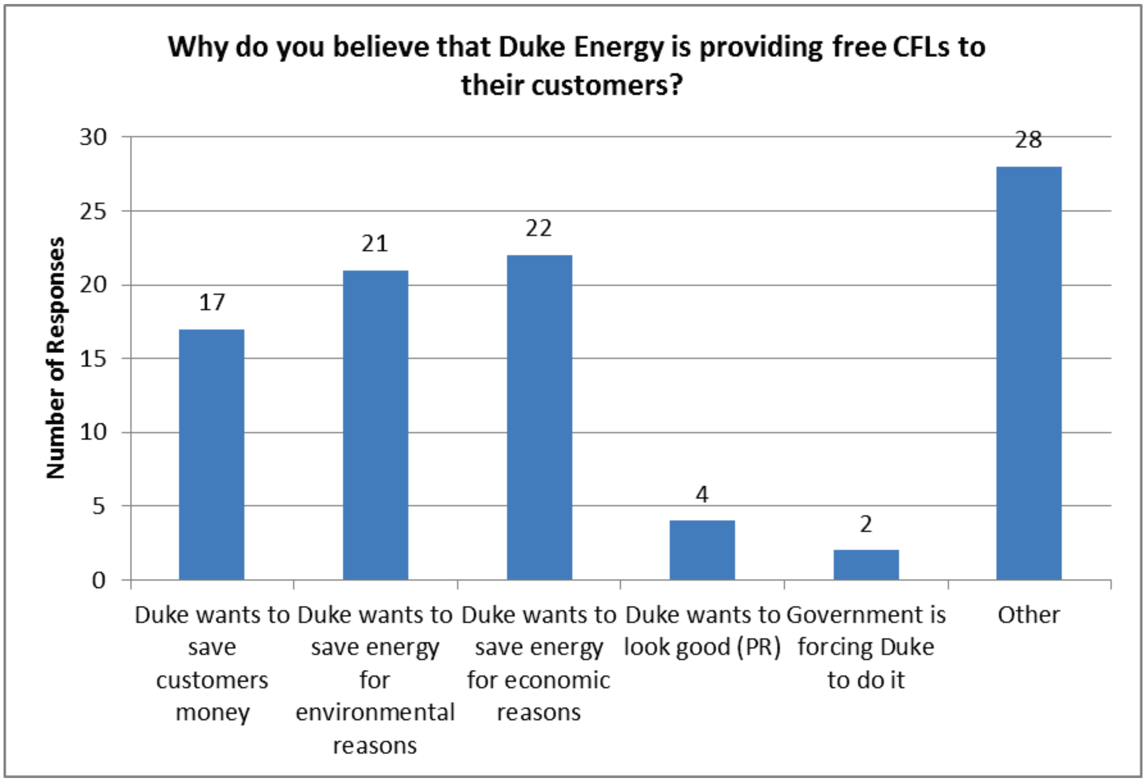

Figure 26. Customer Perceptions of Duke Energy's Reasons for Giving Free CFLs

Table 31. Reasons for Other Response

Reason for Other Response	Frequency of Response
Don't Know/Not Sure	8
Saves Duke Energy money	4
So people to start using CFLs	4
Save customers money/ lower rates	3
Duke wants to promote energy efficient living.	1
Duke wants to save energy.	1
Duke wants to address increased demand for power.	1
Duke wants to make customers happy.	1
Because Duke is a good company.	1
Maybe because Duke loves us.	1
This benefits Duke Energy somehow.	1
Duke receives incentives from the maker of the bulbs.	1

Verbatim responses are listed below.

- "Duke Energy gets a tax break."
- "Duke Energy wants to introduce more people to CFLs. A lot of people probably wouldn't have tried them."

- "Duke Energy wants to save money."
- "Duke is doing this so that we can start using CFLs."
- "Duke receives Incentives from the maker of the bulbs."
- "Duke wants maximum use at lowest price for its customers."
- "Duke wants people to buy CFLs in the future."
- "Duke wants to address increased demand for power."
- "Duke wants to introduce customers to the better bulbs."
- "Duke wants to keep rates lower."
- "Duke wants to make customers happy and provide better lighting."
- "Duke wants to promote energy efficient living."
- "Duke wants to save energy."
- "It reduces costs on Duke Energy's end."
- "It somehow saves Duke money."
- "Maybe because Duke loves us."
- "This benefits Duke Energy somehow."

Customer Satisfaction

Customer satisfaction is very high among surveyed tenants in the Carolina System. No attribute scored less than 8.9 on a 1-to-10 scale with 1 being very dissatisfied and 10 being very satisfied. More specifically tenant ratings were: light quality (8.9) and bulb quality (9.2), ovreall program satisfaction (9.2), and satisfaction with Duke Energy (9.0).

Satisfaction with Light Quality

The overall satisfaction scores for light quality using the 10 point scale are high with a mean satisfaction rating of 8.9 and 71% of respondents rating the light quality with a 9 or 10. The distribution of scores is presented in Figure 27, while Table 32 shows their reasons for being less than fully satisfied.

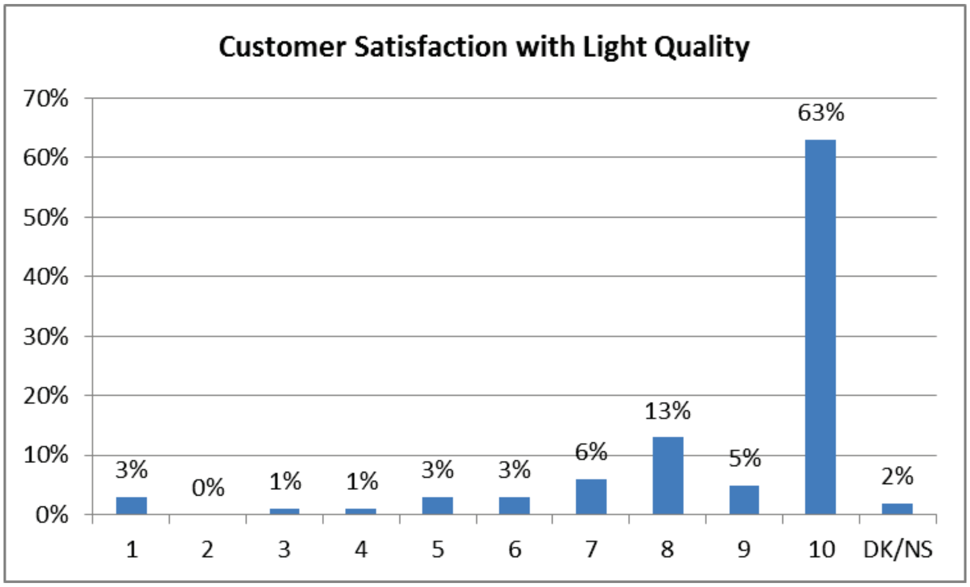

Figure 27. Customer Satisfaction with Quality of Light

The following are the reasons for tenants reporting lower (score of 8 or less) satisfaction scores with the program.

Table 32. Light Quality: Reasons for Satisfaction Ratings of 8 or Less

Reason for Score of 8 or Less	Frequency of Response
Not bright enough	3
Don't like light quality	2
Too long to warm up	1
Appearance	1
Not sure	1
Nothing	1

Satisfaction with Bulb Quality

When asked to use the same 10 point scale to rate their satisfaction with the overall bulb quality, respondents gave an average satisfaction rating of 9.2. Three quarters of them rated their satisfaction as a 9 or 10. The remainder of the ratings is shown in Figure 28. Table 33 shows reasons for lower satisfaction ratings.

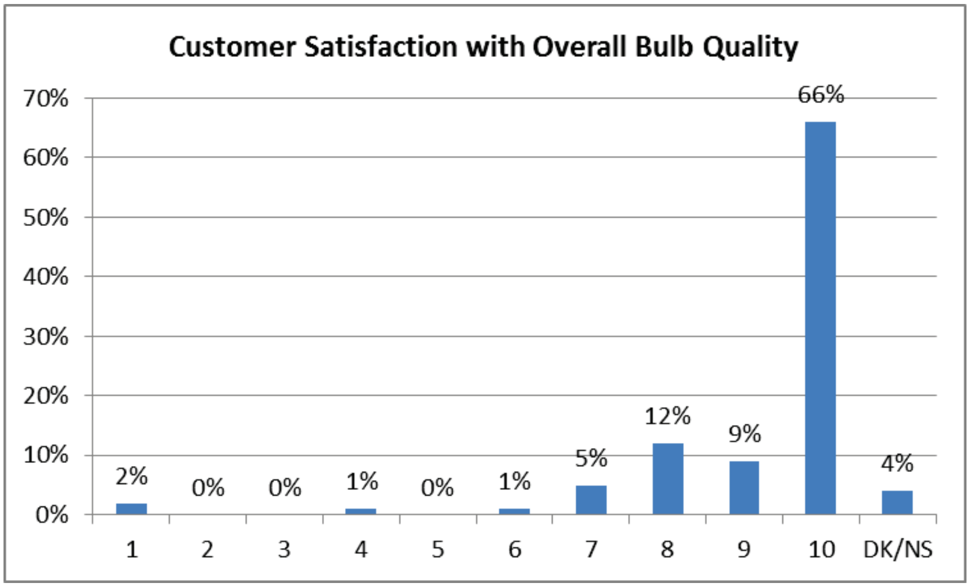

Figure 28. Customer Satisfaction with Overall Bulb Quality

Table 33. Bulb Quality: Reasons for Satisfaction Ratings of 8 or Less

Reason for Score of 8 or Less	Frequency of Response
The light is OK when there is a shade over the bulb.	1
I hate the light quality.	1
The bulbs are too dark.	1
It takes too long for the lights to warm up.	1
I don't like the inconsistent light quality.	1
The light is not as bright as incandescent bulbs.	1
Nothing	1
Not sure	1

Program Satisfaction

The overall satisfaction scores for the direct install CFL program are very high with a mean rating of 9.2. What is more, 76% of respondents rated the program with a 9 or 10. The distribution of scores is presented in Figure 29. For tenants reporting lower (score of 8 or less) satisfaction scores with the program, we asked them how it might be improved. Their responses are shown in Table 34.

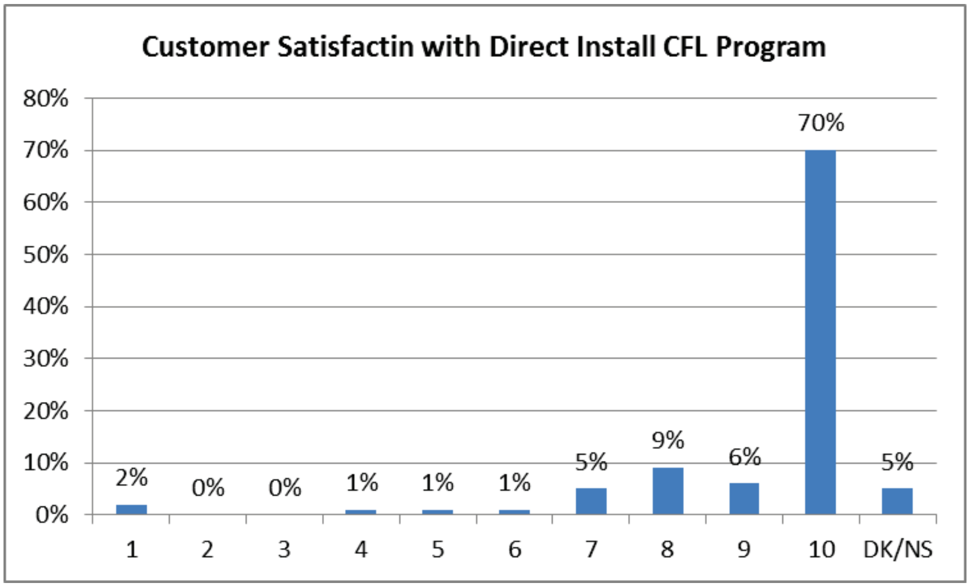

Figure 29. Customer Satisfaction with Direct Install CFL Program

Table 34. Program Satisfaction: How to Improve for Those with Score of 8 or Less

How to Improve Satisfaction	Frequency of Response
No Response	3
Better quality light bulbs	2
Brighter light bulbs	2
Reduce/explain CFL program overlap	1
More energy savings	1
CFLs to fit different fixtures	1

Satisfaction with Duke Energy

Tenants were also highly satisfied with Duke Energy, rendering a mean satisfaction score of 9.0 on the same 10 point scale. However, a slightly more modest 65% of customers deigned to rate Duke Energy with a 9 or 10. The distribution of scores is presented in Figure 30 below. For tenants reporting lower (score of 8 or less) satisfaction scores with Duke Energy, we asked them how those scores might be improved. Their responses are shown in Table 35.

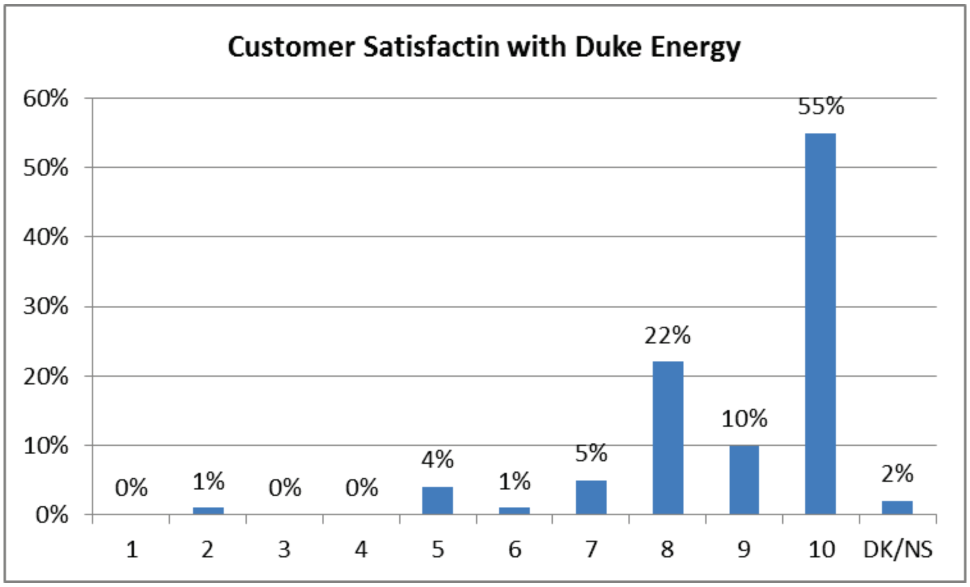

Figure 30. Customer Satisfaction with Duke Energy

Table 35. Duke Energy Satisfaction: How to Improve for Those with Score of 8 or Less

How to Improve Satisfaction	Frequency of Response
Lower rates	7
Better explain rate increases	1
More efficiency programs	1
Fewer/shorter outages	1
Improved customer service	1
In person meter reading for high bill complaints	1
Better explain merger	1
I don't want to get into it.	1

Conclusions and Recommendations for Program Changes

The section below summarizes the most important findings and recommendations of this evaluation.

Management Interviews

1. The program received very few customer complaints and appears to be working smoothly and effectively from the managers' perspective. The managers interviewed all indicate that communications and coordination between all three teams (Duke Energy, Honeywell, and AM Conservation) is working very well.

2. The primary "sales points" that seem to resonate well with properties are: that properties can make a positive environmental impact by participating in program; that CFLs last longer and don't need to be replaced as often; and that CFLs increase tenant satisfaction and decrease their electric bills.

3. Program managers have made efforts to clarify property manager confusion about the differences between this program and other Duke Energy programs, which offer CFLs directly to tenants with individual electric accounts.

4. While shipping costs were initially intended to be used as an "incentive" to encourage timely bulb installed, they appear to be a barrier to program participation instead. Finding an alternative means of incentive should improve enrollment numbers and customer satisfaction. Honeywell's proposal to credit back shipping costs for timely installs is worthy of consideration.

5. The largest barrier to participation and the most frequent complaint about the program focuses on manpower necessary to replace large quantities of bulbs. Providing a Duke Energy-sponsored installer to do the work is a frequently cited proposed solution. Another is to allow properties more time or to create smaller batches of installs so that they can be done over a longer period of time.

6. Bulb recycling is an important aspect of this program that may require more attention. While doing well in terms of educating customers on where and how to recycle the bulbs, property managers, particularly those in rural areas, expressed a desire for greater assistance with kits for safe disposal.

7. Program managers should continue to monitor and address safety issues surrounding CFLs, such as mercury considerations.

Property Manager Surveys

1. Customer satisfaction with the program and with Duke Energy is high, despite the high labor costs, the indirect benefits to the property, and the fact that the majority of property managers were told they needed to participate by their bosses.

2. With 82% of property managers reporting that they would not have otherwise replaced their existing incandescent bulbs with CFL bulbs, and with 65% indicating that they will continue to provide CFLs in the future, the program is clearly having a positive impact on this market segment.

3. In addition to providing bulbs for tenant residences, the program should provide CFLs for common areas, administrative offices, and other locations managed by the properties. Doing so would likely increase property enrollments, improve property manager satisfaction, and facilitate additional energy savings.

4. Given the large number of bulbs to be installed, property managers find the bulbs to be over packaged. Shipping bulbs in containers with less individual packing would help to reduce the install time, eliminate waste, and cut down on shipping costs.

5. Hollywood (globe) bulbs for bathroom vanities are the most requested type of specialty bulb.

6. The tenant form letters and other materials provided by the program are often used and much appreciated by property managers. Further tools to make the process “turn key” are likely to be well received.

7. Allowing properties to retain a small amount of extra CFLs for replacement purposes would be appreciated by property managers and it may help to ensure that broken or burned out CFLs are replaced with similar bulbs rather than reverting to incandescents.

8. Although far from saturating the market at this point, as CFLs increase in market share forward-looking property managers and tenants on the leading edge of the product adoption curve are beginning to look at alternative forms of lighting such as LEDs. Thus the opportunity exists to begin recruiting for pilot studies with other types of bulbs for this audience.

Tenant Surveys

1. The property manager direct install program enjoys a high satisfaction rating among tenants with an average score of 9.2 on a 10-point scale. Customers are also highly satisfied with light quality, bulb quality, and with Duke Energy overall.

2. In general the program appears to be operating as it is designed. That is large numbers of incandescent lights are being systematically replaced with CFLs in residences that would not have otherwise made the switch.

3. With more than half of tenants surveyed indicating that they still have non-CFLs installed in their homes, the opportunity remains to reach out for additional bulb replacements.

4. If tenants are targeted directly, then direct mail offers are their first choice for preferred distribution.

5. Tenants indicate that they will respond most favorably to marketing language that focuses on financial and energy savings, and on the availability of CFLs in stores where they normally shop.

6. With 57% of tenants rating their likelihood of purchasing CFLS in the future, and an overall average likelihood of 8.5 on a 10 point scale, the program has been largely effective for encouraging future CFL purchases.

7. Beyond light bulb replacements, tenant behavior changes were relatively slight. This suggests the potential for increases in the educational aspects of the program.

Appendix A: Management Interview Instrument

Name: ____

Title: ____

Position description and general responsibilities:

____

____

We are conducting this interview to obtain your opinions about and experiences with the [STATE NAME] Property Managers CFL campaign. We'll talk about only this specific campaign and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

General Description of Program

1. Describe the [STATE NAME] Property Managers CFL campaign. How has the program changed since it was it first started?

Program Objectives

2. In your own words, please describe the [STATE NAME] Property Managers CFL campaign's current objectives. How have these changed over time?

3. In your opinion, which objectives do you think are best being met or will be met?

4. Are there any program objectives that are not being addressed or not being addressed as well as possible or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed?

5. Should the program objectives be changed in any way due to technology-based, market-based, or management based conditions? What objectives would you change? What program changes would you put into place as a result, and how would it affect program operations?

Operational Efficiency (Manager's Role)

6. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program? When did you take on this role? *If a recent change in management…*Do you feel that Duke Energy gave you enough time to adequately prepare to manage this program? Did you get all the support that you needed to manage this program?

7. Please review with us how the [STATE NAME] Property Managers CFL campaign operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

8. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

Program Design & Implementation

Property Manager Practices

9. *(If not captured earlier)* Please explain how the interactions between the property managers, tenants and the Duke [STATE NAME] Property Managers CFL campaign management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

10. Describe your quality control and tracking process.

11. Are key industry experts, trade professionals or peers used for assessing what the technologies or models should be included in the program? If so, how does this work?

12. Are key industry experts and trade professionals used in other advisory roles such as market or marketing experts or industry professionals? If so how does this work and what kind of support is obtained?

13. Describe the training and development orientation used to train the property managers for the [STATE NAME] Property Managers CFL campaign. Are property managers getting adequate program information? What can be done that could help improve property manager effectiveness? Can we obtain any informational materials that are being used?

Market Info

14. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

15. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

16. Anything on the horizon that you think will impact the sales or use of CFL or incandescent bulbs? What is that and how do you think it will affect your program

Overall Strengths, Needs, and Suggestions

17. Overall, what about the [STATE] Property Managers CFL campaign works well and why?

18. What doesn't work well and why? Do you think this discourages participation or interest?

19. Do you have suggestions for improvements to the program that would increase participation rates or interest levels?

20. Do you have suggestions for the making the program operate more smoothly or effectively?

21. Do you have suggestions for improving or increasing energy impacts?

Operational, Market, & Technical Barriers and Suggestions

22. Can you identify any market, operational or technical barriers that impede a more efficient program operation?

23. In what ways can these operations or operational efficiencies be improved?

Attracting More Participation (Suggestions)

24. In what ways can the program attract more property managers?

25. In what ways can the program attract more tenant/household participation?

Assessment Basis

26. How do you make sure that the best information and practices are being used in the [STATE NAME] Property Managers CFL campaign?

27. *(If not collected in #14 or other above)* What market information, research or market assessments are you using to determine the best target markets and program opportunities, market barriers, delivery mechanisms and program approach?

Closing Suggestions and Comments

28. If you could change any one thing about the program, what would you change and why?

29. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix B: Property Manager Survey Instrument

INSTRUMENT

We are conducting this interview to obtain your opinions about and experiences with the Duke Energy CFL campaign in [*State Name*]. We'll talk about your understanding of the CFL campaign and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about 20-30 minutes to complete. May we begin?

Identification:*

Survey ID: ___________________________

Name: ___________________________

Title: ___________________________

Company: ___________________________

Address: ___________________________

City: ___________________________

State: ___________________________

Zip: ___________________________

Phone: ___________________________

Email: ___________________________

Position description and general responsibilities:

Program Design and Design Assistance

1. Of the ## CFLs that Duke sent to you, how many do you think have been installed?
(fill in as number if close estimate is possible): _________________________

(fill in as estimated percentage if number is not readily recalled): _________________________

Not Sure *(enter NS)*: _________________________

2. Was the number of bulbs appropriate?
( ) Yes

( ) No *ask:* **What should it be?**: _________________

( ) Not sure

3. How many bulbs do you typically order per one bedroom unit?
( ) 0

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) 11

( ) 12+

( ) Don't have units of this size

4. How many bulbs do you typically order per two bedroom unit?

( ) 0

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) 11

( ) 12+

( ) Don't have units of this size

5. How many bulbs do you typically order per three bedroom unit?

( ) 0

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) 11

( ) 12+

( ) Don't have units of this size

6. Of the bulbs you order, on average how many bulbs do you eventually install per unit?
( ) All that were ordered for that unit
( ) One less than ordered for that unit
( ) Two less than ordered for that unit
( ) Three less than ordered for that unit
( ) More than three less than ordered for that unit
( ) Don't know / Not sure

7. Do you feel that the proper CFLs (wattage, size, etc.) are being covered through the program?
( ) Yes
( ) No *ask:* **Why?**: _________________
( ) Not sure

8. Are there other types of bulbs that you think should be included in the program? If so, what are they?
[ ] No
[ ] Higher watt equivalent
[ ] Lower watt equivalent
[ ] Dimmable bulbs
[ ] Outdoor flood bulbs
[ ] Three-way bulbs
[ ] Spotlight bulbs
[ ] Recessed bulbs
[ ] Candelabra bulbs
[ ] Other
[ ] Don't Know / Not Sure

9. Are there other energy efficient products that you think should be included in the program? If so, what are they?
[ ] No
[ ] Power strips

[ ] Weather stripping

[ ] Door sweeps

[ ] Programmable thermostats

[ ] Water heater blankets

[ ] Other *(please specify:)*

[ ] Don't Know / Not Sure

Reasons for Participation in the Program

We would like to better understand why property managers become partners in the Duke Energy CFL campaign in [*State Name*].

10. How long have you been a partner in the Duke Energy CFL campaign?

( ) Less than 3 months

( ) 3-6 months

( ) 6-12 months

( ) 12-18 months

( ) Longer than 18 months

( ) Don't Know / Not Sure

11. What are your primary reasons for becoming involved in the program? Why do you continue to be a partner?

(Check all that apply)

[ ] Your company told you to

[ ] It provides a service to your tenants

[ ] It's something you believe in professionally

[ ] It's a wise business move

[ ] It saves money

[ ] It's good for the environment

[ ] Other

[ ] Don't Know / Not Sure

12. Are your primary reasons for participation being met?

( ) Yes

( ) No - *ask:* **Why?**: ________________

13. Has this program made a difference in your business? How?

14. How do you think Duke Energy can get more property managers to participate in this program?
(Check all that apply)

[ ] Free shipping

[ ] Hire someone to do the bulb installations

[ ] Simpler sign up process *(Ask how to improve.)*

[ ] Easier bulb ordering process *(Ask how to improve.)*

[ ] Allow bulbs to be installed in common areas

[ ] Different bulb types

[ ] Schedule during slow periods for easier workflow

[ ] Longer time to do the installs *(Ask how much longer.)*

[ ] Allow bulb replacements as units become vacant instead of all at once

[ ] Simpler documentation process *(Ask how to improve.)*

[ ] Easier extra bulb return process *(Ask how to improve.)*

[ ] Better marketing to property managers *(Ask how to improve.)*

[ ] Better materials for tenants

[ ] Other *(Ask to specify.)*

[ ] Don't Know / Not Sure

Program Participation Experiences

The next questions ask about the process for participation.

15. Do you think the bulb ordering and shipping process could be improved in any way? How?

16. Do you feel that the lead time, ordering support, and training provided by Duke Energy, Niagara, or Honeywell was adequate? Did you receive any support, what did you receive, was it helpful, would you change any of this?

17. How do you make tenants aware of the CFL Program?
[ ] Use the form letter provided

[ ] Use our own letter

[ ] Post notice in common areas

[ ] Phone calls

[ ] Emails

[ ] Public meetings

[ ] Newsletter

[ ] I don't inform them

[ ] No formal process

[ ] Other

18. Do tenants generally respond favorably or unfavorably?
[ ] Favorably

[ ] Unfavorably

[ ] Don't know

19. Do you have the right amount of materials such as information sheets, brochures or marketing materials that you need to understand the benefits of the bulbs and discuss them effectively with your tenants?
( ) Yes

( ) No *ask:* **What else do you need?**: _________________

( ) I don't use them

( ) I don't discuss this with tenants

20. Please describe the process you used to install the new bulbs. What challenges did you have with the installation process? What could be improved? What worked well?

21. Did you install the full amount of (#) bulbs in each unit? If not, why?

[ ] Yes

[ ] No, only replaced burned out bulbs

[ ] No, not existing CFLs

[ ] No, only at tenant request

[ ] No, other *(specify)*

[ ] Don't Know / Not Sure

21a. If you did not install the full amount of bulbs, what happened to the bulbs that didn't make it into sockets?

[ ] Returned

[ ] Still in storage

[ ] Installed in common areas such as hallways, parking garages, laundry rooms, fitness rooms, etc.

[ ] Given to tenants for future use

[ ] Took them home

[ ] Other *(specify)*

[ ] Don't Know / Not Sure

22. Overall, what about the Duke Energy CFL campaign do you think works well and why?

(Check all that apply)

[ ] Sign up process

[ ] Ordering process

[ ] Variety of bulbs

[ ] Shipping costs

[ ] Shipping process

[ ] Property manager training

[ ] Tenant leave behind materials

[ ] Installation checklists

[ ] Documentation / reporting process

[ ] Communication with Honeywell

[ ] Communication with Duke

[ ] Follow up process

[ ] Other *(specify)*

[ ] Don't Know / Not Sure

23. What changes would you suggest to improve the program?

(Check all that apply)

[ ] Free shipping

[ ] Hire someone do the bulb installations

[ ] Better website *(ask how to improve?)*

[ ] Simpler sign up process *(ask how to improve?)*

[ ] Easier bulb ordering process *(ask how to improve?)*

[ ] Allow bulbs to be installed in common areas

[ ] Different bulb types

[ ] Schedule during slow periods for easier workflow *(ask when?)*

[ ] Longer time to do the installs *(ask how much longer?)*

[ ] Allow bulb replacements as units become vacant instead of all at once

[ ] Simpler documentation process *(ask how to improve?)*

[ ] Easier extra bulb return process *(ask how to improve?)*

[ ] Better marketing to property managers *(ask how to improve?)*

[ ] More / better materials for tenants *(ask how to improve)*

[ ] Other *(please specify)*

[ ] Don't Know / Not Sure

24. Do you feel that communications between you and Duke/Honeywell program staff is adequate? How might this be improved?

(check all that apply)

[ ] Fine as is

[ ] Ask my preference for how to be contacted

[ ] Faster / more responsive communication

[ ] More email communications

[ ] Other *(specify)*

[ ] Don't Know / Not Sure

25. What specific benefits do you and your company receive as a result of participating in this CFL campaign?
(check all that apply)

[ ] Improves image by doing something to save tenants money

[ ] Improves image by doing something for environment

[ ] Improves relations with existing tenants

[ ] Makes it easier to attract new tenants

[ ] Other *(please specify)*

[ ] Don't Know / Not Sure

26. What do you think are the primary benefits to the tenants who have CFLs installed as part of this campaign?

[ ] They save money on purchasing the bulbs

[ ] Lower monthly bills

[ ] Improved lighting quality

[ ] Other *(please specify)*

[ ] Don't Know / Not Sure

27. Have you heard any tenant feedback about the bulbs or the program? What have you heard?
(check all that apply)

[ ] Like the program

[ ] Don't like the program

[ ] Like the bulbs

[ ] Don't like the bulbs

[ ] Like the lighting quality

[ ] Don't like the lighting quality

[ ] Liked the installation process

[ ] Didn't like the installation process

[ ] Appreciate saving money by not purchasing the bulbs themselves

[ ] Lower monthly bills

[ ] Positive impression of Duke Energy

[ ] Negative impression of Duke Energy

[ ] Other *(please specify)*

[ ] Don't Know / Not Sure

OHIO only

28. If you were rating your overall satisfaction with the CFL Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?

( ) Very Satisfied

( ) Somewhat Satisfied

( ) Neither Satisfied nor Dissatisfied

( ) Somewhat Dissatisfied

( ) Very Dissatisfied

( ) Refused

( ) Don't Know

(Ohio only)

28a. Why do you give it that rating?

Standard Practice vs. Duke Energy coupon campaign CFL Practices

We would like to know what your bulb replacement practices were before your involvement in the Duke Energy CFL campaign.

29. Prior to your participation in this program what was your standard practice for bulb replacement?
(check all that apply)

[ ] Replaced burned out bulbs after tenants moved out

[ ] Replaced burned out bulbs as needed/upon request

[ ] Replaced burned out bulbs according to maintenance schedule

[ ] Didn't replace bulbs / Tenant responsibility

[ ] No standard practice

[ ] Other *(please specify)*

[ ] Don't Know / Not Sure

30. What wattage bulbs did you typically use before?
(check all that apply)

[ ] Incandescent 40 watt

[ ] Incandescent 60 watt

[ ] Incandescent 75 watt

[ ] Incandescent 100 watt

[ ] Incandescent >100 watt

[ ] CFL 9-13 watt (40 watt equivalent)

[ ] CFL 13-15 watt (60 watt equivalent)

[ ] CFL 18-25 watt (75 watt equivalent)

[ ] CFL 23-30 watt (100 watt equivalent)

[ ] CFL 30-52 watt (150 watt equivalent)

[ ] No standard bulbs

[ ] Other *(please specify)*

[ ] Don't Know / Not Sure

31. Have you changed your standard process for bulb replacement after participating in this program?

( ) Yes (*ask* **How?**): _________________

( ) No

32. Would you have provided or installed CFLs without the program?

( ) Yes

( ) No

( ) Other *(please specify)*: _________________

( ) Don't Know / Not Sure

33. If the program were to be discontinued, would you continue to provide the CFLs?

( ) Yes

( ) No (*ask* **Why?**): _________________

( ) Other *(please specify)*: _________________

( ) Don't Know / Not Sure

34. In your opinion is the Duke Energy CFL campaign needed to get people to buy and use more efficient bulbs? Why?

( ) Yes (*ask* **Why?**): _________________

( ) No (*ask* **Why?**): _________________

On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with…

35. The Property Manager CFL program

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less to q35 (NC and SC only),

35a. How could this be improved?

36. …Duke Energy overall.

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less to q36

36a. How could this be improved?

Property Information

We're just about done. We just need to ask you some questions about your units.

37. What year were your units built?

( ) 1959 and before

( ) 1960-1979

( ) 1980-1989

( ) 1990-1997

( ) 1998-2000

( ) 2001-2007

( ) 2008-present

( ) Don't Know

38. Which of the following best describes your units' heating systems?

( ) **None**

( ) Individual forced air furnace

( ) Electric Baseboard

( ) Heat Pump

( ) Geothermal Heat Pump

( ) Shared central heating

( ) Other *(please specify)*: _________________

39. How old are your heating systems?
(mark all that apply)

[ ] 0-4 years

[ ] 5-9 years

[ ] 10-14 years

[ ] 15-19 years

[ ] 19 years or older

[ ] DK/NS

[ ] Do not have

[ ] Other

40. What is the primary fuel used in your heating systems?

( ) Electricity

( ) Natural Gas

( ) Oil

( ) Propane

( ) Other: _________________

( ) None

41. What is the secondary fuel used in the heating system, if applicable?

( ) Electricity

( ) Natural Gas

( ) Oil

( ) Propane

( ) Other: _________________

( ) None

42. Do you use one or more of the following to cool your units? (Mark all that apply)

[ ] **None, do not cool the units**

[ ] Through the wall or window air conditioning unit

[ ] Individual central air conditioning

[ ] Shared central air conditioning

[ ] Heat pump for cooling

[ ] Geothermal Heat pump

[ ] Other

43. What is the fuel used in the cooling systems?

[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] None

44. How old are your cooling systems?
(Mark all that apply)

[ ] 0-4 years

[ ] 5-9 years

[ ] 10-14 years

[ ] 15-19 years

[ ] 19 years or older

[ ] Don't know

[ ] Do not have

[ ] Other

45. What is the fuel used by your water heaters?
(Mark all that apply)

[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] No water heaters

46. How old are your water heaters?
(Mark all that apply)

[ ] 0-4 years

[ ] 5-9 years

[ ] 10-14 years

[ ] 15-19 years

[ ] 19 years or older

[ ] Don't know

[ ] Do not have

[ ] Other

47. Do your units have clothes dryers?
(Mark all that apply)

[ ] Yes, individual dryers in units

[ ] Yes, shared dryers in common areas

[ ] Some units have individual dryers. Others do not

[ ] No, there are no dryers

[ ] Other

[ ] Don't know / Not sure

48. What type of fuel do you use for clothes drying?
(Mark all that apply)

[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] No clothes dryers

[ ] DK/NS

49. About how many square feet of living space are in your units?

(Mark all that apply)
(Do not include garages or other unheated areas)
Note: A 10-foot by 12 foot room is 120 square feet

[ ] Less than 500

[ ] 500 – 999

[ ] 1000 – 1499

[ ] 1500 – 1999

[ ] 2000 – 2499

[ ] 2500 – 2999

[ ] 3000 – 3499

[ ] 3500 – 3999

[ ] 4000 or more

[ ] Don't know

50. Do your units have heated or unheated basements?
(Mark all that apply)

[ ] Heated

[ ] Unheated

[ ] No basements

[ ] Don't know / Not sure

To help improve our evaluation of this program, we are looking for property managers to provide us with a list of bulbs being used in the buildings they manage. We will provide a $50 Visa card in exchange for your tracking of the wattage of any bulb replaced for one month. We will provide a form to you and will be available to answer any questions that you have during the course of the study. Would you be interested in participating in this study?

( ) Yes - **Someone will be in touch with you in the next two weeks.**

( ) No - *thank them for their time.*

Thank You!
Thank you for taking our survey. Your response is very important to us.

Appendix C: Tenant Survey Instrument

INSTRUMENT

Use four attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. Eastern, or 9-7 Central Monday through Saturday. No calls on Sunday.

Note: Only read words in bold type.

for answering machine 1st through penultimate attempts:

Hello, my name is [name] and I am calling with a survey about the CFLs that your landlord installed. I'm sorry I missed you. I'll try again another time.

for answering machine - Final Attempt:

Hello, my name is [name] and I am calling with a survey about the CFLs that your landlord installed. This is my last attempt at reaching you, my apologies for any inconvenience.

if person answers

Hello, my name is ____________. May I speak with _______ please?

I am calling on behalf of Duke Energy to conduct a customer survey about a program offered by Duke Energy where your landlord installed compact fluorescent light bulbs (or CFLs) in your apartment.

We are conducting this survey to get feedback on what happened to the CFLs installed, which may have been installed before you moved in. We are not selling anything, there are no wrong answers, and your responses to our survey questions will be combined with other responses and used to help us make improvements to the program.

Note: If this is not a good time, ask if there is a better time to schedule a callback.

State*

( ) Ohio

( ) North Carolina

( ) South Carolina

Survey Identification*

Surveyor Name: ________________________

Survey ID: ________________________

1. I'd like to talk about the CFLs installed in your home through this program. Our records indicate that your landlord installed (#) CFLs, is this correct?*

( ) Yes

( ) I think so / probably

( ) No

( ) Don't Know

2. How many of the CFLs are now installed in the permanent light fixtures in your home?*

*Enter **-99** for Don't know, Not sure, or Refused*

____

Questions about 3 installed CFLs

"Now I'm going to ask you about some of the CFL bulbs installed in your home…"
(Repeat Q3 a to e for up to 3 installed bulbs)

3. For the first CFL, in which room was the bulb installed?

( ) Living / family room

( ) Dining room

( ) Kitchen

( ) Master bedroom

( ) Bedroom 2

( ) Bedroom 3 or other bedroom

( ) Hall

( ) Closet

( ) Basement

( ) Garage

( ) Bathroom

( ) Other: __________________

3a. Was the previously installed bulb a standard bulb or a CFL?

( ) Standard Incandescent

( ) I had a CFL installed there

( ) There was no bulb in the socket

( ) New CFL bulb was in place when I moved in

( ) Don't know/Don't remember – *ask if it was installed when they moved in*

3b. How many watts was the old bulb that was removed?

( ) Less than 44

( ) 45-70

( ) 71-99

( ) 100 or more

( ) There was no bulb in the socket

( ) DK/NS

3c. What did you do with the incandescent you removed?

( ) Recycled It

( ) Threw it away

( ) Stored it

( ) Installer removed it

( ) DK/NS

3d. On average, approximately how many hours per day is this light used?

( ) Less than 1

( ) 1 to 2

( ) 3 to 4

( ) 5 to 10

( ) 11 to 12

( ) 13 to 24

( ) DK/NS

3e. Did the hours of use for this fixture increase, decrease or stay the same since you replaced the old bulb with the CFL?

( ) Increased (*ask:* **How many hours per day?**): _________________

( ) Decreased (*ask:* **How many hours per day?**): _________________

( ) Stayed the same

( ) The bulb has been in place since I moved in

( ) DK/NS

( ) Not Applicable

Second Bulb

3~. For the second CFL, in which room was the bulb installed?

( ) Living / family room

( ) Dining room

( ) Kitchen

( ) Master bedroom

( ) Bedroom 2

( ) Bedroom 3 or other bedroom

( ) Hall

( ) Closet

( ) Basement

( ) Garage

( ) Bathroom

( ) Other: _________________

3a~. Was the previously installed bulb a standard bulb or a CFL?

( ) Standard Incandescent

( ) I had a CFL installed there

( ) There was no bulb in the socket

( ) New CFL bulb was in place when I moved in

( ) Don't know/Don't remember – *ask if it was installed when they moved in*

3b~. How many watts was the old bulb that was removed?

( ) Less than 44

( ) 45-70

( ) 71-99

( ) 100 or more

( ) There was no bulb in the socket

( ) DK/NS

3c~. What did you do with the incandescent you removed?

( ) Recycled It

( ) Threw it away

( ) Stored it

( ) Installer removed it

( ) DK/NS

3d~. On average, approximately how many hours per day is this light used?

( ) Less than 1

( ) 1 to 2

( ) 3 to 4

( ) 5 to 10

( ) 11 to 12

( ) 13 to 24

( ) DK/NS

3e~. Did the hours of use for this fixture increase, decrease or stay the same since you replaced the old bulb with the CFL?

( ) Increased (*ask:* **How many hours per day?**): _________________

( ) Decreased (*ask:* **How many hours per day?**): _________________

( ) Stayed the same

( ) The bulb has been in place since I moved in

( ) DK/NS

( ) Not Applicable

Third Bulb

3-. For the third CFL, in which room was the bulb installed?

( ) Living / family room

( ) Dining room

( ) Kitchen

( ) Master bedroom

( ) Bedroom 2

( ) Bedroom 3 or other bedroom

( ) Hall

( ) Closet

( ) Basement

( ) Garage

( ) Bathroom

( ) Other: _________________

3a- Was the previously installed bulb a standard bulb or a CFL?

( ) Standard Incandescent

( ) I had a CFL installed there

( ) There was no bulb in the socket

( ) New CFL bulb was in place when I moved in

( ) Don't know/Don't remember – *ask if it was installed when they moved in*

3b- How many watts was the old bulb that was removed?

( ) Less than 44

( ) 45-70

( ) 71-99

( ) 100 or more

( ) DK/NS

3c- What did you do with the incandescent you removed?

( ) Recycled It

( ) Threw it away

( ) Stored it

( ) Installer removed it

( ) DK/NS

3d- On average, approximately how many hours per day is this light used?

( ) Less than 1

( ) 1 to 2

( ) 3 to 4

( ) 5 to 10

( ) 11 to 12

( ) 13 to 24

( ) DK/NS

3e- Did the hours of use for this fixture increase, decrease or stay the same since you replaced the old bulb with the CFL?

( ) Increased (*ask:* **How many hours per day?**): _________________

( ) Decreased (*ask:* **How many hours per day?**): _________________

( ) Stayed the same

( ) The bulb has been in place since I moved in

( ) DK/NS

( ) Not Applicable

Satisfaction

4. How many standard incandescent bulbs do you have in storage to replace bulbs that burn out?*

( ) 0

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7 – 11

( ) 12+

( ) DK/NS

5. Have you removed or replaced any of the CFLs?*

[ ] Yes, my property manager replaced them with one or more CFLs from the company's supply of bulbs (*ask:* **How many?**)

[ ] Yes, my property manager replaced them with one or more normal incandescent bulbs from the company's supply of bulbs (*ask:* **How many?**)

[ ] Yes, I replaced them with one or more CFLs of my own (*ask:* **How many?**)

[ ] Yes, I replaced them with one or more normal incandescent bulbs of my own (*ask:* **How many?**)

[ ] Left the socket empty

[ ] No

[ ] Don't know / Not sure

5a. Why did you remove or replace them?

[ ] Not bright enough

[ ] Did not like the color of the light

[ ] The light was too bright

[ ] Too slow to start

[ ] Burned out

[ ] Not working properly

[ ] Did not like appearance / shape of the bulbs

[ ] Other

6. On a 1-to-10 scale with 1 being very dissatisfied and 10 being very satisfied, please rate your satisfaction with the light quality of your free CFLs.*

( ) very dissatisfied
1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) very satisfied
10

( ) DK/NS

If 7 or less.

6a. Why were you less than satisfied with the light quality?

____

7. On a 1-to-10 scale with 1 being very dissatisfied and 10 being very satisfied, please rate your satisfaction with the overall bulb quality of your free CFLs.*

( ) very dissatisfied
1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) very satisfied
10

( ) DK/NS

If 7 or less.

7a.Why were you less than satisfied with the quality of the CFLs?

____

8. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the direct install CFL program?*

( ) very dissatisfied
1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) very satisfied
10

( ) DK/NS

If 7 or less (NC and SC only),

8a. How could this be improved?

____

9. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with Duke Energy overall?*

( ) very dissatisfied
1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) very satisfied
10

( ) DK/NS

If 7 or less (NC and SC only),

9a. How could this be improved?

____

More questions about CFLs

10. If you were rating your overall satisfaction with the CFL Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?

(Ohio only)

( ) Very Satisfied

( ) Somewhat Satisfied

( ) Neither Satisfied nor Dissatisfied

( ) Somewhat Dissatisfied

( ) Very Dissatisfied

( ) Refused

( ) Don't Know

(Ohio only)

11. Why do you give it that rating?

____

12. Before you received these free CFLs from Duke Energy had you already installed CFLs in your home?*

( ) CFL bulbs were installed before I moved in

( ) Yes, I installed one or more CFL bulbs

( ) No

( ) Don't Know / Not sure

12a. How many CFLs were you using in your home before your property manager had the new bulbs installed?

____

13. How many years have you been using CFLs?*

( ) Never purchased before

( ) 1 year or less

( ) >1 to 2 years

( ) >2 to 3 years

( ) >3 to 4 years

( ) 4 or more years

14. Did your experience with the CFLs provided by the Duke Energy Free CFL program make it more or less likely that you would purchase and install CFLs in the future when these eventually burn out?*

( ) More likely

( ) Less likely

( ) Neither more nor less likely

14a. Why are you more likely to use CFLs in the future?

14b. Why are you less likely to use CFLs in the future?

15. Have you purchased any additional CFLs since receiving the free CFLs?*

( ) Yes

( ) No

( ) Don't Know / Not Sure

15a. How many did you purchase?

*Enter **-99** for Don't know, Not sure, or Refused*

____

15b. How many of those are you currently using?

*Enter **-99** for Don't know, Not sure, or Refused*

____

15c. Using a 1 to 10 scale, with 1 meaning that the Duke program had no influence, and a 10 to mean that the Duke program was very influential, please rate the influence of the Duke Energy free CFL program on your decision to purchase additional CFLs.

( ) Not at all influential
1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) very influential
10

( ) DK/NS

15d. On a 1-to-10 scale with 1 being very unlikely and 10 being very likely, please rate your likelihood of buying and using CFLs in the future:

( ) very unlikely
1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) very likely
10

( ) DK/NS

Non-CFLs installed?

16. What is your best estimate of the number of bulbs installed in your home that are not CFLs?*

*Enter **-99** for Don't know, Not sure, or Refused*

____

17. How many of these non-CFL bulbs are in sockets that are typically used for more than 2 hours a day?*

*Enter **-99** for Don't know, Not sure, or Refused*

____

18. Please list the number of CFL and non-CFL bulbs currently installed in your home that are specialty bulbs such as dimmable bulbs, three-way bulbs, recessed, flood or directional lights, candelabra lights or other non-standard bulbs.

*Enter **-99** for Don't know, Not sure, or Refused*

	CFLs	non-CFLs
Dimmable bulbs	___	___
Outdoor flood bulbs	___	___
Three-way bulbs	___	___
Spotlight bulbs	___	___
Recessed bulbs	___	___
Candelabra bulbs	___	___
Other *(specify below)*	___	___

19. What other type of specialty bulb?

____

NOTE: the next page asks about the customer's interest in potential CFL programs. half the time the questions will ask about FREE CFLs, and the other half the questions will be about DISCOUNT CFLs. SurveyGizmo randomizes the choice, just make sure you get the Free vs Discount part correct

---

Interest in FREE CFLs

We would like to know if the direct installation of CFLs in your home made you more likely or less likely to obtain and use CFLs compared to several other methods:

20. On a 1-to-10 scale with 1 being very unlikely and 10 being very likely, please rate your likelihood of participating in a CFL program that:*

	1	2	3	4	5	6	7	8	9	10	DK/NS
a. Offers free CFLs by direct-mail sent to your home	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

b. Offers free CFLs through a retailer or store coupon	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
c. Offers free CFLs through a manufacturers coupon that can be used at any store where that brand is sold	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
d. Offers free CFLs at a stand at a community event such as a fair	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
e. Offers free CFLs at a stand in a public parking lot	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
f. Offers free CFLs through an online vendor such as Amazon.com	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

Interest in DISCOUNT CFLs

We would like to know if the direct installation of CFLs in your home made you more likely or less likely to obtain and use CFLs compared to several other methods:

21. On a 1-to-10 scale with 1 being very unlikely and 10 being very likely, please rate your likelihood of participating in a CFL program that:*

	1	2	3	4	5	6	7	8	9	10	DK/NS
a. Offers discount CFLs by	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

direct-mail sent to your home											
b. Offers discount CFLs through a retailer or store coupon	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
c. Offers discount CFLs through a manufacturers coupon that can be used at any store where that brand is sold	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
d. Offers discount CFLs at a stand at a community event such as a fair	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
e. Offers discount CFLs at a stand in a public parking lot	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
f. Offers discount CFLs through an online vendor such as Amazon.com	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

Importance of bulb characteristics

22. On a 1-to-10 scale with 1 being not at all important and 10 being very important, please rate the importance of each of the following characteristics on choosing a light bulb for your home*

	1	2	3	4	5	6	7	8	9	10	DK/NS
a. Mercury content of the bulb	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
b. Ability to dim the lighting level	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
c. Speed of which the bulb comes up to full lighting level	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
d. Purchase price of the bulb	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
e. Availability of the bulb in stores you normally shop	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
f. Selection of wattage and light output levels available	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
g. Cost savings on your utility bill	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
h. Energy savings	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
i. Attractiveness or appearance of the bulb	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
j. Recommendations from family and friends	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
k. Recommendations from the utility company	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
l. Availability of utility programs or services that offer the bulbs to you directly	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
m. Ease of bulb disposal	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

23. On a scale from 1-10, with 1 indicating not at all interested and 10 indicating very interested, please rate your interest in Duke Energy providing a direct mail specialty CFL program that ships discounted specialty bulbs directly to your home:*

( ) Not at all interested
1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) very interested
10

( ) DK/NS

24. Since you received the free CFLs from Duke Energy, have you made energy efficiency improvements in your home, such as...?*

(read all choices)

[ ] **Wall or ceiling insulation**

[ ] Caulking

[ ] Faucet aerators

[ ] Outlet or switch gaskets

[ ] Low flow showerhead

[ ] Programmable thermostat

[ ] Weatherstripping

[ ] None of these

25. Since you received the free CFLs from Duke Energy, have you changed any of your habits related to energy use?*

( ) Yes

( ) No

( ) DK/NS

If YES to question 25, ask:

25a. What have you changed?

26. Why do you believe that Duke Energy is providing free CFLs to their customers?*

[ ] Duke Energy wants to save their customers money

[ ] Duke Energy wants to save energy for environmental reasons

[ ] Duke Energy wants to save energy for economic reasons

[ ] Duke Energy wants to look good (PR)

[ ] The government is forcing Duke Energy to do it

[ ] Other *(specify)*

Demographics

Finally, we have some general information questions…

27. In what type of building do you live?*

( ) Two or Three family attached residence-traditional structure

( ) Apartment (4 + families)---traditional structure

( ) Condominium---traditional structure

( ) Other

( ) Refused

( ) Don't Know

28. Does your home have cold drafts in the winter?*

( ) Yes

( ) No

29. Does your home have sweaty windows in the winter?*

( ) Yes

( ) No

30. Do you notice uneven temperatures between the rooms in your home?*

( ) Yes

( ) No

31. Does your heating system keep your home comfortable in winter?*

( ) Yes

( ) No

32. Does your cooling system keep your home comfortable in summer?*

( ) Yes

( ) No

33. Do you have a programmable thermostat?*

( ) Yes

( ) No

( ) Don't know

34. What temperature is your thermostat set to on a typical summer weekday afternoon?*

( ) Less than 69 degrees

( ) 69-72 degrees

( ) 73-78 degrees

( ) Higher than 78 degrees

( ) Off

( ) DK/NS

35. What temperature is your thermostat set to on a typical winter weekday afternoon?*

( ) Less than 67 degrees

( ) 67-70 degrees

( ) 71-73 degrees

( ) 74-77 degrees

( ) Higher than 78 degrees

( ) Off

( ) DK/NS

36. Would a two-degree increase in the summer afternoon temperature in your home affect your comfort….*

( ) **Not at all**

( ) Slightly

( ) Moderately

( ) Greatly

37. How many people live in this home?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8 or more

( ) Prefer Not to Answer

38. How many people are usually home on a weekday afternoon?*

( ) 0

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8 or more

( ) Prefer Not to Answer

The following questions are for classification purposes only and will not be used for any other purpose than to help Duke Energy continue to improve service.

Reading the answers is not necessary, but you may read them if they hesitate or seem unsure. Ranges are easier to identify with than specific numbers.

39. What is your age group?*

( ) 18-34

( ) 35-49

( ) 50-59

( ) 60-64

( ) 65-74

( ) Over 74

( ) Prefer Not to Answer

40. Please indicate your annual household income.*

( ) Under $15,000

( ) $15,000-$29,999

( ) $30,000-$49,999

( ) $50,000-$74,999

( ) $75,000-$100,000

( ) Over $100,000

( ) Prefer Not to Answer

We have reached the end of the survey. Do you have any comments that you would like for me to pass on to Duke Energy?

In addition, we are looking for residential customers to participate in a research study in which a Duke Energy representative will visit homes for 20 to 30 minutes and place small lighting monitors on 4 or 5 light fixtures, which would remain in place for 2 to 3 weeks. The monitors are smaller than a bar of soap and help us measure how often lights are turned on and off during the week. We plan on conducting this study in June 2012, and if your home is selected for the study you will receive $50 for participating.

Are you interested in participating?*

( ) Yes

( ) No

If yes, "Interested in participating":

Thank you, a Duke representative will contact you by mid-May to discuss the study in more detail and set up the two appointments to install and remove the light loggers, if you are eligible and available.

Survey ID*

____

Do you have any comments that you would like to pass on to your supervisor about this survey?

Thank You!

Thank you for your time and feedback today!

(Politely end call)

Appendix D: Impact Algorithms

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW = ISR \times units \times \left[\frac{Watts_{base} - Watts_{ee}}{1000}\right] \times CF \times (1 + HVAC_d)$$

Gross Annual Energy Savings

$$\Delta kWh = ISR \times units \times \left[\frac{(Watts \times HOU)_{base} - (Watts \times HOU)_{ee}}{1000}\right] \times 365 \times (1 + HVAC_c)$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of units installed under the program
$Watts_{ee}$	= connected load of energy-efficient unit = 13
$Watts_{base}$	= connected (nameplate) load of baseline unit(s) displaced = 55.33
HOU	= Average daily hours of use (based on connected load) = 2.89
CF	= coincidence factor = 0.081
$HVAC_c$	= HVAC system interaction factor for annual electricity consumption = -0.037
$HVAC_d$	= HVAC system interaction factor for demand = 0.168

The coincidence factor for this analysis was taken from Duke Energy's Residential Smart $aver lighting logger study performed in North Carolina with participants from the 2010 CFL campaigns.

$HVAC_c$ - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The weights were determined through appliance saturation data from the Home Profile Database supplied by Duke Energy.

Charlotte, NC

Heating Fuel	Heating System	Cooling System	Weight	HVACc	HVACd
Other	Any except Heat Pump	Any except Heat Pump	0.0042	0.069	0.170
		None	0.0004	0	0.000

Any	Heat Pump	Heat Pump	0.2782	-0.1	0.170
Gas Propane Oil	Central Furnace	None	0.0067	0	0.000
		Room/Window	0.5508	0.069	0.170
		Central AC		0.069	0.170
Electricity	Electric baseboard/ central furnace	None	0.0030	-0.43	0.000
		Room/Window	0.1493	-0.31	0.170
		Central AC		-0.31	0.170
None	None	Any	0.0074	0	0.170
Total Weighted Average			1	-0.037	0.168

$HVAC_d$ - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 31.

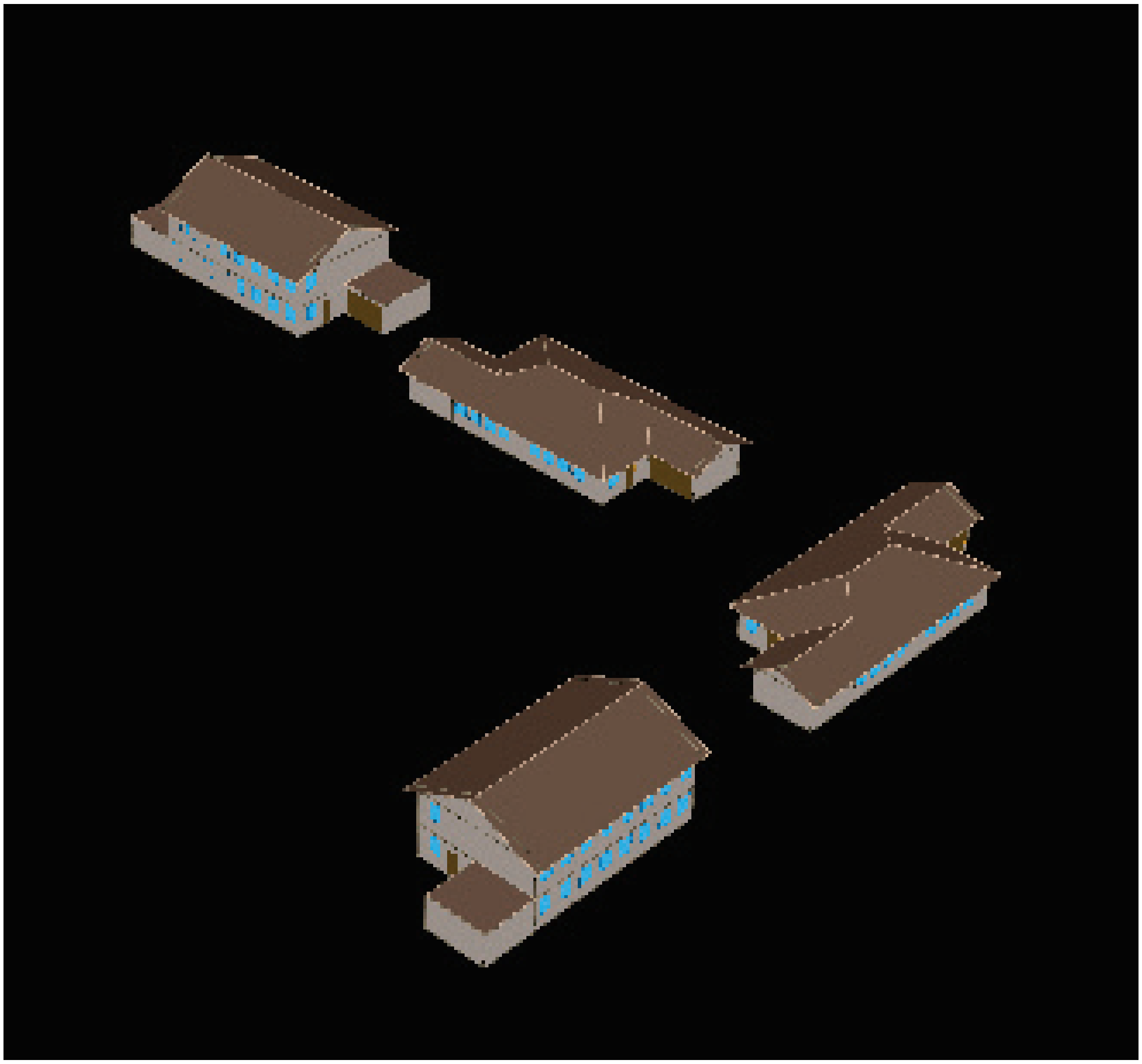

Figure 31. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F

Characteristic	Value
Duct location	Attic (unconditioned space)
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	26%; evenly distributed between supply and return
Cooling season	Charlotte – April 17 to October 6
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix E: DSMore Table

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (customer peak/unit)	EM&V gross kW (coincident peak/unit)	Unit of measure	Combined spillover less freeridership adjustment	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
CFLs		NC & SC	40.7	0.0469	0.0038	bulb	14.00%	35.0	0.0403	0.0033	yes	5
Program wide			**40.7**	**0.0469**	**0.0038**		**14.00%**	**35.0**	**0.0403**	**0.0033**		**5**

Process and Impact Evaluation of the Residential Energy Assessments Program (Home Energy House Call) in the Carolina System

Final Report

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

February 19, 2013

Submitted by

Nick Hall, Dave Ladd,
and Brian Evans

TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

Subcontractors:
May Wu, Michael Ozog
Integral Analytics, Inc.

Pete Jacobs
BuildingMetrics, Inc.

Matthew Joyce

TABLE OF CONTENTS

Executive Summary

Key Findings and Recommendations

This section presents the key findings and recommendations identified through this evaluation of Duke Energy's Residential Energy Assessments Program: Home Energy House Call in the Carolina System. The program evaluation covers the period of time from August 1st 2010 through August 31st 2012 (n= 8,193participants). Table 1 presents the estimated overall ex post energy impacts from the billing analysis. The billing analysis approach used to assess energy savings provides a direct net (net of short term freeridership, short term participant spillover and participation in other Duke Energy programs) energy impact estimate[1] by employing quasi-experimental analysis designs.

Table 1. Estimated Overall Impacts

	Net Savings
Annual Savings Per Participant Per Year	
kWh	928
kW	0.1149

The billing analysis gives the estimated overall net kWh savings per participant but is incapable of estimating coincident kW reduction. As a result, kW was calculated based upon the kWh savings and the kW/kWh ratio from the engineering analysis. Additionally, the billing analysis gives estimated impact of both kit and recommendations together. The main goal of the engineering analysis, aside from providing the kW/kWh ratio, is to offer insight into individual measure contributions to overall savings. All official impact results are net savings and are based on the outcome of the billing analysis.

Significant Process Evaluation Findings

From the Management Interviews

- Program performance has been close to goal in all Duke Energy states including the Carolinas for the 2010-2012 period.
- Direct mail is the primary marketing channel. Materials were recently upgraded with increased images, tighter copy, and a stronger call to action.
- All parties report that they work well as team. Communication and productivity are excellent.
- Quality assurance measures are working well and all vendors are meeting service level agreements.
- A new firm providing home energy auditors has been added to the team. This new firm, Thorpe Services, provides "floating" auditors who fill in during peak periods, substitute

[1] The evaluation did not document net long term spillover or short and long term market effects savings. These savings are in addition to those identified in this report but are beyond researchable issues associated with this evaluation.

for Thermo-Scan auditors who are sick, and drive longer distances to provide home energy audits in rural and disparate areas.

From the Participant Surveys

- About half of participants (53.8%) became aware of this program through mailings from Duke Energy; friends, family and coworkers (10.6%) were the only other source of awareness mentioned by more than 10% of participants.
- Two-thirds of participants surveyed (66.3%) had not been considering a home energy audit before learning about the Residential Energy Assessment program, and only 4.4% would have purchased an audit from another company within the next year if they hadn't participated in this program.
- The major motivating factor for customers to participate in this program is to reduce their energy costs, mentioned by 77.5% overall, and the most important motivating factor for 53.8%. The next most frequently mentioned motivating factor was receiving an audit of their home, mentioned by 26.3% but the most important factor for only 8.1%.
- However, their favorite part of participating in the program was the audit and the auditor's assistance and advice (mentioned by 48.1%), followed by receiving the audit and energy efficiency kit at no cost (mentioned by 30.0%), and the education and information gained (22.5%), while saving money on bills was only the fourth most mentioned favorite thing about the program (12.5%).
- Participants are generally very satisfied with this program, giving it a mean rating of 9.27 on a 10-point scale for overall satisfaction. All specific areas of the program were also rated at 9.0 or higher, except for "the audit recommendations provided new ideas," which received a satisfaction score of 8.19 (still quite high). Participants' mean satisfaction score for Duke Energy overall was 8.85.
- Two-thirds of participants (66.3%) would be interested in a follow-up program, though only 19.8% said they'd pay even $25 for such a program. Most (61.3%) who were interested in a follow-up program said they would not pay anything for it.
- The energy efficiency kit items with the highest installation rates are the CFL bulbs (94.4% for 13-watts and 89.4% for 20-watts), with the other items being installed by between 44.4% (low flow showerhead) and 28.1% (bathroom faucet aerator) of participants.
- Half of the participants surveyed (50.0%) read the DOE Energy Savers booklet included with the kit, and many took action based on the booklet's advice. The most common areas of action included lighting (by 31.3% of those who read the booklet), insulation and air leaks (28.8%), heating and cooling (27.5%) and appliances (27.5%).
- A large majority of participants recall receiving the home audit report (82.5%). The most common recommendations followed in the Carolinas were reducing water temperature to 120 degrees (by 33.8% of participants), closing vents in winter (30.0%), and sealing leaky attic access (28.1%).
- This survey also asked participants if they would be interested in a program for ordering specialty CFL bulbs by mail. Carolinas residents were most interested in such a program for outdoor flood lights (63.1%), which also has one of the lowest levels of pre-CFL installations (13.6% of bulbs currently installed), though these bulbs are also the ones that are used the least (average 2.4 hours/day). There is lower but still significant interest in

dimmable (41.9%) and three-way bulbs (38.8%), which are used for more hours (3.4 and 4.4 hours/day respectively) and still have relatively low CFL installation rates in the Carolinas (11.5% and 25.7% respectively).

Significant Impact Evaluation Findings: Billing Analysis

A billing analysis was conducted to estimate the net energy savings from the program. The billing analysis relies upon a statistical analysis of actual customer-billed electricity consumption before and after participation in the Home Energy House Call (HEHC) program, compared to the change in savings over that same period for a matched comparison group[2] to estimate the impact for the kit and recommended measures from the audit.

The estimated impacts are presented in the "Impact Estimates: Billing Analysis" section of the report, and a summary of the results is shown below:

	Carolinas
Savings (kWh/yr)	928
T-value	-18.2
R-Square	71%
Sample Size (HEHC Participants)	8,193

Significant Impact Evaluation Findings: Engineering Analysis

- Mean wattage of a replaced bulb is 62 watts for the 13-watt CFL and 72 watts for the 20-watt CFL.
  - o See Table 57 on page 79.
- An ISR of 91.7% was reported for the 13-watt CFL and 88.9% for the 20-watt CFL.
  - o See Table 57 on page 79.
- Average daily hours of use are 3.89 and 3.58 for 13-watt and 20-watt CFLs respectively.
  - o See Table 58 on page 80.

Recommendations

Everyone interviewed agreed that the teamwork between different organizations was excellent. Daily operations flow well between Customer Link, WECC, and TSI. Weekly meetings ensure that everyone is well informed and any issues that arise are addressed in a timely manner. The team's attitude of continuous improvement has shown itself in a consistent process of observation, hypothesis, testing, and implementation of new changes.

Although there are no notable issues with the program, the team does note a dip in direct mail response rates compared to years past. Low response rates mean higher overall program costs. To address this issue head-on, the team has identified recipient fatigue as the most likely source of the problem. To address this, Duke Energy has reworked its marketing materials and is in the process of improving its customer targeting through the use of customer segmentation and

[2] The comparison group consists of all pre-program energy use for all HEHC participants within each targeted state so that the comparison group is a cluster of non-program impacted energy use homes for non-participants that are matched both demographically, psychographically, attitudinally and whose pre-energy-use-profiles match to the test group. This type of comparison group analysis represents a best practice approach within the energy program evaluation field.

energy use modeling. To fully appreciate the effectiveness of these new and separate improvements, we suggest that AB split testing be used to test one factor at a time. Such a methodical approach of using a control letter and a challenger or a control list and a new targeted list will enable the team to isolate and measure each variable independently and thus maximize the effectiveness of the mailing.

Should the efforts to adjust the marketing creative and improve the customer mailing lists still not deliver the desired results, the HEHC team may also consider changing the offer of the program itself. For instance, if customers know they can order the audit at any time, they may never get around to doing so. However, limiting the time of the offer within a given area may stimulate a sense of scarcity that increases response rates. Likewise, the offer may be adjusted to provide a “teaser” service in addition to standard audit checklist items, such as focusing even more on decreasing the costs of heating or cooling depending upon the season.

Introduction and Purpose of Study

Summary Overview

This document presents the process evaluation report for Duke Energy's Home Energy House Call (HEHC) program as it was administered in North Carolina and South Carolina. The evaluation was conducted by TecMarket Works, BuildingMetrics, Integral Analytics, and Matthew Joyce, subcontractors to TecMarket Works.

Summary of the Evaluation

TecMarket Works performed a process evaluation comprised of management interviews to review program operations and administration, and a customer survey to determine satisfaction levels and identify any program implementation issues.

The impact findings presented in this report were calculated using monthly billing data (for program net savings) and participant survey data linked to engineering analysis (measure savings estimates) as presented in Table 2 below.

Table 2. Evaluation Date Ranges

Evaluation Component	Dates of Analysis
Participant Surveys	Surveys conducted from 9/10/12 through 10/10/12
Management Interviews	September and October, 2012
Engineering Estimates	October and November, 2012
Billing Analysis	October and November, 2012

Evaluation Objectives

The objective of this evaluation is to determine the effectiveness of and customer satisfaction with Duke Energy's Home Energy House Call program as it was administered in the Carolina System, and to determine estimated energy impacts.

Description of Program

The Home Energy House Call (HEHC) program sends trained energy specialists (auditors) to customers' homes to conduct an energy audit of their houses' characteristics and appliances. The auditors visually inspect the home and generate a personalized energy report that educates customers about energy saving opportunities and actions to reduce their energy bills. During the Home Energy House Call, customers receive an energy efficiency starter kit containing three CFLs and other low cost energy saving measures.

Throughout their visits, auditors identify specific energy savings opportunities and explain their findings to the homeowners. Whenever allowed by the customer, auditors directly install the three CFLs from the kit. Auditors are also directed to install up to 12 additional CFLs for a maximum of 15 CFLs per household. These additional CFLs are to be installed in high use sockets, and the appropriate number of extra bulbs provided is cross-checked against Duke Energy's CFL Tracker database to determine eligibility based upon previous participation in other efficiency programs.

During the Home Energy House Call, auditors also install kitchen aerators, faucet aerators and low flow showerheads when the old plumbing fixtures can be removed by hand. The audit and energy savings measures provided and installed during the visit are offered at no charge to the customer.

In this way the program is designed to achieve three primary purposes:

1. Customer education and behavior change
2. Direct installation of CFLs and other energy savings measures
3. Data collection for more informed future decision making

Program Goals and Participation

The program's primary measure of success is the number of audits conducted per year (see table below). While not having a specific metric for CFL installs, the program strongly encourages auditors to install as many CFLs as possible. Those installation numbers are also noted in the table below.

In North Carolina, the 2010 program performance reached 97% of goal, while in 2011 it surpassed expectations, reaching 104%. As of September 2012, the program in North Carolina stood at 86% of goal.

In South Carolina the program achieved 96% of goal in 2010 and 99% of goal in 2011. As of September 2012, performance stood at 54% of goal. As result, resources are being shifted from North Carolina to South Carolina to increase performance there.

Table 3. Program Performance through September 2012

Year	State	Annual Goal	# of Audits	% of Goal
2010	**NC**	**5020**	4850	97%

2011	**NC**	**3960**	4135	104%
2012	**NC**	**4356**	3760	86%
2010	**SC**	**1700**	1631	96%
2011	**SC**	**1540**	1526	99%
2012	**SC**	**1694**	908	54%

While direct installs of CFLs are not an official program goal, they are a fundamental aspect of the program. In North Carolina, during 2010 the program was directly responsible for 23,788 CFL installs, while it installed 26,324 and 20,172 CFLs in 2011 and 2012 respectively. In South Carolina during those same time periods the program installed 4,584, 7,234, and 3,874 CFLs respectively.

Table 4. Program Participation

Program	State	*Participation Count From: August 1, 2010 To: August 31, 2012
Home Energy House Call	NC	8245
Home Energy House Call	SC	2690
Home Energy House Call	**TOTAL**	**10935**

*The participation period data range for the billing analysis is larger than that of the process evaluation because it was revised subsequent to the completion of the phone surveys. Many customers had to be dropped from the engineering sample if, for various reasons, they were ineligible to participate in the phone survey. To aid reconciliation between the engineering and billing analyses, these customers were also excluded from the billing data sample. The total number of participants is, however, used for the total program savings extrapolation portion of the engineering estimates. This table includes every participant from the sample date range. That is why it shows a greater number of total participants than the billing analysis.

Methodology

Overview of the Evaluation Approach

This process evaluation had four components: management interviews, participant surveys for the process evaluation, and a billing analysis and an engineering analysis for the impact evaluation.

Study Methodology

Management Interviews

TecMarket Works conducted interviews with Duke Energy's HEHC program manager, as well as managers from the prime contractor Wisconsin Energy Conservation Corporation (WECC), call center provider Customer Link, Thermo-scan, which supplies in-home energy auditors, and AM Conservation, which handles energy efficiency kit and CFL fulfillment[3]. The interviews covered program design, execution, operations, interactions between organizations, data transfer methods, and personal experiences in order to identify any implementation issues and discuss opportunities for improvement.

Participant Surveys

TecMarket Works fielded a phone survey with randomly selected participants in order to measure satisfaction and to identify areas for program improvement. One hundred and sixty (160) interviews were completed with Home Energy House Call participants in the Carolinas. Half of the participants surveyed live in North Carolina (50.0% or 80 out of 160) and the other half live in South Carolina (also 50.0% or 80 out of 160).

Billing Analysis

The billing analysis used consumption data from HEHC participants in North Carolina (6,338 customers) and South Carolina (1,855 customers) that participated between August of 2010 and August of 2012. A panel model specification was used that analyzed the monthly billed energy use across time and participants. The model included terms to control for the effect of weather on usage, the effect of impact from other Duke offers, the effect of normal non-program induced energy use changes, as well as a complete set of monthly indicator variables to capture the effects of non-measureable factors that vary over time (such as economic conditions and season loads).

Engineering Analysis

Engineering algorithms taken from the Draft Ohio Technical Resource Manual (TRM) were used to estimate savings. These unit energy savings values were applied to customers in the engineering analysis sample.

Data collection methods, sample sizes, and sampling methodology

[3] AM Conservation began this role in April 2012. Prior to that time the function was performed by Niagara Conservation, which was not interviewed for this evaluation.

Management Interviews

Management interviews and follow-up phone calls for questions and answers were conducted with staff members from Duke Energy, Wisconsin Energy Conservation Corporation, Customer Link, Thermoscan, and AM Conservation. The interview instrument can be found in Appendix A: Management Interview Instrument.

Participant Surveys

A sample list of customer records was randomly pulled by TecMarket Works from a list of 3,212 participants (between the dates of August 10, 2010 and March 30, 2012) with contact information provided by Duke Energy. Surveys were conducted by telephone with 160 participants. The survey instrument can be found in Appendix B: Participant Survey Instrument.

Billing Analysis

The billing analysis used consumption data from all complete data provided for the HEHC participants in North Carolina (6,338 customers) and South Carolina (1,855 customers) that participated between August of 2010 and August of 2012. Exceptions were made to aid reconciliation between the engineering and billing analyses. Those customers that were deemed ineligible to participate in the phone survey, and therefore did not feed the engineering data were also excluded from the billing data sample.

Engineering Analysis

Phone surveys were conducted with a random sample of 160 participants.

Number of completes and sample disposition for each data collection effort

Management Interviews

During September and October 2012 TecMarket Works interviewed the Duke Energy program manager and four vendors for this evaluation. This represents a completion rate of 100%.

Participant Surveys

From the sample list of customers, 716 participants were called between September 10, 2012 and October 10, 2012, and a total of 160 usable telephone surveys were completed yielding a response rate of 22.3% (160 out of 716).

Table 5. Summary of Data Collection Efforts

Residential Energy Assessments: Home Energy House Call				
Data Collection Effort	**State**	**Size of Population in Sample for Surveys**	**# of Successful Contacts**	**Sample Rate**
Management Interviews	NC, SC	5	5	100%
Participant Surveys	NC, SC	3,212	160	5.0%

Billing Analysis

N/A (all participants included, sampling was not used)

Engineering Analysis

A total of 160 participants responded to the phone survey.

Expected and achieved precision

Participant Surveys

The survey sample methodology had an expected precision of 90% +/- 6.3% and an achieved precision of 90% +/- 6.3%.

Billing Analysis

All savings estimates from the billing analysis were statistically significant at the 95% confidence level.

Engineering Analysis

Engineering estimates rely on participant survey responses. Sampling procedures for the participant survey had an expected precision of +/- 6.3% at 90% confidence and an achieved precision of +/- 6.3%.

Description of baseline assumptions, methods and data sources

Baseline assumptions were determined through phone surveys with customers providing self-reported values of impact relevant data. Robust data concerning HVAC system fuel and type was available from Duke Energy's Home Profile Database (appliance saturation survey type data) in the Carolinas. Interaction factors derived from this data were used in favor of deemed values from secondary sources as they recognize only Duke Energy customers and, therefore, more accurately represent the participant population. A breakdown of these factors by system and fuel type can be seen in Appendix F: Impact Algorithms.

Description of measures and selection of methods by measure(s) or market(s)

The energy efficiency kits contain the following:

- One 20 watt CFL
- Two 13 watt CFLs
- One low flow showerhead
- One bathroom faucet aerator
- One kitchen faucet aerator
- One small roll of Teflon tape for plumbing installations
- Two foam insulation gaskets for light switch plates
- Four foam outlet gasket insulators
- 17 feet of closed-cell foam weather-stripping
- One CFL eligibility worksheet
- One booklet with tips saving energy produced by the Department of Energy
- One pamphlet with installation instructions for the kit items.

Threats to validity, sources of bias and how those were addressed

Billing Analysis

The specification of the model used in the billing analysis was designed specifically to avoid the potential of omitted variable bias by including monthly variables that capture any non-program effects that affect energy usage, as well as other Duke offers. The model did not correct for self-selection bias because there is no reason to as long as the program remains voluntary.

Engineering Analysis

The participant responses are self-reports and therefore may be affected by self-selection bias, false response bias or positive result bias. If these biases are present, the savings achieved can be expected to be higher than those reported in the impact evaluation.

Note on Evaluation Methodology and Net to Gross

The analysis used in this study is based on improvements made within the field of energy program evaluation over the last year. Specifically, studies conducted prior to this year used standardized billing analysis techniques linked to net analysis adjustment methods to estimate net impacts for all measures without differentiating between low-cost standard consumable measures (part of normal purchase behaviors because first cost, product availability and transaction barriers are not signficant) and measures with significant acquisition barriers. In the last year the field has differentiated analysis approaches associated with normal low-cost item purchase behavior measures (CFLs, aerators, shower heads, caulking, etc.) from products that have significant cost and other purchase barriers (furnaces, air conditioners, compressors, etc.). Impact analysis approaches associated with low-cost low-barrier products that have few if any significant purchase barriers can produce net savings directly from a billing analysis that controls for weather and pre-existing (before the program) changes in market conditions over the evaluation period. In these approaches, the use of a rolling pre-program billing period, consisting of all participants' consumption before they enroll in a program can be effectively used as a control group and as a result, that analysis produces net savings without identifying gross savings. For these analyses there is no need to adjust savings to account for freeriders. However, for large impact measures that are procured only a few times during a lifetime, the same analysis approach produces gross savings that have to be adjusted for freeriders. This advancement in the field of evaluation has resulted in the analysis used in this study and as a result, the results provided are net of freerider savings and also include impacts associated with short-term spillover. A description of prior approaches and the updated approach can be found in Appendix K: Prior Methodology and Updated Approach.

Management Interviews

Operational Roles

Program operational roles are assigned as follows: Duke Energy provides overall program oversight and marketing. WECC holds the contract with Duke Energy and handles normal program operations, overseeing subcontractors: Thermo-Scan, which provides the in-home energy audits, and Thorpe Services, which provides back up energy auditors. Customer Link operates the call center, handling audit scheduling and customer questions. AM Conservation provides fulfillment services for the energy efficiency kits and CFLs distributed by the program. Each role is discussed in more detail below.

Program Eligibility

To be eligible for the program, participants must 1) be a Duke Energy customer, 2) own a single family home, 3) have at least four months of billing history, and 4) have at least one of the following: electric heat, central air or an electric water heater. Mobile homes and rental properties are not covered by the program.

Energy Efficiency Kits

The energy efficiency kits contain the following:

- One 20 watt CFL
- Two 13 watt CFLs
- One low flow showerhead
- One bathroom faucet aerator
- One kitchen faucet aerator
- One small roll of Teflon tape for plumbing installations
- Two foam insulation gaskets for light switch plates
- Four foam outlet gasket insulators
- 17 feet of closed-cell foam weather-stripping
- One CFL eligibility worksheet
- One booklet with tips saving energy produced by the Department of Energy
- One pamphlet with installation instructions for the kit items.

The contents of the energy efficiency kits have remained the same since 2008 when window film was removed from the offering. However, the HEHC team continues to discuss potential changes to the kits. The primary change now under consideration is the addition of specialty CFL bulbs. Duke Energy is currently considering the inclusion of specialty bulbs in several efficiency programs and the bulbs' inclusion in the HEHC program will depend upon the larger strategy adopted by the utility.

Program Marketing

Direct mail is the primary marketing vehicle for the program. The Duke Energy program manager, WECC manager, and TSI project manager plan mailings according to zip code in order to deploy the auditors most efficiently. The marketing strategy focuses first on those zip codes with high numbers of potential participants and those areas that can be served in a timely manner by auditors who are available in that geographic region. Once zip codes are identified, the Duke Energy Marketing Analytics department uses Claritas PRIZM data to target desired segments. The analytics group then filters those customers by the eligibility requirements to generate a mailing list.

After Duke Energy generates the mailing list, the contact information is sent to ProtoType, a mail vendor that verifies the addresses against the National Change of Address (NCOA) database before sending out the mailers. Larger mailings are divided into state specific batchesand sent out over a few days so that customers do not overwhelm the Customer Link call center. The Duke Energy program manager indicated that virtually all mailers are successfully delivered and that there are few returned mailers. After each mail drop, ProtoType sends to Duke Energy the list of customers who received the mailers and the proof of mailing for invoicing purposes. The Duke Energy program manager communicates with the ProtoType account manager approximately twice per week, as well as holding weekly meetings for regular updates.

Mailings are sent out approximately twice per month to targeted customers in each state served by the program. The timing of the mailings is coordinated with the audit scheduling so that all newly acquired customers can be served within the 45 day wait list timeline. Advance planning also helps ensure that WECC, Customer Link, and TSI have sufficient staffing to handle the volume of customer responses. However, customers can take longer than expected to respond, misaligning audit schedules with wait lists, which causes additional work on the back end to maintain customer satisfaction.

Tracking of marketing metrics is working well. Duke Energy tracks customers by campaign codes so they know when each customer received the mailing and how long it took for them to respond. This helps the program team to better understand the specifics of that geographic region and plan how long to continue operations in a specific area. The campaign tracking system also notes which mail piece was used, which channel the customer responded to, if the customer has been targeted before, and how they learned about the program.

While response rates are naturally expected to be stronger during periods of high energy usage, such as hot summers or cold winters, overall response rates to the mailings average between one and two percent (although they are higher in newly targeted communities and in those communities that have not been targeted in a long time). While these numbers are close to national averages for direct mail, the program manager expressed a desire for stronger performance.

The team noted one reason for the one to two percent response rates was the age of the marketing collateral being used. It had not been updated since 2008. With some customers receiving the same mailing multiple times in a single year, the team concluded that the marketing materials appear to suffer from recipient fatigue, meaning customers ignore materials they have seen and rejected before. To address this issue, Duke Energy completely revamped the program’s marketing materials to include more images, less (but more tightly written) copy, and a stronger call to action. The new marketing materials were placed into service in September of 2012. Testing results regarding their improved effectiveness were not yet available at the time of this evaluation.

Paper mailings are supplemented by email campaigns targeted at Duke Energy's Online Services customers. The email messages are sent to all Online Services customers throughout the state. Although email campaigns are less frequent than paper mailings, the team has conducted two email campaigns per state this year with additional efforts scheduled for October 2012. Other forms of marketing used by the program include radio ads, business reply cards, booths at events such as home and garden shows, and advertising on My Home Energy Report, Duke Energy's personalized mailer that compares one home's energy use to other residential customers.

Call Center Operations

Customer Link serves as the call center vendor, providing customer service representatives who schedule audits using a scheduling software developed by WECC. Customer Link representatives explain the HEHC program to customers, inform them about the items in the energy efficiency kit, and answer any questions. Customer Link also handles all rescheduling should a customer or auditor need to change or cancel an appointment.

When a call comes in, Customer Link representatives note the customer's name and address and review qualification questions. Once confirmed they open the scheduling software to check openings and find a time that works for the customer. Additional information regarding preferred phone number and specific notes such as "Beware of dog" are also recorded. The Telescript software gathers the customer information and captures all events during the call, making tracking and reporting easy. Outbound calls are placed through the Telescript system so they can be tracked as well.

Customer Link's service level agreement obligates them to answer 80% of inbound customer calls within 30 seconds or less, and Duke Energy confirms that they meet this goal consistently. To maintain this high level of service, Customer Link and the entire HEHC management team carefully plan and track HEHC mail drops to ensure program enrollment goals are met while allowing sufficient time for Customer Link to ensure sufficient staffing to handle the call volume.

Customer Link also processes all business reply card (BRC) and internet sign ups, making outbound calls to customers to schedule appointments, which are offered Monday through Saturday with evening appointments scheduled for added customer convenience. BRC and internet orders are processed within three business days of receipt. If the customer does not answer the outbound phone call, standard procedure has Customer Link leave a voice mail message, followed seven to ten business days later by a second call, and a third call at a similar interval, indicating that it is the final attempt so "please contact us or you'll be removed from the list."

The program maintains a goal of ensuring that enough appointment times are available so that no customer need wait longer than 45 days for an audit. Customers are scheduled in a four hour window on the selected date. They receive an automated reminder call two days before the appointment, and an advance notification call 30 minutes prior to arrival. If customers are not ready for their appointment, then the four hour window enables the auditor to visit the next customer and then return to serve the customer who was unavailable. To ensure closely clustered appointments for the auditors, the scheduling software limits appointments to a specific number of zip codes within 45 minutes driving distance. It is possible to override the software to schedule appointments in an adjacent zip code, but such occurrences are rare.

Audit Process and Direct Installs

The home energy audits are conducted by Thermo-Scan Inspections (TSI), which employs nine auditors: four in North Carolina, two in South Carolina, and three serving Ohio and Kentucky. The company can also bring on additional auditors as needed through Thorpe Services. All auditors are certified BPI (Building Performance Institute) in Building Analysis. In addition to the BPI certification, the TSI-specific training program consists of one week of book learning and field training to ensure that auditors are capable of identifying energy saving opportunities and are well-versed in explaining how their recommendations can help the customer. Training also covers potential customer service issues, such as how an auditor can best deal with high bill complaints. After the formal training, new auditors shadow an experienced auditor for a week to observe actual in-home activities. After this, new employees are authorized to conduct independent audits.

The TSI project manager works with Customer Link to schedule audits in a way that maintains even workflow. Each auditor conducts 5-6 audits per day. The auditors visit the customer homes and use a touch-screen laptop computer to fill out a 100-question checklist over a period of between 60 to 90 minutes. Items on the list range from property details, such as the age and square footage of the home, to customer motivations, such as why the Home Energy House Call was requested. It also covers efficiency and consumption items regarding everything from HVAC and attic insulation to appliance questions regarding fuel types and ages. The walk through inspection is, however, only visual. So the auditor estimates rather than measures the thickness of home insulation and performs no complex testing, such as blower door tests.

As the auditor follows the sequence on the checklist he or she makes recommendations for ways the homeowner can increase energy efficiency and save on energy bills. Recommendations are specific to the customer's home, covering the following items as appropriate: home shell insulation, home shell air tightness, duct insulation, duct air tightness, heat pump condition (if any), furnace filter, furnace fan run time, crawlspace vents, summer window shading, hot water, and extra refrigerator. Recommendations tend to focus on low cost and no cost measures, but auditors are trained to mention other Duke Energy efficiency programs and rebates, using marketing materials supplied by the utility. All recommendations are recorded on the laptop, and upon completion of the site visit, the file is uploaded to the WECC database where the data collected by the auditor is processed and verified before being sent on to Duke Energy. A copy of the final report is provided for the customer's reference.

In addition to identifying the energy saving opportunities in the home, the onsite assessments are also designed to maximize the educational value of the visit. This means that rather than the auditor walking around the customer's home alone with the checklist to identify energy saving measures, the program design requires the customer to be present throughout the audit. This creates a continuous opportunity for the auditor to educate the customer by pointing out energy saving opportunities, as well as for the customer to learn by observing the process and asking questions. Auditors are instructed to provide explanations in layman's terms so the customer can share the information with other members in the household, such as one spouse explaining something to the other who was not present. This helps ensure that both influencers and decision makers are well informed.

While in the home, the auditor installs the three CFLs contained in the energy efficiency kit, as well as up to 12 more CFLs which are stocked in the auditor's vehicle. To increase the likelihood of installing the extra CFLs, Customer Link places an automated call to HEHC customers 48 hours in advance reminding them about their upcoming appointment and encouraging them to look for high use sockets where the customer might place the additional CFLs. While TSI auditors do not have a specific quota of extra CFLs to install, they strive to install the maximum number of CFLs possible. According to WECC reports, in 2012 auditors averaged an additional 3.8 CFLs in North Carolina and 3.1 CFLs in South Carolina beyond the three provided in the kits.

Installation of water-saving measures is generally low due to liability concerns regarding old plumbing. Only when the old plumbing fixtures can be removed by hand do auditors install low flow showerheads and aerators. Other energy savings have similarly low direct install rates. Since installing these measures takes more time, auditors generally refer homeowners to the instructions provided with the kits.

WECC monitors counts of audits completed, as well as the number of CFLs installed. If numbers are lagging, then WECC pushes auditors to increase efforts to achieve direct install objectives. The firm also places comparable emphasis on the educational value of the in-home visits, striving to ensure that the auditors take every opportunity to increase customer awareness of energy consumption and encourage appropriate behavior changes.

Efficiency Kit Fulfillment

AM Conservation packages the energy efficiency kits and bundles them with extra CFLs for shipment to TSI offices. Until April of 2012, fulfillment operations were provided by Niagara Conservation. At that point Duke Energy changed providers to AM Conservation. Duke Energy program managers report that the transition went well and fulfillment efforts are going smoothly so far. Because this process evaluation was conducted after the change in vendor, only AM Conservation was interviewed. The new fulfillment vendor reports that operations are running well and that Duke Energy is providing adequate notice to ensure that TSI auditors are stocked with sufficient kits and CFLs.

Management Communication and Coordination

The Duke Energy program manager convenes weekly telephone meetings with team representatives from WECC, Customer Link and TSI. Items discussed include performance score cards, appointments scheduled, status of wait listed customers, progress toward goals, mailing list analysis, and marketing planning to ensure appropriate scheduling to meet goals or clear the wait list. For instance, a new mailing may be initiated to generate more program sign ups or it may be postponed by a week or two to ensure that the backlog of customers on the wait list is reduced.

All parties interviewed spoke highly of their excellent communications and a team atmosphere that encourages everyone to make suggestions for the betterment of the program. What is more, each team member has earned the trust of their colleagues who know they can be relied upon to deliver their share of the results.

Quality Control and Reporting

Call Handling
Customer Link sends Duke Energy weekly reports on disposition of calls, including numbers of inbound and outbound calls, calls transferred, sales, appointments canceled, number of ineligible, etc. In addition, Customer Link and Duke Energy managers monitor customer calls on a regular basis to ensure high call quality. On a weekly or semi-weekly basis they listen to randomly-selected inbound and outbound calls to ensure that customer service is appropriate, scheduling is efficient, and that programmatic points are adequately addressed. Once per month, Duke Energy employs a call center scoring team, which scores 50 calls to ensure that Customer Link is meeting its service level agreement. Customer Link staff are required to score at least 92% and the Duke Energy program manager reports that they consistently score above that.

Auditing Process
To control quality of the home auditing process the WECC project manager accompanies auditors on quarterly ride-alongs to ensure that auditor training and practices are in compliance with program standards. The TSI program manager also conducts similar but independent quality control checks. This process of shadowing helps to ensure auditors are treating customers appropriately and following procedures, such as reviewing data history, explaining terms and conditions, going through the main points of the audits and checking information, providing recommendations, and leaving behind customer satisfaction cards. The ride-alongs also create opportunities for the reviewers to give feedback and share best practices gleaned from other auditors.

Duke Energy also uses several methods of quality control to ensure a high quality customer experience. The program manager is a BPI certified auditor and she too conducts random ride-alongs with the auditors. The program also uses secret shoppers, by which someone unknown to WECC, Customer Link or TSI places an order for a Home Energy House Call audit and then provides feedback directly to the program manager.

While the auditors are generally working very effectively, these collective quality control efforts do occasionally identify training gaps, such as a substitute auditor not knowing about the appliance recycling program, or performance shortfalls, such as an auditor failing to check personal stocks of Smart $aver brochures and running out. Such minor issues are quickly identified and resolved.

Duke Energy also uses customer comment cards to solicit feedback about customers' audit experiences. The reply cards consist of eight questions asking: whether the customer was contacted in a timely manner to schedule the appointment; whether the scheduling was to their convenience; whether the auditors clearly explained the audit process and recommendations; whether the auditors responded to specific customer concerns; whether the report and accompanying materials were easy to understand; if the auditor offered to install items from the kit; does the customer plan to take advantage of the recommendations; and does the customer have any suggestions to improve service. There is also a spot on the card to list the auditor's name. These comment cards are mailed in and the results are discussed with TSI during regular meetings.

Notable Changes and Improvements Made since Previous Process Evaluation

The HEHC team maintains a philosophy of continuous improvement whereby team members consistently look for opportunities to increase the effectiveness of the program. The Duke Energy program manager indicated the following notable changes since the program was last evaluated in 2010:

- In years past, the program focused predominantly on high density population areas because audits needed to be scheduled within limited geographical bounds for operational efficiency. Otherwise auditors would spend more time driving between customer homes than they would spend conducting the audits themselves. As of 2012 WECC has subcontracted with a fourth party firm, Thorpe Services, to provide 6-8 additional auditors on an as needed basis. This increase in staffing provides floating coverage in the event of unanticipated high response rates or if a primary TSI auditor gets sick. Perhaps more importantly, it enables TSI to serve more Duke Energy customers in multiple regions and rural areas within the 45 day time window.

- The staffing increase has also created more opportunity for marketing the program. While the previous geographic limitations were in place, the program favored targeted marketing and local promotional efforts because it was not cost effective to advertise to customers outside the immediate area to be serviced. This approach precluded internet advertising, which is now being considered.

- The contract with Thorpe Services has also facilitated an increase in the amount of email marketing done by the team, since Duke Energy can now email Online Services customers statewide with confidence that it will have the auditors necessary to provide the requested Home Energy House Calls.

- Marketing materials, which had not been revised since 2008, have been redone for 2012. Duke Energy made changes to the collateral, brochures, folders, and emails. The primary marketing message was improved to further clarify how the program works and its benefits, as well as strengthening the call to action to encourage customer enrollment.

- The messaging strategy has also been adjusted. Because Duke Energy recognizes that some customers intend to respond but never get around to it, they now re-mail to customers who do not sign up the first time.

- Duke Energy is now testing the use of follow up letters sent to customers after the audit is completed to encourage them to follow the recommendations made during the Home Energy House call and take as many additional energy savings actions as possible.

- Auditors are now required to be familiar with Duke Energy's other energy efficiency programs and are provided with promotional materials to leave behind with customers as appropriate.

- Software changes to the scheduling tool improve efficiency for Customer Link representatives by enabling them to filter scheduled appointments by auditor. This is particularly helpful when substitutions and reschedules arise when an auditor gets sick.

- The Customer Link automated call to customers reminding them about their appointments was changed from 24 to 48 hours in advance. This shift has proven worthwhile since customers who are prone to cancellation do so earlier, which creates a larger window for filling cancellations with alternative appointments for the auditors.

- The 48 hour reminder call script was also improved to ask customers to look for opportunities to install CFLs in high use areas of the home, thus increasing the likelihood of additional CFL installations.

Program Changes Interviewees Would Like to See

While the managers we spoke with are generally satisfied with the program, they are continually looking for opportunities for improvement. Their suggestions are noted below.

Hogs and Dogs. To improve program targeting, Duke Energy's market insights team is working on incorporating a model that will estimate customer usage by type. While too preliminary to be discussed in any detail, the primary idea behind the effort is to identify and target those homes with the highest energy usage in order to generate the highest yields in terms of energy savings.

iPads or tablets for direct contact between Customer Link, TSI, and auditors in the field. Under the current arrangement, Customer Link does not have direct contact with auditors. Those communications are channeled through the TSI program manager who coordinates auditor scheduling. Such an arrangement helps to ensure tight coordination of auditor schedules, but it also results in an intermediate layer between those individuals doing the scheduling at Customer Link and auditors. This causes delays when changes in schedules need to be made. One proposed solution is to switch from the current laptops to iPads or similar tablets with WiFi and phone connections. With the new technology, auditors could remain in contact with Customer Link and TSI about cancelations and no-shows, thus making last minute scheduling easier and more efficient. Likewise, the touch pads would make the walk through process easier, and the ready connection to WECC servers would ensure timely delivery of files.

Increased customer scheduling efficiency with improved mailing strategies. One of the challenges faced by the program is the desire for consistent scheduling in a program that has inconsistent program enrollments due to the variable timing and volume of customer responses. For instance, despite the program's intentions to sign customers up several weeks in advance, response rates may vary or people may respond to a mailing right before an audit is to be performed in their area or sometime after other audits in the area have been performed. Such lulls and rushes in scheduling may be mitigated by more efficacious mailing strategies, such as more clearly delineated mail drop schedules or the use of limited time offers or additional incentives that encourage customers to respond within a specific time frame.

Conclusions and Recommendations for Program Changes

Everyone interviewed agreed that the teamwork between different organizations was excellent. Daily operations flow well between Customer Link, WECC, and TSI. Weekly meetings ensure that everyone is well informed and any issues that arise are addressed in a timely manner. The team's attitude of continuous improvement has shown itself in a consistent process of observation, hypothesis, testing, and implementation of new changes.

Although there are no notable issues with the program, the team does note a dip in direct mail response rates compared to years past. Low response rates mean higher overall program costs. To address this issue head-on, the team has identified recipient fatigue as the most likely source of the problem. To address this, Duke Energy has reworked its marketing materials and is in the process of improving its customer targeting through the use of customer segmentation and energy use modeling. To fully appreciate the effectiveness of these new and separate improvements, we suggest that AB split testing be used to test one factor at a time. Such a methodical approach of using a control letter and a challenger or a control list and a new targeted list will enable the team to isolate and measure each variable independently and thus maximize the effectiveness of the mailing.

Should the efforts to adjust the marketing creative and improve the customer mailing lists still not deliver the desired results, the HEHC team may also consider changing the offer of the program itself. For instance, if customers know they can order the audit at any time, they may never get around to doing so. However, limiting the time of the offer within a given area may stimulate a sense of scarcity that increases response rates. Likewise, the offer may be adjusted to provide a "teaser" service in addition to standard audit checklist items, such as focusing even more on decreasing the costs of heating or cooling depending upon the season.

Participant Surveys Results

Awareness of the Program

About half of the participants in the Carolinas (53.8% or 86 out of 160) became aware of the HEHC program through mailings from Duke Energy, as seen in Figure 1. Friends, family and co-workers were mentioned as sources of awareness by another 10.6% (17 out of 160), followed by information at the Duke Energy website (6.9% or 11 out of 160) and the customers' own inquiries as to how they might save energy (6.9% or 11 out of 160). Only 8.8% (14 out of 160) couldn't recall how they became aware of the program.

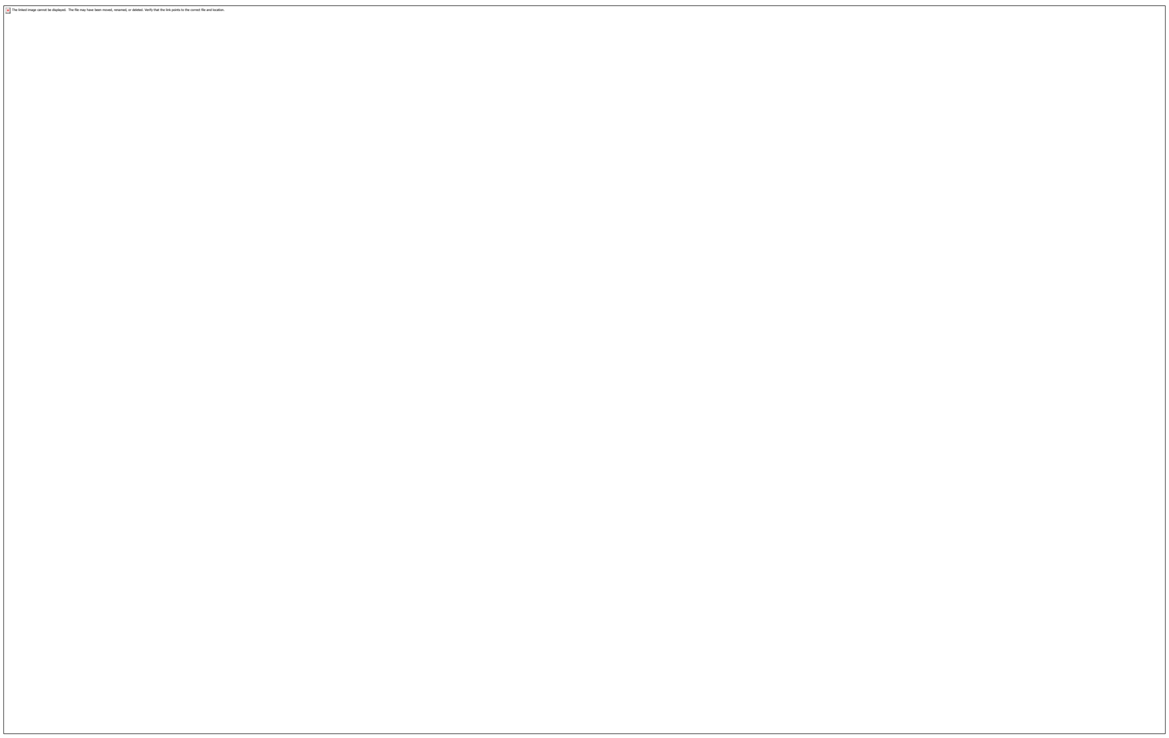

Figure 1. Source of Program Awareness for HEHC Participants in the Carolinas (n=160)
Percentages total to more than 100% because participants could name multiple sources of awareness.

Among the eight respondents (5.0% of 160) who mentioned advertising as the source of their awareness, most recalled seeing an advertisement in a newspaper. The specific sources of advertising are listed below.

- *Charlotte Observer* newspaper (n=2)
- *The Herald* newspaper (n=1)
- *The News and Observer* newspaper (n=1)
- Unspecified local newspaper (n=2)
- TV (n=1)
- TV or newspaper (n=1)

Table 6 indicates that nearly a third of participants (30.6% or 49 out of 160) were already considering a home energy audit before becoming aware of the Home Energy House Call program. However, fewer than one in twenty (4.4% or 7 out of 160) said they would have purchased an audit within the next year in the absence of the program. The overwhelming majority (88.1% or 141 out of 160) say they would not have purchased an audit in the absence of the program.

Table 6. Home Energy Audit Intentions (n=160)

	Carolinas (n)	Carolinas (%)
Before you heard about Home Energy House Call, had you already been considering getting a home energy audit?		
Yes	49	30.6%
No	106	66.3%
Don't know / not specified	5	3.1%
If Duke Energy's Home Energy House Call had not been available, would you still have purchased an audit from another company?		
Yes, within the next year	7	4.4%
Yes, not within the next year (or not sure when)	4	2.5%
No	141	88.1%
Don't know / not specified	8	5.0%

The seven participants who said they would have purchased an audit if there had been no Home Energy House Call from Duke Energy were asked how much they would have been willing to spend on an audit. Their responses are listed below.

- $100 to $200
- $175
- $75
- "*$50 at the very most*"
- $39
- $25
- Don't know / not specified

Motivating Factors

Participants were asked to list all of the factors that motivated them to participate in the program in the order of their importance. The primary factor was a desire to reduce energy costs with 124 participants (77.5% of 160) indicating it as a factor and 86 (53.8% of 160) indicating it was the most important factor motivating them to participate in the program. Receiving an energy audit was the second-most cited motivating factor. Forty-two participants (26.3% of 160) indicated the audit itself as a factor and 13 (8.1% of 160) said it was the most important factor motivating participation. Other motivating factors cited included the technical assistance (20.0% or 32 out of 160), the energy efficiency kit (18.8% or 30 out of 160), the information provided by the program (13.1% or 21 out of 160) and saving energy and helping the environment (11.3% or 18 out of 160).

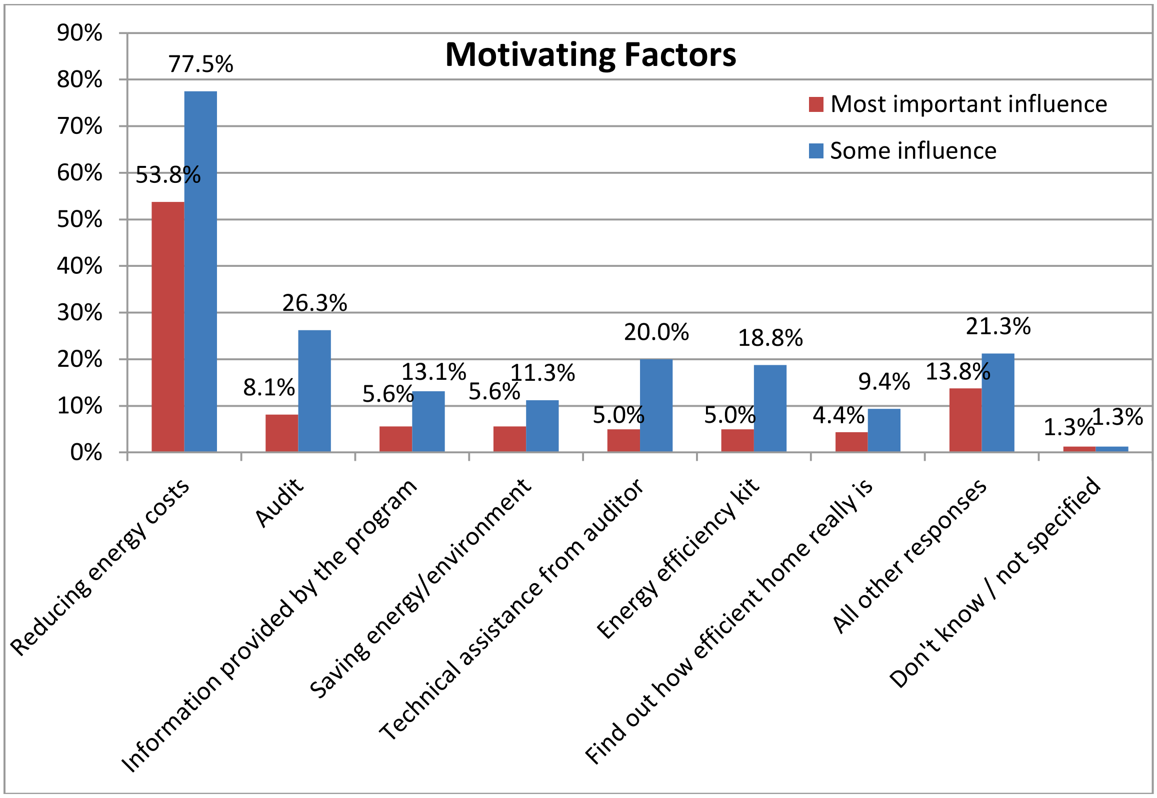

Figure 2. Motivating Factors for HEHC Participants in the Carolinas (n=160)
Percentages total to more than 100% because participants could name multiple factors.

Thirty-four (21.3% of 160) respondents gave "other" reasons for participating in the HEHC program, which are presented below.

- Recommendation of friends / family / neighbors (n=7)
- Just upgraded and want to have new system checked out (n=6)
- To improve / upgrade / maintain home (n=5)
- To fix comfort issues (n=5)
- To learn about energy efficiency and products (n=5)
- The program was free (n=4)
- Previous experience with other Duke Energy programs (n=3)
- The program incentives (n=2)
- Previous experience with this program (n=1)
- Recommendation of someone else (n=1)

The list above totals to more than 34 responses because participants could name multiple factors that influenced them.

Participant Satisfaction

Participants were asked for their levels of satisfaction on a 1 to 10 scale (with one being the lowest and ten being the highest) for the kit measures as well as aspects of the program. The survey can be found in Appendix B: Participant Survey Instrument and the results of the satisfaction questions are presented below.

Measure Satisfaction

The surveyed participants were satisfied with the measures provided by the Home Energy House Call kit. Table 7 below shows the respondents' mean satisfaction scores with various measures.

The outlet and switch gaskets had the highest ratings at 9.31 and 9.39, respectively. The lowest satisfaction (8.53, still a high score) was with the 13-watt CFL.

Table 7. Mean Satisfaction with Kit Measures (n=160)

Measure	Average Rating	Valid N (not including don't know)	Percentage of ratings at or below 7
13-watt CFL	8.53	150	20.0%
20-watt CFL	8.76	140	17.9%
Low-flow showerhead	9.03	70	17.1%
Bathroom aerator	8.78	45	17.8%
Kitchen aerator	9.12	69	11.6%
Outlet gasket	9.31	61	9.8%
Switch gasket	9.39	51	7.8%

Program Satisfaction

The surveyed participants are very satisfied with the Home Energy House Call program. Table 8 below shows the respondents' mean satisfaction scores with various aspects of the program.

Table 8. Mean Satisfaction with Program Components (n=160)

Metric	Average Rating	Valid N (not including don't know)	Percentage of ratings at or below 7
Audit report was trustworthy	9.70	152	0.7%
Audit report looked professional	9.67	145	3.4%
Web Site usability	9.62	47	0.0%
Knowledge and helpfulness of auditor	9.58	159	2.5%
Scheduling audit	9.56	154	3.2%
Interactions with Duke Staff	9.55	138	1.4%
Interactions with auditor	9.54	157	2.5%
Energy efficiency kit quality	9.45	155	7.1%
Audit report easy to understand	9.35	147	5.4%
Likelihood of using recommendations	9.05	149	10.7%
New ideas from	8.19	147	24.5%

recommendations			
Overall Satisfaction	9.27	160	5.6%

Overall program satisfaction is very high with a mean of 9.27 on a 10-point scale. Surveyed participants also rated their satisfaction with the auditors who came to their homes and performed the audit: on a 1 to 10 scale, the auditors' helpfulness and knowledge were rated at 9.58. The audit report itself also received high marks: the average rating for the trustworthiness of the report was 9.70, while in terms of professional appearance the average rating was 9.67, and the mean rating for the ease of reading and understanding the audit report was 9.35. The lowest mean satisfaction rating (8.19) was with the audit report providing new ideas for improving efficiency.

For overall program satisfaction ratings of "7" or below, participants were asked what could be done to improve the program. The verbatim responses of the nine respondents (5.6% of 160) who gave ratings of 7 or less are listed below.

Respondents rating the program a "7" out of 10:

- "*The auditor was unprofessional*."
- "*The program could include thermal testing and air tightness testing*."

Respondents rating the program a "6" out of 10:

- "*I am moderately happy with the results. It was genuinely useful in indirectly finding where energy was being over-used*."
- "*I can't think of anything that needs improvement*."
- "*The auditor made outlandish recommendations that I change my storm windows and heat pump. That's just too much money to be spending*."

Respondents rating the program a "5" out of 10:

- "*Duke could offer financial incentives for home-energy improvements*."

Respondents rating the program a "4" out of 10:

- "*I don't feel confident that they did good job on the audit*."

Respondents rating the program a "3" out of 10:

- "*The auditor didn't leave switch/outlet gaskets or weather-stripping, which I need. I'm also confused about what needs to be done*."

Respondents rating the program a "1" out of 10:

- "*The auditor could spend more time performing the actual audit. I was surprised to learn of any recommendations the auditor made as he never did a walk through, and I did not receive a report afterwards*."

For specific program areas where satisfaction ratings of "7" or below were given, participants were asked what could be done to improve that area of the program. The verbatim responses for these areas can be found in Appendix H: Verbatim comments about improving aspects of the program.

Predicting Overall Program Satisfaction from Satisfaction with Ten Aspects of the Program

Simple linear regressions were performed to predict overall participant satisfaction with the program using ratings of satisfaction for ten different aspects of the program[4]. Two models were used: a stepwise model that selects predictors based on incremental improvements to the model (producing the most efficient model that predicts the most variance using the fewest predictors), and a "complete" model that uses all ten predictors simultaneously (which represents the maximum variance that can be explained using this set of predictors).

The two regression models produce highly consistent results, as both indicate the aspects of the program that have the most influence on overall program satisfaction are being satisfied with "audit report being easy to understand", "interactions with the auditor" and "likelihood of using the audit recommendations". "Knowledge and helpfulness of the auditor" also has a significant, though smaller, impact. The two models also produce very similar levels of variance explained, indicating that the non-significant predictors included in the complete model have little additional effect.

The stepwise algorithm is iterative, adding or subtracting predictors from the model based on predetermined criteria. For the model presented in Table 9, predictors are added to the model as long as their coefficients when added to the model are significant at the $p<.10$ level, and removed from the model if the significance of their coefficients falls below $p<.20$ (due to multicolinearity with other predictors added to the model on subsequent steps). The algorithm will take as many steps as necessary until all predictors that meet the criteria have been added to (or subtracted from) the model. For this model, the algorithm added four predictors (and removed none) in order to arrive at the final regression equation in four steps.

Table 9. Stepwise Regression to Predict Overall Program Satisfaction (n=114[5])

Predictor	Beta coefficient	Significance
Audit report easy to understand	.273	P<.01
Interactions with auditor	.249	P<.01
Likelihood of using recommendations	.236	P<.01
Knowledge and helpfulness of auditor	.195	P<.10

The four-predictor regression model produced using the stepwise method predicts 49.9% (R-squared) of the variance in overall program satisfaction, and is significant at the $p<.01$ level (using ANOVA). Beta coefficients are standardized values and indicate the relative importance of the predictors in the model (absolute value of 1.0 would indicate that the predictor determines

[4] Satisfaction with "website usability" was withheld from this analysis, since most participants did not visit the website and thus did not provide ratings for this aspect of the program (as seen in Table 8.)

[5] Though there are 160 participants in this survey, the number of valid cases used for regression models is 114 due to "listwise" deletion of missing data. In order to be included in the model, a participant had to have valid answers to all eleven questions used in the model (the ten predictors and the dependent variable being predicted).

the predicted variable perfectly, and zero indicates no effect at all. Negative coefficients would represent negative influence, though for this model all coefficients are positive).

For the "complete" model, all ten predictors are used simultaneously to predict overall program satisfaction. Since there are no criteria used to determine which predictors are included in the model, most of the predictors do not reach the level of statistical significance. However the complete model does show the maximum amount of variance in overall satisfaction that can be predicted from this set of predictors.

Table 10. "Complete" Regression to Predict Overall Program Satisfaction (n=114)

Predictor	Beta coefficient	Significance
Likelihood of using recommendations	.269	P<.01
Audit report easy to understand	.266	P<.05
Interactions with auditor	.235	P<.01
Knowledge and helpfulness of auditor	.219	P<.10
Audit report was trustworthy	.138	-
Scheduling audit	.030	-
New ideas from recommendations	.010	-
Audit report looked professional	-.026	-
Interactions with Duke Staff	-.094	-
Energy efficiency kit quality	-.119	-

The "complete" ten-predictor regression model produced using the stepwise method predicts 52.3% (R-squared) of the variance in overall program satisfaction, and is significant at the p<.01 level (using ANOVA). Beta coefficients are standardized values and indicate the relative importance of the predictors in the model (absolute value of 1.0 would indicate that the predictor determines the predicted variable perfectly, and zero indicates no effect at all. Negative coefficients represent negative influence, although for this model none of the negative coefficients are significantly different from zero at the p<.10 level).

Satisfaction with Duke Energy

Satisfaction with Duke Energy was generally high among these program participants, with a mean rating of 8.85 on a 10-point scale where "10" means "very satisfied." The full distribution of responses is shown in Figure 3.

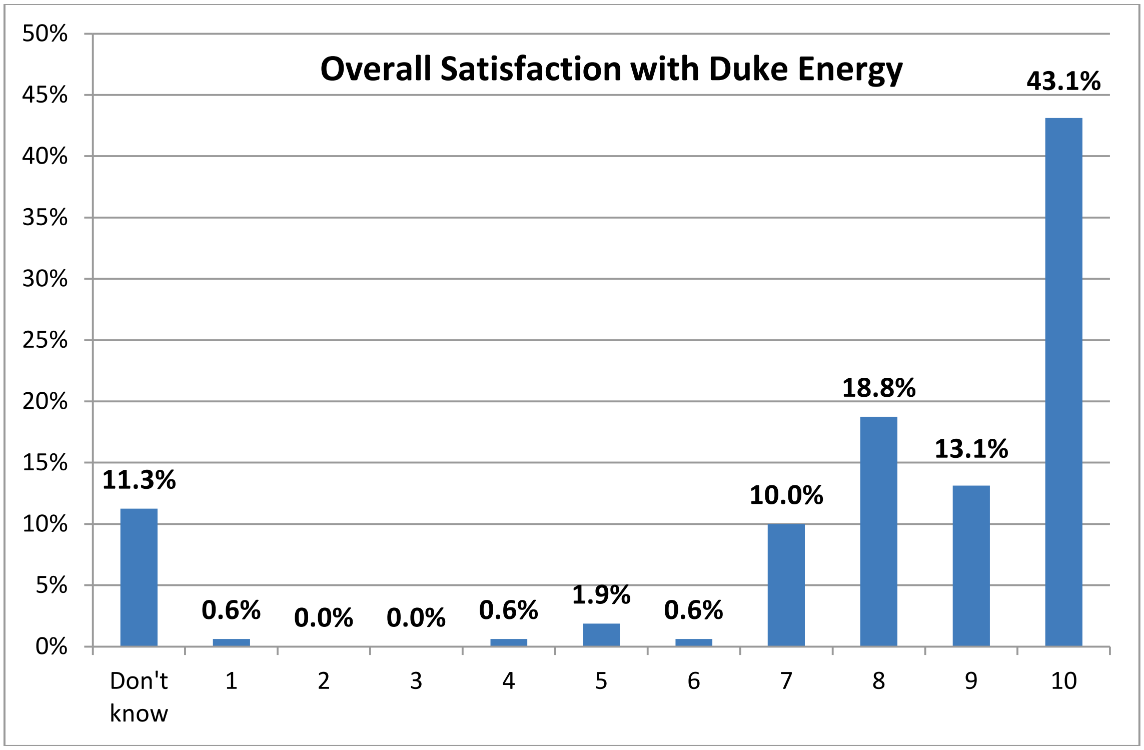

Figure 3. Program Participants' Overall Satisfaction with Duke Energy (n=160)

Twenty-two participants (13.8% of 160) who rated their satisfaction with Duke Energy at "7" or less on a 10-point scale were asked how the situation could be improved. The most common responses to this question had to do with energy rates being too high, as seen in the list below.

Respondents who rated Duke Energy a "7" out of 10:

- Rates are too high / too many rate increases (n=8)
- Encourage use of wind or solar power (n=2)
- Offer discounted rates for seniors (n=1)
- Don't know (n=1)
-

Four participants what rated Duke Energy a "7" out of 10 gave unique responses:

- "*I would like Duke to offer peak energy reduction incentives*."
- "*I would have appreciated knowing about the incentives offered for purchasing a new heat pump*."
- "*I'd like to pay my bills online without automatic draft or paying a fee. Also, more trees should be trimmed in a way that isn't ugly*."
- "*They need to train the auditors better*."

One respondent who rated Duke Energy a "6" out of 10 gave a unique response:

- "*In Ohio they offer full house surge protectors for free, which is a service I pay for*."

Respondents who rated Duke Energy a "5" out of 10:

- Rates are too high / too many rate increases (n=2)
- Offer discounted rates for seniors (n=1)

Respondents who rated Duke Energy a "4" out of 10:

- Rates are too high / too many rate increases (n=1)

One respondent who rated Duke Energy a "1" out of 10 gave a unique response:

- *"The customer service is condescending when I have called in the past. In particular I had called about my July 2011 bill. For the 24 days out of that billing cycle our AC was broken so we didn't have it running and the bill was only $23 less than it was the month before when we had the AC running every day. As I am an electrician ('journeyman') I know a bit more than the average customer so I didn't appreciate being talked down to by customer service the times I called to find out why my bill was still so high. Our home has Energy Star ratings on everything and we use CFLs. One person in customer service said that we could get our meter changed to the digital meters and then when I called back to have it done another person told me that it could be done only if something happened to our meter, which I think is not accurate. I find it hard to believe that someone can accurately read our meter from 3 miles away like someone in customer service told me. I'd believe that they can read the meter from almost any distance if they're in the line of sight of the meter but I never see anyone out here."*

Installing Items from the Energy Efficiency Kit

Participants were asked about their usage of items provided in the energy efficiency kit. Overall installation rates are shown in Table 11.

The overwhelming majority of participants installed at least one of the 13-watt (94.4% or 151 out of 160) and the 20-watt (89.4% or 143 out of 160) CFLs. None of the other items were installed by a majority of respondents, though installation rates for low-flow showerheads (44.4%), kitchen faucet aerators (43.1%), weather stripping (41.3%) and outlet gasket insulators (40.0%) were closest to 50%. Participants were least likely to have installed bathroom faucet aerators (28.1%) and switch gasket insulators (32.5%).

Table 11. Installation of Energy Efficiency Kit Items (n=160)

	Carolinas (n)	Carolinas (%)
Installed 13-watt CFL	151	94.4%
Installed 20-watt CFL	143	89.4%
Installed low-flow showerhead	71	44.4%
Installed kitchen faucet aerator	69	43.1%
Installed bathroom faucet aerator	45	28.1%
Installed outlet gasket insulators	64	40.0%
Installed switch gasket insulators	52	32.5%
Installed weather stripping	66	41.3%

Installing CFLs from the Energy Efficiency Kit

Four out of five participants surveyed in the Carolinas (79.4% or 127 out of 160) said they received two CFLs during the course of their Home Energy House Call, while 30 participants (18.8% of 160) received more than two CFL bulbs (up to a self-reported maximum of 20 CFLs)[6].

Most of the CFLs were installed by the participants themselves (71.9% or 115 out of 160 for 13-watt CFLS, 68.1% or 109 out of 160 for 20-watt CFLs). However, nearly one quarter of participants had the auditor install the CFLs (22.5% or 36 out of 160 for 13-watt CFLs, and 21.3% or 34 out of 160 for 20-watt CFLs).

Table 12. Installation of Kit Items: CFLs (n=160)

	Carolinas (n)	Carolinas (%)
How many CFLs did you receive with the kit?		
Two CFLs	127	79.4%
Three to nine CFLs	16	10.0%
Ten or more CFLs	14	8.8%
Don't know / not specified	3	1.9%
Did you install the 13-watt CFLs from the kit?		
Yes, I did	115	71.9%
Yes, auditor did	36	22.5%
No, but I plan to	7	4.4%
No, don't plan to or not sure	2	1.3%
Did you install the 20-watt CFLs from the kit?		
Yes, I did	109	68.1%
Yes, auditor did	34	21.3%
No, but I plan to	11	6.9%
No, don't plan to or not sure	6	3.8%

Participants who did not intend to use the CFLs were asked why not. Only two respondents (1.3% of 160) said they did not intend to install the 13-watt CFLs, and their reasons are listed below.

- "*I received 20-watt CFLs only.*" (This respondent said they received two CFLs with their kit.)
- Not specified

Six respondents (3.8% of 160) said they did not intend to install the 20-watt CFL, and their reasons are listed below.

- "*I didn't receive these. I got two 13-watt CFLs.*"
- "*I haven't needed it yet.*" (This respondent said they received 8 CFLs in total.)
- Not specified (4 respondents)

[6] Although the standard kit provided participants with two 13-watt CFLs and one 20-watt CFL, the survey question was worded "did you receive two CFLs?" per the information that was provided at the time of the survey. The error in the number of CFLs that were in the kit was due to a communication error and was not discovered after the surveys were completed.

Table 13 shows the wattage and hours of use of bulbs that were replaced with kit-provided CFLs. Participants who installed 13-watt CFLs[7] typically replaced a bulb of between 45 to 70 watts (58.9% or 89 out of 151) that was used between 3 to 10 hours per day (73.5% or 111 out of 151). Participants who installed the 20-watt bulb typically replaced a bulb of between 71 and 99 watts (44.1% or 63 out of 143) that was used between 3 to 10 hours per day (67.8% or 97 out of 143).

Table 13. Installation of Kit Items: CFL Wattage and Hours of Use (n=151 for 13-watt CFLs, n=143 for 20-watt CFLs)

	Carolinas (n)	Carolinas (% of those installing CFL)
How many watts was the bulb replaced by the 13-watt CFL?		
44 watts or less	21	13.9%
45 to 70 watts	89	58.9%
71 to 99 watts	13	8.6%
100 watts or more	11	7.3%
Don't know / not specified	17	11.3%
How many hours per day is the light with the 13-watt bulb used?		
Less than 1	3	2.0%
1 to 2	19	12.6%
3 to 4	68	45.0%
5 to 10	43	28.5%
11 to 12	4	2.6%
13 to 24	7	4.6%
Don't know / not specified	7	4.6%
How many watts was the bulb replaced by the 20-watt CFL?		
44 watts or less	10	7.0%
45 to 70 watts	37	25.9%
71 to 99 watts	63	44.1%
100 watts or more	20	14.0%
Don't know / not specified	13	9.1%
How many hours per day is the light with the 20-watt bulb used?		
Less than 1	6	4.2%
1 to 2	27	18.9%
3 to 4	46	32.2%
5 to 10	51	35.7%
11 to 12	1	0.7%
13 to 24	3	2.1%
Don't know / not specified	9	6.3%

Nearly one-quarter of participants who installed kit-provided CFLs (23.7% or 36 out of 152) have since uninstalled at least one bulb, as seen in Table 14. Three respondents who received more than two bulbs with their kits uninstalled more than two kit-provided bulbs; one participant

[7] Although participants received (at least) two 13-watt CFLs, the survey only asked them follow-up questions about one 13-watt CFL installation. The error in the number of CFLs that were in the kit was due to a communication error and was not discovered after the surveys were completed.

who received 12 CFLs uninstalled 7 of them, and two participants who received 15 apiece removed 8 and 10 of their kit-provided CFLs.

Table 14. Installation of Kit Items: Uninstalling CFLs (n=152 who installed either CFL)

	Carolinas (n)	Carolinas (%)
Did you remove either of the CFLs provided through this program?		
Yes, removed one CFL	20	13.2%
Yes, removed two CFLs	13	8.6%
Yes, removed three or more CFLs	3	2.0%
No	110	72.4%
Don’t know	6	3.9%

The 36 participants who removed kit-provided CFLs were asked why they did so. Their responses are characterized below; in most cases bulbs were uninstalled because they burned out.

- Bulb burned out (n=30)
- Bulb broke (n=3)
- Did not work properly (n=2)
- Not bright enough (n=1)
- Do not like the quality of the light (n=1)
- Unappealing appearance of the bulb itself (n=1)

The list above totals to more than 36 because participants could give multiple reasons.

Table 15 indicates that nearly two-thirds of participants (63.8% or 102 out of 160) already had some CFLs installed in their homes before receiving the Home Energy House Call and efficiency kit.

Furthermore, 40.0% (64 out of 160) of participants were already intending to buy CFLs before participating in the program, not including the 4.4% (7 out of 160) who say they already have CFLs installed in every outlet. There were another 18.8% (30 out of 160) who said they “maybe” were going to buy CFLs before participating in the program, plus 3.8% (6 out of 160) who “don’t know”.

Sixty-nine participants (43.1% of 160) have purchased additional CFLs since participating in the program. These participants purchased at least 513 additional bulbs, an average of 7.4 CFLs per household that purchased additional CFL bulbs.

Table 15. Preinstalled CFLs and Intent to Purchase Additional CFLs (n=160)

	Carolinas (n)	Carolinas (%)
Did you have any CFLs installed before you received the kit?		
No	55	34.4%
Yes, from 1 to 5	59	36.9%
Yes, from 6 to 11	20	12.5%
Yes, 12 or more	23	14.4%
Don't know / not specified	3	1.9%
Were you planning on buying CFLs for your home before receiving the kit?		
No	53	33.1%
No, already installed in all available outlets	7	4.4%
Maybe	30	18.8%
Yes, in less than 6 months	23	14.4%
Yes, 6 months to one year from now	25	15.6%
Yes, more than one year from now	2	1.3%
Yes, as they burn out or budget permits	9	5.6%
Yes, I already purchase CFLs	3	1.9%
Yes, when specialty bulbs become available	2	1.3%
Don't know / not specified	6	3.8%
Have you purchased any CFLs since receiving the Home Energy House Call kit?		
No	89	55.6%
Yes, from 1 to 5	32	20.0%
Yes, from 6 to 11	22	13.8%
Yes, 12 or more	15	9.4%
Don't know / not specified	2	1.3%

Installing the Low-Flow Showerhead from the Energy Efficiency Kit

Table 16 indicates that 71 participants (44.4% of 160) installed the low-flow showerhead, and another 23 (14.4% of 160) still intend to. Typically, participants take 5-10 showers per week (46.5% or 33 out of 71 who installed the showerhead) and about half used the Teflon tape (53.5% or 38 out of 71).

Table 16. Installation of Kit Items: Low-Flow Showerhead

	Carolinas (n)	Carolinas (%)
Did you install the low-flow showerhead from the kit?		
Yes, I did	53	33.1%
Yes, auditor did	18	11.3%
No, but I plan to	23	14.4%
No, don't plan to	55	34.4%
Don't know / not sure	11	6.9%
How many showers per week are taken using this showerhead		**Percent of Those Using the Item**
0 to 4	11	15.5%
5 to 10	33	46.5%
11 to 15	18	25.4%
16 to 20	4	5.6%
21 or more	5	7.0%
Don't know	-	0%
Flow of water after replacing showerhead		
Less than the old unit	35	49.3%
About the same as the old unit	31	43.7%
More than the old unit	5	7.0%
Don't know / not specified	-	0%
Used the Teflon tape		
Yes	38	53.5%
No	6	8.5%
Don't know / not specified	27	38.0%

None of the respondents who installed their own showerheads indicated that the installation was difficult.

The 55 participants who did not intend to install the low-flow showerhead were asked why not; their responses are characterized below. In most of these cases, the participant either already had a low-flow showerhead installed or else claimed they didn't receive one with their kit.

- Did not receive / do not recall receiving / auditor kept item (n=16)
- Already have low-flow showerhead installed (n=16)
- Prefer current showerhead / customized fixtures (n=13)
- Not enough water pressure (n=7)
- Does not fit / have in-line filter so can't use (n=3)
- Tried it but it leaked (n=1)
- Seems difficult to install (n=2)

The list above totals to more than 55 because participants could give multiple reasons.

Nearly one-third of participants (30.6% or 49 out of 160) already had a low-flow showerhead installed, as seen in Table 17. Prior to the program, only 14 respondents (8.8% of 160) had intended to purchase a low-flow showerhead, and another 14 respondents (8.8% of 160) said they "maybe" would have installed a new showerhead before participating in the program, while 116 (72.5% of 160) did not intend to purchase one and 14 (8.8% of 160) already have low-flow showerheads installed in all showers. Fifteen respondents (9.4% of 160) have purchased additional showerheads since participating in the program.

Table 17. Preinstalled Showerheads and Intent to Purchase Additional Showerheads (n=160)

	Carolinas (n)	Carolinas (%)
Previously installed showerheads		
Already had low-flow showerhead(s) installed	49	30.6%
Did not already have low-flow showerhead(s) installed	94	58.8%
Don't know / not specified	17	10.6%
Were you planning on purchasing a low-flow showerhead before receiving the kit?		
No	116	72.5%
No, already installed in all available showers	14	8.8%
Maybe	14	8.8%
Yes	14	8.8%
Don't know / not specified	2	1.3%
Additional showerheads purchased since program		
Have not purchased additional showerhead(s)	131	81.9%
Purchased one additional showerhead	12	7.5%
Purchased two or more additional showerheads	3	1.9%
Already have in all available showers	14	8.8%

Installing Faucet Aerators from the Energy Efficiency Kit

Table 18 shows that 39 participants (24.4% of 160) installed the kitchen faucet aerator provided with the kit themselves, another 30 (18.8% of 160) had the auditor install it for them, and 19 more (11.9% of 160) still intend to install it but have not done so yet. At least 29.0% (20 out of 69 households that installed the aerator) of these installations replaced an older aerator with a new one, but in most cases (at least 56.5% or 39 out of 69) the kit-provided aerator did not replace a previously installed aerator (another 10 respondents, or 14.5% of 69, were not sure). Nearly half of those who installed the kitchen aerator (44.9% or 31 out of 69) said that it decreased the water flow from their faucet, while only 5.8% (4 out of 69) said the flow increased.

Table 18. Installation of Kit Items: Kitchen Aerators (n=160)

	Carolinas (n)	Carolinas (%)
Did you install the kitchen faucet aerator from the kit?		
Yes, I did	39	24.4%
Yes, auditor did	30	18.8%
No, but I plan to	19	11.9%
No, don't plan to	55	34.4%
Don't know / not sure	17	10.6%
Was there a kitchen aerator already installed that you had to remove?		**Percent of Those Using the Item**
Yes	20	29.0%
No	39	56.5%
Don't know / not specified	10	14.5%
Flow of water after replacing kitchen aerator		
Less than the old unit	31	44.9%
About the same as the old unit	34	49.3%
More than the old unit	4	5.8%

None of the respondents who installed their own kitchen aerators indicated that the installation was difficult.

The 55 participants who did not intend to install the kitchen aerator were asked why not; their responses are characterized below. In most of these cases, the participant either already had aerators installed, the aerator wouldn't fit or else they claimed they didn't receive one with their kit.

- Did not receive / do not recall receiving / auditor kept item (n=19)
- Does not fit on faucet (n=12)
- Already have aerators installed (n=10)
- Prefer current faucet / custom fixture / can't use due to hose or filter (n=6)
- Not enough water pressure (n=2)
- Don't like aerator attachment because it is too big (n=1)
- Tried to install but it didn't work properly (n=1)
- Renter so don't pay water bill (n=1)
- Installed kitchen aerator in bathroom (n=1)
- Don't know / not specified (n=3)

The list above totals to more than 55 because participants could give multiple reasons.

Table 19 shows that 27 participants (16.9% of 160) installed the bathroom faucet aerator provided with the kit themselves, another 18 (11.3% of 160) had the auditor install it for them, and 21 more (13.1% of 160) still intend to install it but have not done so yet. At least 33.3% (15 out of 45 households that installed the aerator) of these installations replaced an older aerator with a new one, but in most cases (at least 55.6% or 25 out of 45) the kit-provided aerator did not replace a previously installed aerator (five respondents, or 11.1% of 45, were not sure). Nearly half of those who installed the bathroom aerator (48.9% or 22 out of 45) said that it decreased the water flow from their faucet, while only 6.7% (3 out of 45) said the flow increased.

Table 19. Installation of Kit Items: Bathroom Aerators (n=160)

	Carolinas (n)	Carolinas (%)
Did you install the bathroom faucet aerator from the kit?		
Yes, I did	27	16.9%
Yes, auditor did	18	11.3%
No, but I plan to	21	13.1%
No, don't plan to	66	41.3%
Don't know / not specified	28	17.5%
Was there a bathroom aerator already installed that you had to remove?		**Percent of Those Using the Item**
Yes	15	33.3%
No	25	55.6%
Don't know / not specified	5	11.1%
Flow of water after replacing bathroom aerator		
Less than the old unit	22	48.9%
About the same as the old unit	20	44.4%
More than the old unit	3	6.7%

None of the respondents who installed their own bathroom aerators indicated that the installation was difficult.

The 66 participants who did not intend to install the bathroom aerator were asked why not; their responses are characterized below. In most of these cases, the participant either claimed they didn't receive one with their kit, or else already had aerators installed.

- Did not receive / do not recall receiving / auditor kept item (n=34)
- Already have aerators installed (n=9)
- Prefer current faucet / custom fixture (n=6)
- Not sure what it does / how to install it (n=5)
- Does not fit on faucet (n=4)
- Not enough water pressure (n=3)
- Renter so don't pay water bill (n=1)
- Don't know / not specified (n=4)

Table 20 shows information about participants' previously installed aerators and intentions to purchase additional aerators. Forty-seven respondents (29.4% of 160) said they already had aerators installed before participating in the program. One hundred and eighteen respondents (73.8% of 160) said they had not intended to purchase any aerators before participating in the program, not including another 16 (10.0% of 160) who said they already have aerators installed on all available faucets. Ten respondents (6.3% of 160) have purchased additional aerators since participating in the program.

Table 20. Preinstalled Aerators and Intent to Purchase Additional Aerators (n=160)

	Carolinas (n)	Carolinas (%)
Previously installed aerators (kitchen & bathroom combined)		
Already had faucet aerator(s) installed	47	29.4%
Did not already have faucet aerator(s) installed	96	60.0%
Don't know / not specified	17	10.6%
Were you planning on purchasing any faucet aerators before receiving the kit? (kitchen & bathroom combined)		
No	118	73.8%
No, already installed on all available faucets	16	10.0%
Maybe	5	3.1%
Yes	14	8.8%
Don't know / not specified	7	4.4%
Additional faucet aerators purchased since program (kitchen & bathroom combined)		
Have not purchased additional faucet aerators	126	78.8%
Purchased additional faucet aerators	10	6.3%
Already have in all available faucets	16	10.0%
Don't know / not specified	8	5.0%

Installing Gasket Insulators from the Energy Efficiency Kit

Table 21 and Table 22 show installation rates for outlet and switch gasket insulators. Roughly half of respondents have installed, or intend to install, both outlet (55.6% or 89 out of 160) and switch gaskets (48.1% or 77 out of 160).

Among those who installed kit-provided gaskets, the majority were installed on exterior walls (an average of 3.3 outlet and 2.7 switch gaskets per household), though a significant number were installed on interior walls (an average of 2.2 outlet gaskets and 1.7 switch gaskets[8]) where they provide no energy efficiency benefits.

[8] Self-reported mean number of gaskets installed exceeds the number of gaskets provided in the kit.

Table 21. Installation of Kit Items: Outlet Gasket Insulators (n=160)

	Carolinas (n)	Carolinas (%)
Did you install the outlet gasket insulators from the kit?		
Yes, I did	56	35.0%
Yes, auditor did	8	5.0%
No, but I plan to	25	15.6%
No, don't plan to or not sure	71	44.4%
How many did you install on interior walls?		**Percent of Those Using the Item**
None	21	32.8%
1 to 2	14	21.9%
3 to 5	13	20.3%
6 to 8	3	4.7%
9 to 12	2	3.1%
Don't know / not specified	11	17.2%
Average number of outlet gaskets installed on interior walls: 2.2		
How many did you install on exterior walls?		**Percent of Those Using the Item**
None	12	18.8%
1 to 2	17	26.6%
3 to 5	15	23.4%
6 to 8	7	10.9%
9 to 12	5	7.8%
Don't know / not specified	8	12.5%
Average number of outlet gaskets installed on exterior walls: 3.3		

Table 22. Installation of Kit Items: Switch Gasket Insulators (n=160)

	Carolinas (n)	Carolinas (%)
Did you install the switch gasket insulators from the kit?		
Yes, I did	47	29.4%
Yes, auditor did	5	3.1%
No, but I plan to	25	15.6%
No, don't plan to or not sure	83	51.9%
How many did you install on interior walls?		**Percent of Those Using the Item**
None	13	25.0%
1 to 2	20	38.5%
3 to 5	6	11.5%
6 to 8	2	3.8%
9 to 12	-	0%
Don't know / not specified	11	21.2%
Average number of switch gaskets installed on interior walls: 1.7		
How many did you install on exterior walls?		**Percent of Those Using the Item**
None	6	11.5%
1 to 2	18	34.6%
3 to 5	12	23.1%
6 to 8	3	5.8%
9 to 12	1	1.9%
Don't know / not specified	12	23.1%
Average number of switch gaskets installed on exterior walls: 2.7		

The next two tables, Table 23 and Table 24, show that few respondents had outlet gaskets installed prior to participating in the HEHC program: 20.0% (32 out of 160) had preinstalled outlet gasket insulators and 14.4% (23 out of 160) had switch gaskets previously installed.

More than four out of five participants were not intending to install outlet (83.8% or 134 out of 160) or switch (85.0% or 136 out of 160) gasket insulators prior to the program, and similar percentages have not purchased any outlet (83.8% or 134 out of 160) or switch (85.6% or 137 out of 160) gasket insulators since participating in the program.

The 12 participants (7.5% of 160) who purchased additional outlet gaskets purchased an average of 9.0 outlet gaskets per household. The 9 respondents (5.6% of 160) who purchased additional switch gaskets purchased an average of 6.4 switch gaskets per household.

Table 23. Preinstalled Outlet Gaskets and Intent to Purchase Additional Gaskets (n=160)

	Carolinas (n)	Carolinas (%)
Previously installed outlet gasket insulators		
Already had outlet gaskets installed	32	20.0%
Did not already have outlet gaskets installed	107	66.9%
Don't know / not specified	21	13.1%
Were you planning on purchasing any outlet gaskets before receiving the kit?		
No	134	83.8%
No, already installed in all available outlets	11	6.9%
Maybe	5	3.1%
Yes	5	3.1%
Don't know / not specified	5	3.1%
Additional outlet gaskets purchased since program		
Have not purchased additional outlet gaskets	134	83.8%
Purchased less than 12 additional outlet gaskets	7	4.4%
Purchased 12 or more additional outlet gaskets	4	2.5%
Purchased additional outlet gaskets, not sure how many	1	0.6%
Already have in all available outlets	11	6.9%
Don't know / not specified	3	1.9%

Table 24. Preinstalled Switch Gaskets and Intent to Purchase Additional Gaskets (n=160)

	Carolinas (n)	Carolinas (%)
Previously installed switch gasket insulators		
Already had switch gaskets installed	23	14.4%
Did not already have switch gaskets installed	112	70.0%
Don't know / not specified	25	15.6%
Were you planning on purchasing any switch gaskets before receiving the kit?		
No	136	85.0%
No, already installed on all available switches	10	6.3%
Maybe	3	1.9%
Yes	5	3.1%
Don't know / not specified	6	3.8%
Additional switch gaskets purchased since program		
Have not purchased additional switch gaskets	137	85.6%
Purchased less than 12 additional switch gaskets	5	3.1%
Purchased 12 or more additional switch gaskets	2	1.3%
Purchased additional switch gaskets, not sure how many	2	1.3%
Already have on all available switches	10	6.3%
Don't know / not specified	4	2.5%

Installing Weather Stripping from the Energy Efficiency Kit

Installation rates for kit-provided weather stripping are shown in Table 25. Sixty-six participants (41.3% of 160) have installed this kit item (or had the auditor install it for them), and another 24 (15.0% of 160) intend to install the weather stripping but have not yet done so. Among those that installed the weather stripping, about half (47.0% or 31 out of 66) used 11 or more feet of stripping.

Table 25. Installation of Kit Items: Weather Stripping (n=160)

	Carolinas (n)	Carolinas (%)
Did you install the weather stripping from the kit?		
Yes, I did	59	36.9%
Yes, auditor did	7	4.4%
No, but I plan to	24	15.0%
No, don't plan to or not sure	70	43.8%
How many feet did you install?		**Percent of Those Using the Item**
1 to 5	5	7.6%
6 to 10	17	25.8%
11 to 17	31	47.0%
Don't know / not specified	13	19.7%

More than half of participants (54.4% or 87 out of 160) already had weather stripping installed before receiving the HEHC energy efficiency kit, as seen in Table 26, including 10.0% (16 out of 160) who already have it installed on every available door. Only 28 respondents (17.5% of 160) had been intending to purchase weather stripping before the program, and 22 respondents (13.8% of 160) have purchased additional weather stripping since participating in the program.

Table 26. Preinstalled Weather Stripping and Intent to Purchase Additional (n=160)

	Carolinas (n)	Carolinas (%)
Previously installed weather stripping		
Already had weather stripping installed	87	54.4%
Did not already have weather stripping installed	66	41.3%
Don't know / not specified	7	4.4%
Were you planning on purchasing any weather stripping before receiving the kit?		
No	87	54.4%
No, already installed on all available doors	16	10.0%
Maybe	1	0.6%
Yes	28	17.5%
Don't know / not specified	28	17.5%
Additional weather stripping purchased since program		
Have not purchased additional weather stripping	107	66.9%
Purchased additional weather stripping for 1 or 2 Doors	12	7.5%
Purchased additional weather stripping for 3 or more doors	6	3.8%
Purchased additional weather stripping "one roll"	2	1.3%
Purchased additional weather stripping, not sure how much	2	1.3%
Already have on all available doors	28	17.5%
Don't know / not specified	3	1.9%

Auditor Installations and Participant Satisfaction

Some kit items were installed by the participants, and some were installed by auditors. Table 27 shows the satisfaction ratings for each item, the program, and Duke Energy overall according to who installed the items. In a few instances, there is a statistically significant relationship between who installed an item and the participant's satisfaction scores: for showerheads and aerators, participants were more satisfied when they installed the items themselves, but for outlet gaskets participants were more satisfied when the auditor did the installation.

There were only two kit items for which there was a statistically significant difference in satisfaction with the item itself. For the low flow showerheads and kitchen faucet aerators, satisfaction with the kit item installed was about one point lower (on a 10-point scale) when the auditor did the installation (significant at $p<.05$ using ANOVA).

There was also a statistically significant difference in satisfaction with Duke Energy for the low flow showerheads and kitchen faucet aerators, as well as bathroom aerators. Satisfaction with Duke Energy overall was also about one point lower when the auditor did the installation of these items (significant at $p<.05$ using ANOVA).

Outlet gasket insulators were the only item for which participants were significantly more satisfied when the auditor did the installation: eight participants who had the auditor install the outlet gaskets gave average ratings of 10.0 (all perfect scores) for their satisfaction with Duke

Energy overall, which is significantly higher than the 8.96 rating given by participants who installed their own outlet gasket insulators (p<.10 using ANOVA).

There were no cases where there were statistically significant differences between participant and auditor installations regarding satisfaction with the Home Energy House Call program as a whole.

Note that a statistically significant relationship does not tell us the direction of causation: it may be that the participants' attitudes towards Duke Energy effect their interactions with the auditor, rather than the auditor's actions effecting participant satisfaction.

Table 27. Satisfaction Ratings by Installer

Mean ratings on 10-point scale	**Installed by participant**	**Installed by auditor**
13-watt CFL	**N=115**	**N=36**
Satisfaction with 13-watt CFL	8.52	8.58
Satisfaction with HEHC program as a whole	9.27	9.36
Satisfaction with Duke Energy overall	8.74	9.24
20-watt CFL	**N=109**	**N=34**
Satisfaction with 20-watt CFL	8.75	8.79
Satisfaction with HEHC program as a whole	9.28	9.35
Satisfaction with Duke Energy overall	8.74	9.16
Low flow showerhead	**N=53**	**N=18**
Satisfaction with low flow showerhead	9.25	8.39
Satisfaction with HEHC program as a whole	9.36	9.22
Satisfaction with Duke Energy overall	9.11	8.06
Kitchen faucet aerator	**N=39**	**N=30**
Satisfaction with kitchen faucet aerator	9.59	8.50
Satisfaction with HEHC program as a whole	9.41	9.33
Satisfaction with Duke Energy overall	9.34	8.46
Bathroom faucet aerator	**N=27**	**N=18**
Satisfaction with bathroom faucet aerator	8.93	8.56
Satisfaction with HEHC program as a whole	9.52	9.17
Satisfaction with Duke Energy overall	9.65	8.40
Outlet gasket insulators	**N=56**	**N=8**
Satisfaction with outlet gasket insulators	9.22	10.0
Satisfaction with HEHC program as a whole	9.46	9.88
Satisfaction with Duke Energy overall	8.96	10.0
Switch gasket insulators	**N=47**	**N=5**
Satisfaction with switch gasket insulators	9.34	10.0
Satisfaction with HEHC program as a whole	9.49	9.80
Satisfaction with Duke Energy overall	8.79	10.0

DOE Energy Savers Booklet

Participants were asked "Did you read the 'DOE Energy Savers' booklet?" Half (50.0% or 80 out of 160) answered yes. Participants who read the booklet were then asked if they shared and discussed the booklet with their family. Twenty-seven participants (33.8% of 80) answered yes.

Participants were also asked to list any improvements made in ten areas based on advice in the booklet, shown in Figure 4. The most commonly taken actions have to do with lighting (mentioned by 31.3% or 25 out of 80 participants who read the booklet). The least commonly mentioned actions had to do with renewable energy (7.5% or 6 out of 80) and home offices (6.3% or 5 out of 80). All of the other actions that were asked about were performed by between 20% and 30% of participants who read the DOE booklet. Among the actions listed, no more than 5.0% (4 out of 80) of respondents were still planning to take steps in any given area though they had not yet done so at the time of the survey.

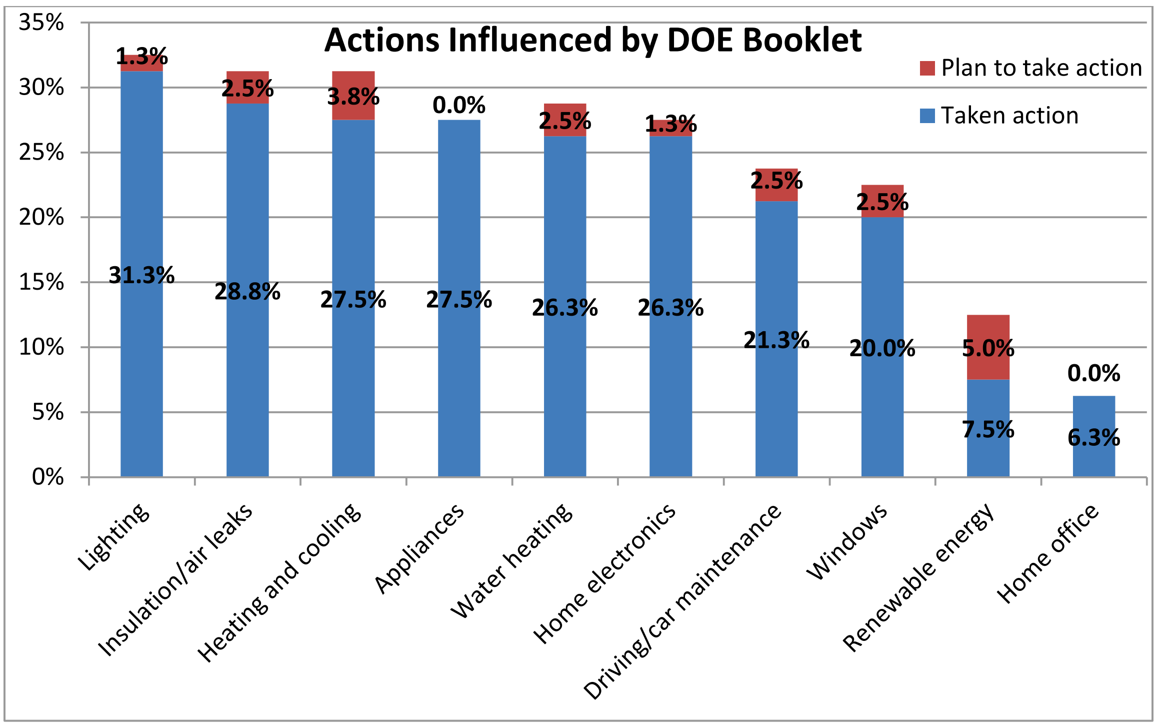

Figure 4. Participants who took energy efficient actions based on the DOE booklet (n=80 respondents who read the booklet)

Participants' verbatim descriptions of the energy efficiency actions they undertook are listed in Appendix I: Verbatim comments: actions inspired by DOE booklet.

Home Energy House Call Audit Report

Table 28 indicates that the vast majority of participants (82.5% or 132 out of 160) recall receiving an audit report as part of their participation in Home Energy House Call.

Table 28. Home Energy House Call Audit Report (n=160)

	Carolinas (n)	Carolinas (%)
Did you recall receiving the audit report?		
Yes	132	82.5%
No	22	13.8%
Don't know / not specified	6	3.8%

Table 29 lists nine areas where participants may have received an audit report recommendation involving building insulation. The most frequently made recommendations were sealing leaky attic access (59.4% or 95 out of 160), sealing leaky doors (45.0% or 72 out of 160), sealing leaky plumbing / electrical / lights / other openings (45.0% or 72 out of 160) and adding attic insulation (36.3% or 58 out of 160).

Corresponding closely to the number of recommendations made, the activities most likely to have been performed were: sealing leaky attic access (done by 45 participants, or 28.1% of 160), sealing leaky doors (done by 37 participants, or 23.1% of 160), sealing leaky plumbing / electrical / lights / other openings (done by 21 participants, or 13.1% of 160), and sealing leaky windows (done by 18 participants, or 11.3% of 160).

The least common recommendations and actions were: insulating basement walls (recommended to 1.9% or 3 out of 160, and not performed by any Carolinas respondents), insulating walls (recommended to 17 or 10.6% out of 160, and performed by two participants or 11.8% of those receiving this recommendation), and insulating floors and perimeters (recommended to 27 or 16.9% out of 160, and performed by three participants or 11.1% of those receiving this recommendation),

For most of these activities, between 20% and 25% of respondents who followed the audit report recommendations had already decided to take these actions before participating in the program. The exceptions are adding attic insulation, where more than half (58.3% or 7 out of 12) had already decided to do this before the program, and sealing leaky fireplaces which 35.7% (5 out of 14) had already decided to do.

Table 29. Home Energy House Call Audit Report: Building Insulation (n=160)

	Carolinas (n)	Carolinas (%)
Audit recommended attic insulation	**58**	**36.3%**
Added insulation to attic (% of recommendations)	12	20.7%
Already decided to insulate attic before audit (% of those who added attic insulation)	7	58.3%
Audit recommended wall insulation	**17**	**10.6%**
Added insulation to walls (% of recommendations)	2	11.8%
Already decided to insulate walls before audit (% of those who added wall insulation)	-	0%
Audit recommended basement wall insulation	**3**	**1.9%**
Added insulation to basement walls (% of recommendations)	-	0%
Already decided to insulate basement walls before audit (% of those who added basement wall insulation)	-	NA
Audit recommended floor or perimeter insulation	**27**	**16.9%**
Added insulation to floors or perimeter (% of recommendations)	3	11.1%
Already decided to insulate floors or perimeter before audit (% of those who added floor or perimeter insulation)	-	0%
Audit recommended sealing leaky windows	**42**	**26.3%**
Sealed leaky windows (% of recommendations)	18	42.9%
Already decided to seal leaky windows before audit (% of those who sealed leaky windows)	4	22.2%
Audit recommended sealing leaky doors	**72**	**45.0%**
Sealed leaky doors (% of recommendations)	37	51.4%
Already decided to seal leaky doors before audit (% of those who sealed leaky doors)	9	24.3%
Audit recommended sealing leaky fireplaces	**29**	**18.1%**
Sealed leaky fireplaces (% of recommendations)	14	48.3%
Already decided to seal leaky fireplaces before audit (% of those who sealed leaky fireplaces)	5	35.7%
Audit recommended sealing leaky attic access	**95**	**59.4%**
Sealed leaky attic access (% of recommendations)	45	47.4%
Already decided to seal leaky attic access before audit (% of those who sealed leaky attic access)	9	20.0%
Audit recommended sealing leaky plumbing / electrical / lights / other openings	**72**	**45.0%**
Sealed leaky plumbing etc. (% of recommendations)	21	29.2%
Already decided to seal leaky plumbing etc. before audit (% of those who sealed leaky plumbing etc.)	5	23.8%
Audit recommended sealing other sources of outside infiltration	**48**	**30.0%**
Sealed other sources of outside infiltration (% of recommendations)	8	16.7%
Already decided to seal other sources of outside infiltration before audit (% of those who sealed other sources of outside infiltration)	2	25.0%

Table 30 lists seven areas where participants may have received an audit report recommendation involving insulating or sealing ductwork.

All of these recommendations were made to fewer than 10% of surveyed participant households, though the most frequent were sealing attic ducts (recommended to 15 participants, or 9.4% of 160, and performed by seven, or 46.7% of those receiving such a recommendation) and making major duct repairs to seal the system (recommended to 13 participants, or 8.1% of 160, and performed by six, or 46.2% of those receiving such a recommendation).

Table 30. Home Energy House Call Audit Report: Duct Insulation (n=160)

	Carolinas (n)	Carolinas (%)
Audit recommended attic duct insulation	**4**	**2.5%**
Added insulation to attic ducts (% of recommendations)	1	25.0%
Already decided to insulate attic ducts before audit (% of those who added attic duct insulation)	-	0%
Audit recommended garage duct insulation	**1**	**0.6%**
Added insulation to garage ducts (% of recommendations)	-	0%
Already decided to insulate garage ducts before audit (% of those who added garage duct insulation)	-	NA
Audit recommended basement or crawlspace duct insulation	**5**	**3.1%**
Added insulation to basement or crawlspace ducts (% of recommendations)	-	0%
Already decided to insulate basement or crawlspace ducts before audit (% of those who added basement or crawlspace duct insulation)	-	NA
Audit recommended sealing attic ducts	**15**	**9.4%**
Sealed attic ducts (% of recommendations)	7	46.7%
Already decided to seal attic ducts before audit (% of those who sealed attic ducts)	1	14.3%
Audit recommended sealing garage ducts	**2**	**1.3%**
Sealed garage ducts (% of recommendations)	-	0%
Already decided to seal garage ducts before audit (% of those who sealed garage ducts)	-	NA
Audit recommended major duct repairs to seal the system	**13**	**8.1%**
Made major duct repairs (% of recommendations)	6	46.2%
Already decided to make major duct repairs before audit (% of those who made major duct repairs)	-	0%
Audit recommended sealing crawlspace or basement	**3**	**1.9%**
Sealed crawlspace or basement (% of recommendations)	-	0%
Already decided to seal crawlspace or basement before audit (% of those who sealed crawlspace or basement)	-	NA

Table 31 lists seven areas where participants may have received an audit report recommendation involving heating or cooling the home.

For many of these recommendations, the percentages of participants who followed the recommendations are higher (up to 75.0%) than for insulation and ductwork, although the percentages who say they were already considering or already had decided to take these actions are also higher (up to 61.9%). A notable exception is recommendations to install or replace a heat pump, which were followed by participants only 8.1% of the time (3 out of 37).

The most frequently performed actions based on recommendations involving heating and cooling were closing vents in winter (done by 48 participants, or 30.0% of 160), installing shades (done by 29 participants, or 18.1% of 160), and closing shades in summer (done by 25 participants, or 15.6% of 160).

Table 31. Home Energy House Call Audit Report: Heating and Cooling (n=160)

	Carolinas (n)	Carolinas (%)
Audit recommended heat pump servicing	**14**	**8.8%**
Had heat pump serviced (% of recommendations)	7	50.0%
Already decided to service heat pump before audit (% of those who had heat pump serviced)	3	42.9%
Audit recommended installing or replacing heat pump	**37**	**23.1%**
Installed or replaced heat pump (% of recommendations)	3	8.1%
Already decided install / replace heat pump before audit (% of those who installed or replaced heat pump)	1	33.3%
Audit recommended clean / replace / repair furnace filter	**28**	**17.5%**
Cleaned / replaced / repaired furnace filter (% of recommendations)	21	75.0%
Already decided clean / replace / repair furnace filter before audit (% of those who cleaned / replaced / repaired furnace filter)	13	61.9%
Audit recommended closing vents in summer	**9**	**5.6%**
Closed vents in summer (% of recommendations)	5	55.6%
Already considering closing vents in summer before audit (% of those who closed vents)	2	40.0%
Audit recommended closing vents in winter	**74**	**46.3%**
Closed vents in winter (% of recommendations)	48	64.9%
Already considering closing vents in winter before audit (% of those who closed vents)	25	52.1%
Audit recommended closing shades in summer	**38**	**23.8%**
Closed shades in summer (% of recommendations)	25	65.8%
Already considering closing shades in summer before audit (% of those who closed shades)	15	60.0%
Audit recommended installing shades	**59**	**36.9%**
Installed shades (% of recommendations)	29	49.2%
Already considering installing shades before audit (% of those who installed shades)	16	55.2%

Table 32 covers recommendations that involve usage of hot water and extra refrigerators.

Reducing hot water temperature to 120 degrees was the audit report recommendation that was performed by the largest number of participants (54 participants, or 33.8% of 160). The number who switched to washing loads in cold water was also relatively high (done by 33 participants, or 20.6% of 160).

Unplugging extra refrigerators was a recommendation that was less likely than most to be undertaken (by only 16.2%, or 6 out of 37 participants who received this recommendation).

Table 32. Home Energy House Call Audit Report: Hot Water and Refrigeration (n=160)

	Carolinas (n)	Carolinas (%)
Audit recommended reducing water temp to 120	**91**	**56.9%**
Reduced water temperature to 120 (% of recommendations)	54	59.3%
Already considering reducing water temp to 120 before audit (% of those who reduced water temp)	16	29.6%
Audit recommended washing in cold water	**65**	**40.6%**
Washing in cold water (% of recommendations)	33	50.8%
Already considering washing in cold before audit (% of those who washed in cold water)	17	51.5%
Audit recommended rinsing in cold water	**3**	**1.9%**
Rinsing in cold water (% of recommendations)	1	33.3%
Already considering rinsing in cold water before audit (% of those rinsing in cold water)	-	0%
Audit recommended unplugging extra refrigerator	**37**	**23.1%**
Unplugged extra refrigerator (% of recommendations)	6	16.2%
Already considering unplugging extra refrigerator before audit (% of those who unplugged)	3	50.0%

Finally, participants were asked if they had made any other changes to their homes which were either directly or indirectly inspired by the home audit report. The verbatim comments of the 51 respondents who said they took further actions can be found in Appendix J: Verbatim comments: actions inspired by audit report.

Interest in a Follow-up Program

Participants were asked about their interest in a follow-up program in which the auditor would return to their home and provide feedback on what they've done and/or provide further recommendations, as well as whether and how much they'd be willing to pay for such a service. The results are shown in Table 33; two-thirds of participants (66.3% or 106 out of 160) said they would be interested in such a program, and about a quarter of those who were interested would be willing to pay for such a service (cumulative 24.5% or 26 out of 106 saying they would be willing to pay some amount). However, 61.3% (65 out of 106) of those interested in a follow-up program say they would not pay anything for such a service.

Table 33. Interest in a Follow-Up Program (n=160)

	Carolinas (n)	Carolinas (%)
Would you be interested in a follow-up program?		
Yes	106	66.3%
No	44	27.5%
Don't know / not specified	10	6.3%
Would you be willing to pay . . . ?		**Percent of Those Interested in Program**
$100 for this service	3	2.8%
$75 for this service	4	3.8%
$50 for this service	8	7.5%
Other amount under $50	11	10.4%
Nothing	65	61.3%
Don't know / not specified	15	14.2%
Would you be willing to pay . . . ? **Cumulative response totals**		
As much as $100	3	2.8%
As much as $75	7	6.6%
As much as $50	15	14.2%
As much as $25	21	19.8%
An amount less than $25 (including not specified)	26	24.5%
Nothing	65	61.3%
Don't know / not specified	15	14.2%

Note: cumulative totals add to more than 100% because respondents can be counted more than once (someone who is willing to pay $100 would also be willing to pay $75 or any lower amount).

Eleven participants stated amounts under $50 which they were willing to pay for a follow-up program. Their responses are listed below.

- "*$25 to $50 (if more materials were provided)*."
- $20 to $30
- $25 (4 respondents)
- $20
- $10 to $20
- $9
- "*Depends on my budget*."
- Not specified

Additional Services and Program Changes

TecMarket Works asked participants in the Carolinas what other services they would like to see be a part of the HEHC program. Sixty-three participants offered suggestions which are categorized and listed below.

- Duke Energy should pay for / discount / incentivize more types of energy efficient equipment (listed below) (n=17)
- Financial assistance / lower rates / discounts for elderly (n=10)
- Use higher tech to detect leaks and drafts (thermal imaging etc.) (n=9)
- Better audits / better auditors / more help from auditors (n=5)
- More frequent / regular audits (n=4)
- Renewable energy programs (n=4)
- Better / more advanced metering (n=4)
- More detailed audit reports (n=3)
- Demonstrate equipment and options during audit (n=3)
- Kit should be customized to my needs (n=3)
- More information about other Duke Energy programs (n=2)
- Audits to include wiring and electrical systems (n=2)
- Unique suggestions (listed below) (n=14)

The list above totals to more than 63 because participants could make multiple suggestions.

Seventeen participants suggested that Duke Energy provide, discount or incent more energy efficiency equipment to improve the program. These participants' verbatim comments are categorized and listed below.

Insulation:

- *"I had an audit done when I lived in Florida that did a pressure test that pressurized the house looking for air leaks and infiltration. They also offered rebates for attic insulation; I think Duke should offer that as well."*
- *"Duke could pay for my attic insulation."*
- *"I wish they would offer some program that offered insulation for the ceiling."*
- *"Provide insulation to wrap water pipes under the house."*

Lighting:

- *"Offer coupons for more light bulbs or other items. Getting the "swag bag" was great but we didn't need all the items that we got. We are saving them in case we'll need them in the future. However, we really could have used more than 2 CFLs to really see the difference on our bill, so coupons to get more free or discounted would have been very helpful."*
- *"Duke could lower the cost of the CFL bulbs."*
- *"Include more CFLs in the energy kit."*

Heating:

- *"Again, financial incentives for improvements. Years ago, I did a program through Duke that reduced the interest I paid on a new heating unit, and I would do that again if offered."*
- *"Help with heat pump replacements and charge them on the installment plan."*

Water saving:

- *"Provide low flow faucets."*
- *"Maybe new toilets."*

Multiple items:

- *"I would like the addition of solar energy and professional assistance installing home solar panels. The energy kit could include ceiling fans. Also, I would like the program to include store vouchers for CFLs."*
- *"Provide water heater blanket, caulking for windows, two shower heads, more aerators and weather stripping, something covering outside faucets for the winter, smaller size CFLs for ceiling fans. I would also like my meter checked and replaced, possibly moved in the future."*

General:

- *"Offer a discount on energy efficient improvements that people make in their home based on income."*
- *"Offer discounts or rebates for purchasing energy efficient items for the home or for going through a company that has been approved as energy efficient by Duke."*
- *"Offer financial assistance for newer energy efficient appliances."*
- *"Provide a rebate program, especially for people with financial barriers. Arrange discounts with contractors."*

Finally, fourteen participants offered unique suggestions, listed below.

- "*I'm too old to be installing many of the items from the kit and since we're on a fixed income we can't afford to pay someone to install the items from the kit or pay for other upgrades that were recommended*."
- "*I'd like to see more information about high efficiency windows and a possible Duke partnership with window providers*."
- "*Consider adding an amp meter to show/tell how much energy we're using. Increased awareness to get more people participating*."
- "*Use a standardized form filled out via laptop rather than hand written audit report*."
- "*I would love to see CFLs made in the USA or not containing mercury*."
- "*I am interested in finding out if there is a way to create additional attic ventilation*."
- "*I tried to return fixtures to the auditor that did not fit. He was not able to take them back. If would be nice if she could get the proper size fixture. Work out a program where a voucher/coupon could be given to purchase the right size fixtures in exchange for giving the ill-filling fixture to a store*."

- "*I would have liked to have received this REA survey sooner after the audit so I could remember things better*."
- "*Offer a booklet educating people (especially seniors) about Energy Star products, like which ones are best for their usage/needs and about the ratings/tiers*."
- "*Offer some way to measure/break out energy use by different components--A/C, lighting, cooking, etc. Offer some way to measure kilowatt use across separate circuits. I made a rudimentary test by looking at rotating meter wheel and counting revolutions/time to see difference when various items are turned on and off*."
- "*If I had money, I would convert from gas to electricity and pay one bill*."
- "*Offer people back up generators for when the power goes out*."
- "*Send e-mail of the recommendations because I save everything in computer files for easy access*."
- "*If there is a timer that we could put on the water heater so it would be running certain hours of the day*."

TecMarket Works asked the surveyed participants what could be done to increase interest and participation in the program; these suggestions are shown in Table 34 below. The most common recommendations were to increase advertising and public awareness (mentioned by 34.4% or 55 out of 160), more and/or better communications by mail (17.5% or 28 out of 160), and highlighting participants' experiences with cost savings (16.9% or 27 out of 160). Other suggestions were made by fewer than 10% of respondents.

Table 34. Participants' Suggestions for Increasing Program Participation (n=160)

What do you think can be done to increase people's interest in participating in the Program?	Carolinas (n)	Carolinas (%)
More advertising / media campaign / increase public awareness	55	34.4%
Direct mail / bill inserts / flyers	28	17.5%
Cost comparisons / document savings / testimonials	27	16.9%
Word of mouth	9	5.6%
Give more info about program / educate public	8	5.0%
Email / web ads / social networking	7	4.4%
More cash incentives / bill credits	7	4.4%
Free program / free items / highlight "free"	7	4.4%
Highlight saving energy / the environment	7	4.4%
Phone calls to customers	6	3.8%
Community outreach (schools, homeowner associations, etc.)	5	3.1%
Target programs / make sure everyone is targeted	5	3.1%
More incentives for upgrades and renovations	3	1.9%
Make more convenient / highlight "convenience"	2	1.3%
More frequent / better HEHC reports and updates	2	1.3%
Unique suggestions (listed below)	10	6.3%
Don't know / not specified / nothing / fine as is	29	18.1%

Ten respondents made unique suggestions, which are listed below.

- "*Give the free CFL bulbs ONLY if people agree to do the audit*."
- "*Help with installing CFLs for older people*."
- "*Duke could send customers one free CFL per month*."
- "*Solicit people in January after they receive their (typically) high December energy bill*."
- "*Push newer efficient technologies*"
- "*Questionnaires in monthly bills? Get feedback from customers*."
- "*Make it clear that it can save them money and make them more comfortable*."
- "*Supply a few postcards to participants so they can give them out to friends and tell them about the program*."
- "*Low-income people like me would be more interested if the program included more financing for home energy improvements*."
- "*Duke Energy representatives could go door to door to follow up*."

What Participants Liked Most about HEHC

TecMarket Works asked participants what they liked most about the program; their responses are shown in Table 35. Positive comments about the audit and the auditors were the most frequently mentioned (by 48.1% or 77 out of 160), followed by the fact that the program and/or kit items were free (30.0% or 48 out of 160), the informational and educational aspects of the program (22.5% or 36 out of 160), and saving money on energy and water bills (12.5% or 20 out of 160). All other aspects of the program were mentioned by fewer than 10% of respondents.

Table 35. What Participants Liked Most About HEHC (n=160)

What do you like most about this program?	Carolinas (n)	Carolinas (%)
The audit / auditor / advice and assistance from auditor	77	48.1%
Free program / free items in kit	48	30.0%
Gaining education and information about energy efficiency	36	22.5%
Saving money on energy and water bills	20	12.5%
Confidence that home is efficient / already doing the right things	8	5.0%
Duke Energy is interested in helping customers	7	4.4%
Easy and convenient	6	3.8%
Saving energy / conservation / environment	5	3.1%
Improvements made to the home	3	1.9%
Don't know / nothing specific	5	3.1%

What Participants Liked Least About HEHC

TecMarket Works also asked the surveyed participants what they liked least about the program. Their responses are shown in Table 36. Three-quarters of participants (75.0% or 120 out of 160) could not name a least favorite aspect of the program. No other response category was mentioned by more than six (3.8% of 160) participants.

Table 36. What Participants Liked Least About HEHC (n=160)

What do you like least about this program?	Carolinas (n)	Carolinas (%)
Audit was not thorough enough	6	3.8%
Did not like kit item / broken or faulty	6	3.8%
Did not get kit / kit was missing items	5	3.1%
Not saving money on bills / rates keep going up	4	2.5%
Difficulty scheduling audit appointment	4	2.5%
Did not learn anything new / recommendations not useful	3	1.9%
Wanted more free items	3	1.9%
Complaints about this survey	3	1.9%
Recommendations are unreasonable / impractical	2	1.3%
Could not use kit item / doesn't fit / inappropriate	2	1.3%
Auditor did not explain / install / was rude	2	1.3%
Unique responses (listed below)	5	3.1%
No complaints / nothing / don't know	120	75.0%

Five respondents made unique comments, which are listed below.

- "*No solar!*"
- "*The program could offer more training for seniors about the latest technologies for energy conservation.*"

- "*The cost of paying someone to seal the attic ducts*."
- "*I wish the audit report would have been organized better for the lay-person. If so, it would encourage more frequent re-reading*."
- "*That I wasn't aware of it sooner*."

Specialty Bulbs: Current Usage and Interest in CFLs

Participants were asked if they had any specialty light bulbs in use in their homes, and how many of these bulbs were currently CFLs. The results are shown in Table 37.

More than three-quarters of respondents (76.9% or 123 out of 160) have outdoor flood lights, and about half have candelabras (51.3%), dimmable bulbs (49.4%) or three-way bulbs (48.1%). CFL installation rates are highest for spotlights (36.3% or 29 out of 80 bulbs), "other" specialty bulbs (34.9% or 38 out of 109 bulbs), three-way bulbs (25.7% or 49 out of 191 bulbs), and recessed bulbs (24.3% or 102 out of 420 bulbs). The lowest rates of CFL installation are for candelabras at 7.7% (55 out of 715 bulbs), dimmable bulbs at 11.5% (69 out of 601 bulbs) and outdoor flood bulbs at 13.6% (73 out of 538 bulbs). These are also the three types of specialty bulbs that are the most numerous among respondent households.

Table 37. Specialty Bulbs: Usage and CFLs (n=160)

Type of specialty bulb	Currently using (n)	Currently using (%)	Total number of bulbs	Total number which are CFL bulbs	% of bulbs which are CFL
Dimmable	79	49.4%	601	69	11.5%
Outdoor flood	123	76.9%	538	73	13.6%
Three-way	77	48.1%	191	49	25.7%
Spotlight	20	12.5%	80	29	36.3%
Recessed	48	30.0%	420	102	24.3%
Candelabra	82	51.3%	715	55	7.7%
Other specialty bulbs	21	13.1%	109	38	34.9%

Figure 5 shows participants' interest in a Duke Energy program that would send discounted specialty CFL bulbs to their homes via direct mail. A plurality (41.9% or 67 out of 160) rated their interest in this potential program "10 out of 10" (highest possible level of interest), while another 13.8% (22 out of 160) rated their interest "1 out of 10" (lowest possible level of interest). The mean interest rating of all participants surveyed was 7.21.

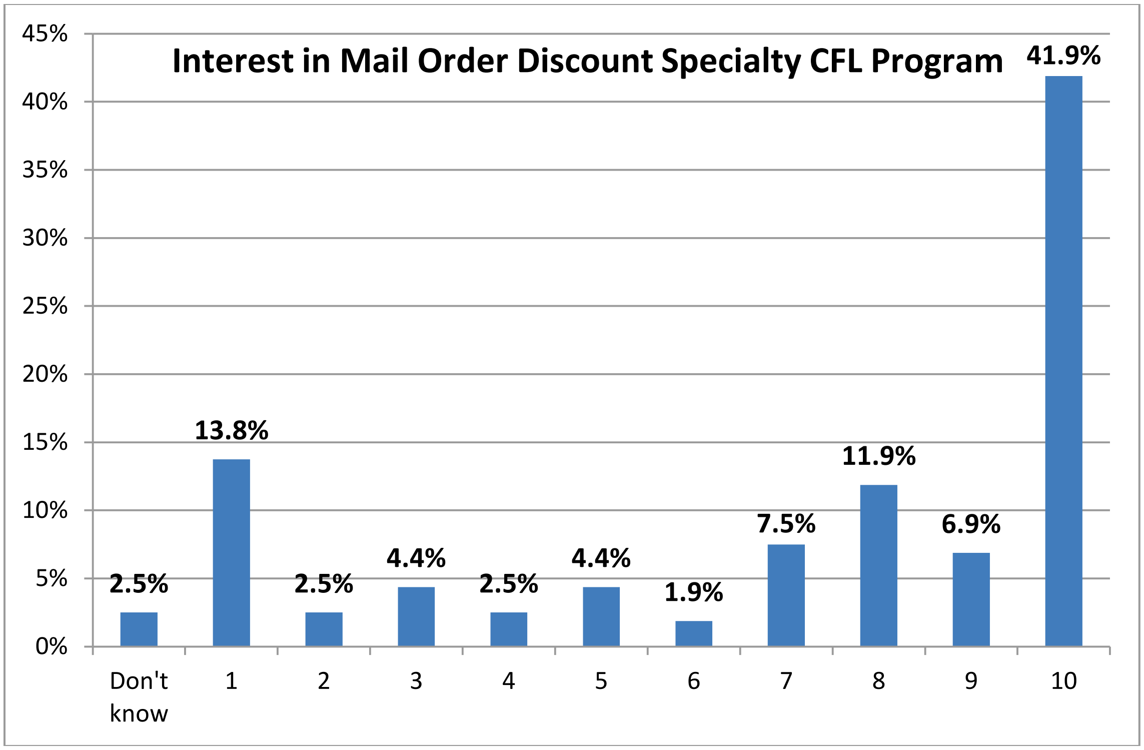

Figure 5. Rating of interest in Duke Energy providing a direct mail CFL program that ships discounted specialty bulbs directly to your home (n=160)

Table 38 shows that most participants expressed interest in a discount mail order program for outdoor flood light CFLs (63.1% or 101 out of 160) – which also happens to be the type of bulb that is used the least (on average 2.4 hours/day). Fewer than half of participants were interested in ordering dimmable (41.9%), three-way (38.8%) or candelabra bulbs (37.5%). Spotlight (16.9%) and "other" specialty bulbs (11.9%) had the least participant interest.

Table 38. Specialty Bulbs: Interest in Ordering (n=160)

Type of specialty bulb	Interested in ordering (n)	Interested in ordering (%)	Average daily hours of use for these bulbs
Dimmable	67	41.9%	3.4
Outdoor flood	101	63.1%	2.4
Three-way	62	38.8%	4.4
Spotlight	27	16.9%	4.0
Candelabra	60	37.5%	3.2
Other specialty bulbs	19	11.9%	4.6

Savings Distributions

There are some risks associated with relying on self-reported behavioral changes because the foundation of the savings estimates are based solely on the participant's responses with no means to verify that the respondent has installed the kit's measures and is using them effectively. In the case of this evaluation, it was determined that the engineering estimates derived from this methodology were unreliable for use as a gross or net program-wide estimation approach and they were not used to estimate impacts in favor of a more reliable billing analysis approach.

There is no adjustment approach required to estimate net savings by factoring out the impacts of freeriders. The quasi-experimental design used in this study provides direct net savings. To estimate short term net savings that exclude short term or longer term market effect only spillover savings need to be added to the program wide net savings estimate.

Net to Gross Analysis

Net to gross figures are applied to the engineering estimates only and not used to estimate program or per participant net savings. The billing analysis does not require a net to gross adjustment because it provides gross savings less freerider impacts directly as a result of the analysis approach employed (quasi-experimental design). This information is provided for management consideration only as it applies to how products and services are being adopted and used in the market. These adjustments are already embedded in the program and per-participant energy savings presented from the billing analysis approach.

Freeridership and Spillover for Showerheads, Aerators, Gaskets and Weather Stripping

Freeridership and spillover were calculated for each set of measures in the Energy Efficiency Kit. For all items except the CFL bulbs, the level of freeridership was determined by using the responses to three questions in the survey (found in Appendix B: Participant Survey Instrument). The three questions and the level of freeridership and/or spillover that was applied to the energy savings are presented in Table 39 below, using the low-flow showerhead as an example measure. All other possible combinations of answers to the series of questions resulted in 0% freeridership and 0% spillover (not shown in table).

Table 39. Freeridership and Spillover Factors for Energy Efficiency Kit Measures

24h: Did you have any low-flow showerheads installed before you got the kit?	24i: Were you planning on buying <additional> low-flow showerheads before you got the kit?	24j: Have you purchased any low-flow showerheads since you got the kit?	% Free-ridership	% Spillover
yes	yes	yes	100	
yes	yes	no	100	
yes	no	yes		75
no	no	yes		100
no	yes	no	50	
no	yes	yes	50	50
don't know	yes	yes	75	25
don't know	yes	no	50	
don't know	no	yes		100

yes	already installed in all available sockets	yes	100	
yes	already installed in all available sockets	no	100	
yes	already installed in all available sockets	don't know	100	
don't know	maybe	yes	25	50
yes	maybe	yes		25
yes	maybe	no	25	
no	maybe	yes		50
yes	don't know	yes		75
no	don't know	yes		100
yes	yes	don't know	100	
don't know	yes	don't know	50	
no	yes	don't know	50	

Applying the scores from Table 39 to participants' responses to questions about low-flow showerheads, faucet aerators (combined[9]), gasket insulators (combined) and weather stripping yields the overall freeridership and spillover scores for each measure, shown in Table 40.

[9] The survey included two questions about aerator intentions prior to the program, one for kitchen aerators and one for faucet aerators. However, there was only one question about previously installed faucet aerators that did not specify kitchen or bathroom.

Table 40. Freeridership and Spillover for Showerheads, Aerators, Gaskets and Weather Stripping

Measure (N=number of kit installations)	Number of participants with free-ridership	Number of participants with spillover	Free-ridership percentage	Spillover Percentage
Low-flow showerhead (N=71)	10	10	10.6%	13.0%
Faucet aerators (N=81)	15	4	13.9%	4.6%
Weather stripping (N=66)	28	12	38.6%	12.9%
Gaskets insulators (N=68)	8	9	9.2%	11.8%

CFL Freeridership

TecMarket Works utilized two questions[10] from the participant survey to estimate CFL freeridership. The first question asked survey respondents whether or not they had installed CFLs prior to participating in the program, and if so, how many they had installed. The second question asked respondents if they had planned on buying any CFLs before participating in the program.

Quantities of pre-installed CFLs in the Carolinas range from 1 to 48 among the 64.5% (98 out of 152) of Duke Energy customers who installed the kit-provided CFLs and indicated that they also had CFLs previously installed.

Freeridership ratios for each customer are based on survey responses and are assigned using a Bass curve based on diffusion of innovation product adoption concepts. Zero pre-installed CFLs correspond to an assigned freeridership score of zero percent, and fourteen or more CFLs correspond to a freeridership level of 100 percent. This allows higher credit for savings to participants with the lowest pre-existing use of CFLs and lower savings to those with a history of CFLs. The curve reflects the condition that if a customer has never used a CFL in the past, they are not historic CFL users and all CFLs they acquire through the program are net energy bulbs. That is, all the energy savings from those bulbs are net savings that would not have occurred without the program. Likewise, if a customer has already purchased and installed 14 or more bulbs, they are committed CFL users and the program's bulbs are providing no net energy savings. These customers are all freeriders. Between these two extremes are people who are at various levels within the Bass adoption process. These customers are assigned NTG ratios in accordance with the degree of pre-program behaviors. This distributes very little savings to the customers who are already using CFLs in many of their fixtures, but who have not fully converted to CFL use in most fixtures. Likewise the Bass curve provides higher levels of NTG savings (but not full savings) to those customers who have tried a few CFLs or who have partially adopted their use. Both of these adoption concepts represent the dominate theories with the product adoption literature and provide similar results within a net energy impact analysis framework. In this analysis the inflection point of the Bass curve is seven CFLs, which is the typical level of CFL penetration among these participants. This inflection point means that there is little impact on net energy savings if the adoption process is faster or slower than projected in a typical Bass curve. That is, a shorter adoption period will give more savings to people with less than average adoption rates, but less savings to those with longer adoption periods, which

[10] Going forward an expanded approach will be used that employs three or more questions per agreement with Commission suggestions.

act to cancel each other out and provide the same net analysis results. Thus, we are confident that this net analysis represents a reliable method of crediting net program impacts for multiple adoption products such as light bulbs.

A graph of this curve is shown in Figure 6, with the corresponding freeridership levels by CFL count shown in Table 41. This approach to estimating freeridership is consistent with the field of product adoption and diffusion research and represents a standard approach within the field of product adoption research. It also recognizes that the more CFLs a home has, the less likely the addition of new Duke Energy CFLs will have an impact on product adoption and use behaviors.

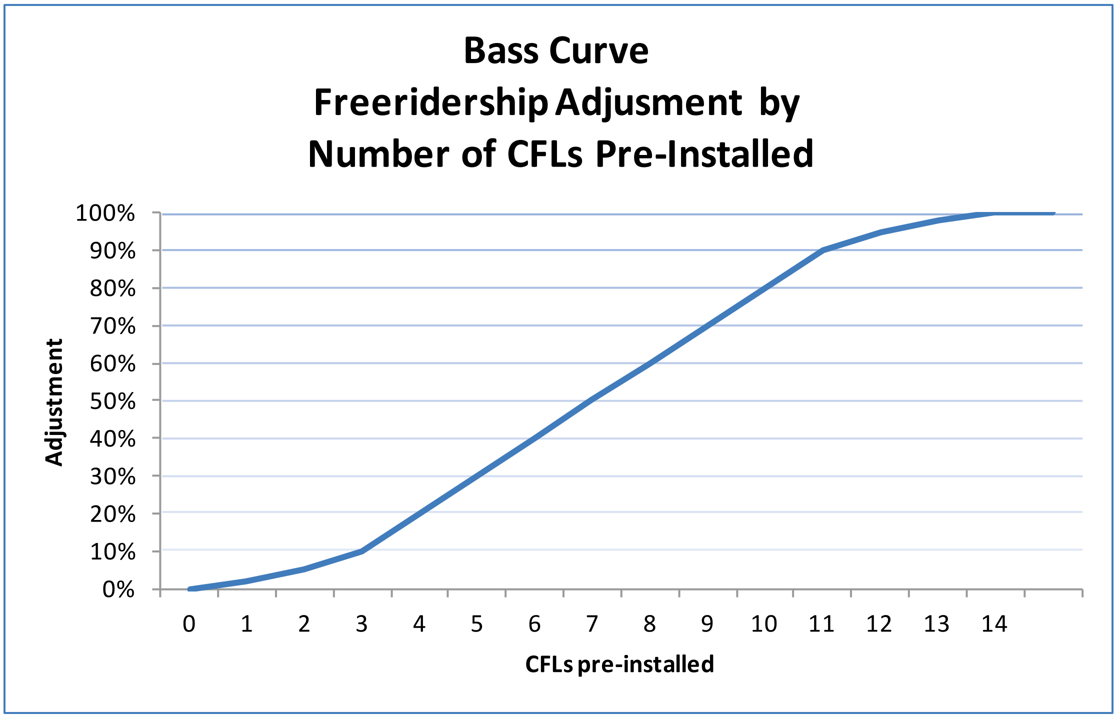

Figure 6. Bass Curve Freeridership Adjustment by Number of CFLs Pre-Installed

Table 41. CFL Freeridership Adjustment Determined by Bass Curve[11]

Number of CFLs pre-installed	Freeridership Pre-installation adjustment factor	Number of customers with number of pre-installed CFLs (n=148)
0	0%	53
1	2%	8
1.5	3.5%	1
2	5%	15
2.5	7.5%	4
3	10%	8
4	20%	11
4.5	25%	2

[11] Fractional values in this table are the result of interpolating ranges given by respondents ("1 to 2" is reported as 1.5, "2 to 3" is reported as 2.5, etc.)

5	30%	7
6	40%	8
7	50%	1
8	60%	3
9	70%	2
10	80%	5
11	90%	
12	95%	4
13	98%	
14 or more	100%	16

Note: Four respondents are not included in this table because they did not know if they previously had CFLs installed, or did not know how many they had installed before the program.

In addition to the pre-installation adjustment factor, TecMarket Works applied a freeridership multiplier based on whether or not respondents indicated they had planned on purchasing the measure (CFLs) before receiving the K12 energy efficiency kit. These multipliers are shown in Table 42.

Table 42. Freeridership Multiplier Based on Measure Purchasing Plans

Did you plan on purchasing <measure> before receiving the K12 kit?	Freeridership multiplier
Yes	1.25 (result cannot exceed 100%) (reduces program savings)
Maybe	1
Don't Know	1
No	0.25 (results cannot be lower than 0%) (increases program savings)
No, already installed in all possible places	Automatic 100% freeridership score

Combining Table 41 with Table 42 produces Table 43.

Table 43. Number of Participants Cross-Referenced by Freeridership Adjustment and Multiplier

Number of CFLs pre-installed	Freeridership Pre-installation adjustment factor	Number of Participants per Freeridership Multiplier				
		1.25	1	0.25	Automatic 0%	Automatic 100%
0 (N=53)	0%	NA	NA	NA	53	
1 (N=8)	2%	3	2	3		
1.5 (N=1)	3.5%		1			
2 (N=15)	5%	7	6	2		
2.5 (N=4)	7.5%	2		2		
3 (N=8)	10%	4	1	3		
4 (N=11)	20%	5	3	3		
4.5 (N=2)	25%	1				1
5 (N=7)	30%	6	1			
6 (N=8)	40%	4		2		2

7 (N=1)	50%			1		
8 (N=3)	60%	3				
9 (N=2)	70%	2				
10 (N=5)	80%	2		1		2
11 (N=0)	90%					
12 (N=4)	95%	1		2		1
13 (N=0)	98%					
14 or more (N=16)	100%	12	2	1		1

TecMarket Works then multiplied the freeridership adjustment factor by the freeridership multiplier for each survey respondent. An average of the resulting freeridership percentage across 148 respondents[12] who installed the kit-provided CFLs produced an overall freeridership level of 25.6% for CFLs in this program.

This level of freeridership is higher than what we have seen in the past from these types of programs and reflects the movement of the market toward higher levels of CFL use over time. While the program is doing an excellent job of getting these CFLs in the sockets of customers who do not typically use high levels of CFLs without the program, it is becoming clear that Duke Energy will need to carefully monitor the CFL use market for the various types of targeted customer segments on which the program focuses and determine the point at which net savings will fall below cost effective program expenditures. TecMarket Works does not project when or if this condition will be experienced by different types of programs because net to gross analysis is not a technology factor, but rather is a target market adoption purchase behavior factor. Thus the value of a freeridership estimates is a program targeting metric rather than a technology metric or building code metric. Effective program targeting is established through the marketing, outreach and implementation design consideration, rather than the technology being pushed by a program.

CFL Spillover

The level of spillover for CFL bulbs was computed using the same factor scores found in Table 39, and the result is shown in Table 44.

Table 44. Freeridership and Spillover for CFL Bulbs

Measure (N=number of kit installations)	Number of participants with freeridership	Number of participants with spillover	Freeridership percentage (computed using Bass curve)	Spillover Percentage
CFL bulbs (N=152)	83	39	25.6%	17.1%

[12] Four respondents (out of 152 who installed kit-provided CFLs) were withheld from the computation of freeridership because they either did not know if they previously had CFLs installed before the program, or did not know how many CFLs they had installed before the program, and thus a foundational Bass curve freeridership score could not be determined.

Audit Freeridership

Freeridership was also calculated for the home energy audit as an independent analysis to determine how many participants would have had their homes audited if Residential Energy Assessments were not made available, which is shown in Table 45. All other possible responses to these questions were counted as 0% freeridership (not shown in table).

Table 45. Questions to Estimate Freeridership for the Home Energy Audit

Considering an audit before the program?	if not available through the program, would you still have purchased an audit?	If yes, would you have purchased it within a year?	% Freeridership
yes	yes	yes	100
yes	yes	no	50
yes	yes	don't know	25

As seen in Table 46, 30.6% (49 out of 160) of the surveyed participants were considering an audit of their home before enrolling in the program, but only eleven (6.9% of 160) would have purchased an audit if they didn't receive one through the program, and only 7 of those (4.4% of 160) would have purchased an audit in the next year.

Table 46. Consideration of Audit Before Program Participation

	Yes	No	DK/NS
Considered before HEHC	49	106	5
Purchased without HEHC	11	141	8
Purchased within a year without HEHC	7	142	11

Ten[13] participants responded in a manner that labeled them as a freerider. Seven participants had a freeridership score of 100%, one had a freeridership score of 50% and the other two had a freeridership score of 25%. Among the 160 participants surveyed, the overall freeridership level for the program's audit is low at 5.0%.

Validity and Reliability of the Freerider Estimation Approach

There is significant debate within the field of evaluation pertaining to the reliability of self-report approaches for estimating freeridership levels. Self-selection and socially acceptable response bias act to increase apparent freeridership levels. Positive outcome bias, in which participants tend to take credit for actions that produce desired effects, and not take credit for actions that do not produce desired effect, may also have an influence on participant responses to survey questions. This bias, similar to the previous biases, would most likely act to drive apparent freeridership higher than actual levels. As a result the freerider ship estimates in this study should be considered conservative, with actual levels of freeridership probably lower than estimated. We do not know the degree of over-estimation of freeridership for this study. However, self-report approaches are the standard in our industry and are a common standard

[13] One of the eleven respondents who said they would purchase an audit was not planning to have their home audited before participating in the program, thus is not considered a free rider.

practice. There is some belief that adding additional freeridership questions to a survey to "triangulate response" act to improve the reliability of the estimate, however there is no evidence in the field of evaluation to support this assumption. In the opinion of TecMarket Works, adding question beyond those needed is more likely to reduce estimate reliability if the original questions are well constructed and objectively scored. TecMarket Work is confident that the questions used in this analysis represent the best and most reliable approach for scoring freeridership levels. However, we are not able to control for the different types of survey response bias and therefore suggest that the findings in this study be considered conservative.

Impact Estimates: Billing Analysis

This analysis presents the results of the billing analysis of Duke's Home Energy House Call (HEHC) Program in Carolinas.[14] This analysis relies upon a statistical analysis of actual customer billed electricity consumption before and after participation in the HEHC program to estimate the impact of the program. Table 47 presents the results of this billing analysis.

Table 47. HEHC Average Annual Net kWh Savings: Audit and Kit

State	HEHC (Annual Net Saving in kWh)
Carolinas	928

For this analysis, data are available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of data, known as "panel" data, it becomes possible to control, simultaneously, for differences across households as well as differences across periods in time through the use of a "fixed-effects" panel model specification that provides net savings estimates that are already adjusted for freeridership and participant spillover that occurs during the analysis period. The approach does not include the program induced savings that are associated with short and longer term non-participant spillover or market effects. As a result, these savings should be considered conservative for an estimate actual achieved savings. The fixed-effect refers to the model specification aspect that differences across homes that do not vary over the estimation period (such as square footage, heating system, etc.) can be explained, in large part, by customer-specific intercept terms that capture the net change in consumption due to the program, controlling for other factors that do change with time (e.g., the weather). The model does control for what would have been done without the program within the participant's homes.

Because the consumption data in the panel model includes months before and after the installation of measures through the program, the period of program participation (or the participation window) may be defined specifically for each customer. This feature of the panel model allows for the pre-installation months of consumption to effectively act as the comparison group for post-participation months. In addition, this model specification, unlike annual pre/post-participation models such as annual change models, does not require a full year of post-participation data. Effectively, the participant becomes their own comparison group, thus eliminating the need for a non-participant comparison or control group. We know the exact month of participation in the program for each participant, and are able to construct customer specific models that measure the change in usage consumption immediately before and after the date of program participation, controlling for weather and customer characteristics.

The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household.

[14] To increase the efficiency of the model, a single model was estimated over Ohio, North Carolina, and South Carolina customers. There are 6,338 distinct accounts in NC; 1,855 in SC; 3,474 in OH; 347 in KY. This report addresses only the results for the Carolinas.

Algebraically, the fixed-effect panel data model is described as follows:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it},$$

where:

y_{it} = energy consumption for home i during month t
α_I = constant term for site i
β = vector of coefficients
x = vector of variables that represent factors causing changes in energy consumption for home i during month t (i.e., weather and participation)
ε = error term for home i during month t.

With this specification, the only information necessary for estimation is those factors that vary month to month for each customer, and that will affect energy use, which effectively are weather conditions and program participation. Other non-measurable factors can be captured through the use of monthly indicator variables (e.g., to capture the effect of potentially seasonal energy loads).

The effect of the program, in the case the HEHC kit as well as recommended measures, is done by including a variable which is equal to one for all months after the customer received the kit and the report.[15] The coefficient on this variable is the savings associated with the kit and recommendations. In order to account for differences in billing days, the usage was normalized by days in the billing cycle. The estimated electric model is presented in Table 48 with full detail in Appendix D: Estimated Model.

Table 48. Estimated Savings Model – dependent variable is daily kWh usage, August 2009 through August 2012 (savings are negative)

Independent Variable	Coefficient (kWh/d)	t-value
Overall HEHC participation	-2.54	-18.2
Sample Size	8,193 homes	
R-Squared	71%	

This estimated model shows that the HEHC results in an average annual savings of 928 kWh (using the estimated daily energy saving multiply by 365). This estimate is statistically significant, with all estimates significant at the 95% confidence interval.

Effect of Additional CFLs

This section investigates the effect on the estimated program impacts from those customers who received the additional CFLs as part of the HEHC program relative to the other participants in

[15] By defining the participation variable as a 1/0 indicator variable, it effectively captures all the savings associated with participating in HEHC, including any CFLs that were installed as part of the audit.

HEHC. While on site, the auditor can give the participant an additional 1-12 CFLs depending on the number of fixtures using incandescent bulbs that the customer has available.

In order to investigate the impact of the additional bulbs on the estimated savings for HEHC, the original participation variable was decomposed into two variables: one denoting the months after the audit was done; the other denoting number of additional bulbs installed. Customers who did not receive additional bulbs would have the 2nd variables equal to zero. This way the impact is decomposed into two parts as well: savings impact from HEHC without additional bulbs, and marginal savings impact from **each additional bulb provided** to the participant. This marginal savings is multiplied by the number of additional bulbs yields total savings from the total number of additional bulbs given.

The results are shown in Table 49 (the dependent variable is in daily kWh form, annual kWh can be calculated using reported numbers times 365):

Table 49. Estimated HEHC impacts with and without accounting for additional CFL bulbs

Savings (daily kWh from original model) (t-value)	Savings (daily kWh from HEHC NO additional CFL) (t-value)	Savings (daily kWh from per additional CFL) (t-value)
-2.54 (-18.2)	-2.52 (-16.45)	-0.009 (-0.55)

These results show that there is no statistically significant impact from the additional bulbs given in the Carolina System. With or without the additional bulbs the program yields the same savings.

The estimated electric model is presented with full detail in Appendix E: Estimated Statistical Models for Additional CFLs.

Impact Estimates: Engineering Analysis

Savings values in this section are not official and are provided only for program's management information and their use to better understand the per measure adoption and use characteristics. The engineering analysis does not take into consideration the recommendations provided by the report, thus the billing analysis is required for an accurate calculation of the kWh savings. The net savings claimed by this program should be taken from the billing analysis results. These engineering estimates provide, for the billing analysis, a ratio of coincident kW reduction to kWh savings as it is incapable of analyzing kW. Additionally, the engineering estimates offer insight into individual measure contributions to overall savings.

Table 51 shows the estimated energy savings per unit distributed adjusted downward for the ISR and accounting for the freeridership and spillover percentages computed from participants' survey responses. CFL savings also incorporate the self-reporting bias applied to the hours of use. Table 50 shows total savings per participant, which includes the extra CFLs distributed by the auditors in addition to the three in the energy efficiency kit. By contrast, Table 51 shows the savings per unit distributed for each item in the kit and, in the final column, savings resulting from the kit only, exclusive of any additional CFLs. All engineering savings estimates exclude audit recommendations as they were too seldom taken to collect sufficient data for statistical relevance through the phone survey. The methods used to determine the effective useful lives presented in these tables, and that of the entire program, are explained in the Effective Useful Life (EUL) Calculation section.

Table 50. Total Savings: kWh and Coincident kW per Participant

Metric	Result
Phone Survey Participants	160
Gross kW per participant	0.06225
Gross kWh per participant	503
NTG Ratio	89.3%
Net kW per participant	0.05559
Net kWh per participant	449
Measure Life (years)[16]	6**
EUL net kWh per participant	2694

Table 51. Kit Savings: kWh and Coincident kW per Unit Distributed

Metric	13W CFL	20W CFL	Low-flow showerhead	Faucet Aerators	Outlet Gaskets	Weather Stripping	Entire Kit
Units	Bulbs	Bulbs	Showerheads	Aerators	Gaskets	Linear Feet	Kit
Amount Distributed*	320	160	160	320	1920	2720	160
In Service Rate	91.7%	88.9%	44.4%	24.7%	15.3%	21.5%	
Gross kW per unit	0.00698	0.00746	0.00768	0.00006	0.00030	0.00010	0.03453
Gross kWh per unit	60.99	58.03	70.08	4.792	0.6062	0.2132	271
Freeridership rate	25.6%	25.6%	10.6%	13.9%	9.2%	38.6%	
Spillover rate	17.1%	17.1%	13.0%	4.6%	11.8%	12.9%	
NTG ratio	87.1%	87.1%	101.0%	90.1%	101.5%	69.3%	91.0%

[16] Consistent with prior evaluations of CFL programs for Duke Energy, a measure life of five years was used for installed CFLs. No derate was performed for post-EISA years.

Net kW per unit	0.00608	0.00650	0.00776	0.00005	0.00030	0.00007	0.03135
Net kWh per unit	53.12	50.54	70.78	4.318	0.6153	0.1477	246
Measure Life (years)	5	5	10	10	20	5	7**
EUL net kWh per unit	266	253	708	43	12	0.74	1722

*This is the amount distributed to the phone survey sample population (n=160 kits).
**Overall measure life is a weighted average derived from the effective useful lives of the individual kit items. The weights were assigned based on each measure's contribution to gross kWh savings.

Effective Useful Life (EUL) Calculation

The overall program EUL is a combination of the EULs of the two program components, the energy efficiency kit and the auditor recommendations.

The EUL of the entire kit is a weighted average derived from the effective useful lives of the individual kit items. The weights were assigned based on each measure's contribution to gross kWh savings, as seen in Table 52. The same method was used to combine the EUL of the entire kit with that of the extra CFLs that were distributed. This combination is shown in Table 53.

Table 52. Energy Efficiency Kit EUL

Measure	EUL	kWh	Weight	Weighted EUL
13W CFL	5	121.97	45.08%	2.25
20W CFL	5	58.03	21.45%	1.07
Low-Flow Showerhead	10	70.08	25.90%	2.59
Faucet Aerators	10	9.58	3.54%	0.35
Outlet Gaskets	20	7.27	2.69%	0.54
Weather Stripping	5	3.63	1.34%	0.07
Entire Kit				**7**

Table 53. Energy Efficiency Kit with Extra CFLs EUL

Measure	EUL	kWh	Weight	Weighted EUL
Entire Kit	7	271.00	53.88%	3.77
Extra CFLs	5	232.00	46.12%	2.31
Entire Kit with Extra CFLs				**6**

The EUL of the audit recommendations could not be computed in the same way as the kit as measure level savings was not available. Table 54 lists the major audit recommendations, or category of recommendations, along with their EULs in ascending order.

Table 54. Audit Recommendations with EULs

Measure	EUL
Reduce hot water temperature	3
HVAC maintenance	5
Air sealing - reduce infiltration	15
Duct insulation	15
Heat pump	18
Duct sealing	20
Shell insulation	25
All Recommendations	**15**

The weighted average EUL for all recommendations is estimated to be 15 years. This is an assumption based upon the EULs of the major recommendations and their expected uptake by participating customers. The most likely action undertaken, that also has appreciable savings, is an "air sealing – reduce infiltration" measure, of which there are six separate recommendations: windows, doors, fireplaces, attics accesses, plumbin/electrical, or other. In addition, there are three "duct insulation" measures, which also have an EUL of 15 years. All other recommended measures' EULs fall above or below.

The Home Energy House Call program's last evaluation report[17] showed that audit recommendations comprise 55% of the total program savings. This weight was used to determine a weighted average EUL that is applicable at the program level to feed the DSMore table seen in Appendix L: DSMore Table. This combination is shown in Table 55.

Table 55. Program-Wide EUL

Measure	EUL	Weight	Weighted EUL
Entire Kit with Extra CFLs	6	45%	2.70
Audit Recommendations	15	55%	8.25
Program-Wide			**11**

Survey Data

Participants were asked how many of the measures distributed through Duke Energy's Home Energy House Call program they had installed. Additional, more specific information was collected for each measure, including the type and wattage of the bulb that the CFLs replaced, the average hours per day that they are in use, and the average number of showers taken per week using the low-flow showerhead. TecMarket Works conducted the phone survey with a random sample of 160 participants from the Carolinas between September 9 and October 9, 2012. The compilation of this data is presented in Table 56 in its unadjusted form; that is before the self-reporting bias is applied to the hours of use. The adjusted values appear in Table 58.

Table 56. Unadjusted CFL Survey Data

Measure	Number of Installations	Average Wattage/GPM of Unit Removed	Average Daily Hours of Use/Showers per week
13W CFL	302	62	5.33
20W CFL	143	72	4.90
Low-flow showerhead	71	3.1	9.58
Faucet aerators	79	2.2	
Outlet gaskets*	294		
Weather stripping	585 feet		

*Only outlet gaskets installed in exterior walls are counted

17 TecMarket Works and Integral Analytics. "Process and Energy Impact Evaluation of the Home Energy House Call Program in North and South Carolina". May 27th, 2011. Pg. 13.

CFLs

The Energy Efficiency Starter Kit included two 13-watt CFLs and one 20-watt CFL. Participants also had the option to have their auditor install additional CFLs to bring the total number of CFLs installed throughout their home up to 15. A total of 320 13-watt and 160 20-watt CFLs were distributed to phone survey participants in the energy efficiency kit. An additional 621 CFLs were given out by the auditors, two-thirds of which were assumed to be 13-watt, and the other one-third 20-watt, the same distribution as the kits. As presented in Table 57, there were a total of 734 13-watt and 367 20-watt CFLs distributed to phone survey participants.

Table 57. Savings Estimates per CFL Distributed

Bulb Type	Number Distributed	In Service Rate	Average Wattage of Bulb Removed	Average Adjusted Daily Hours of Use	Gross kWh per Bulb	Gross kW per Bulb	Net kWh per Bulb	Net kW per Bulb
13-watt	734	91.7%	62	3.89	60.99	0.00698	53.12	0.00608
20-watt	367	88.9%	72	3.58	58.03	0.00746	50.54	0.00650

In Service Rate (ISR) Calculation

Survey participants were asked to report whether or not they used the CFLs in the energy efficiency kit. This information has been extended to the CFLs given out by the auditor in addition to those already received in the kit. Respondents were also asked if they had subsequently removed any of the CFLs provided by the program. Their responses indicate that 6.63% of the CFLs that were initially installed have since been uninstalled. This percentage has been subtracted from the first year ISR.

Using 20-watt CFLs as an example, a total of 160 bulbs were distributed to survey participants in the energy efficiency kits. Respondents reported that 143 of them were used, a first year ISR of 89.4%. Subtracting the aforementioned 6.63% of bulbs removed from use yields a first year ISR of 82.8%. The ISR is calculated to be 88.9% using the following formula:

ISR = first year ISR + (43% * remainder) = **82.8% + (43% * 14.2%) = 88.9%**

The remainder is the percentage of bulbs that are not installed in the first year (100% - 82.8% = 17.2%) less 3% for the 97% lifetime ISR[18]. In this case, the remainder is 14.2%. The 43% represents the percentage of the remainder that will replace an incandescent bulb rather than a CFL[19].

Self-Reporting Bias

Previous CFL studies that have included both customer surveys and lighting loggers have shown that, comparing customers' self-reported hours of operation to the actual hours of operation,

[18] As established in the Nexus Market Research, RLW Analytics, and GDS Associates study, dated January 20, 2009: "New England Residential Lighting Markdown Impact Evaluation".
[19] As established in the Nexus Market Research, RLW Analytics, dated October 2004: "Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs", table 6-4 where 24 out of 56 respondents indicated that they did not purchase the CFLs as spares.

customers responding to the survey overestimated their lighting usage by 27%[20]. Consequently, the self-reported hours of use obtained from the survey were reduced by the 27% established through the collection of data from previous programs. This bias applies to CFLs only.

Table 58 shows the weighted average of the unadjusted hours of use values along with the updated average values after the self-reporting bias is applied. The final value for average daily hours of use is 3.89 and 3.58 for 13-watt and 20-watt CFLs respectively.

Table 58. Adjusted Average Daily Hours of Use

Adjustment	Magnitude of Adjustment	Average Daily Hours of Use (13-watt)	Average Daily Hours of Use (20-watt)
Unadjusted	N/A	5.33	4.90
Self-Reporting Bias	27%	3.89	3.58

Low-Flow Showerhead

Each energy efficiency kit contained one low-flow showerhead. Out of the 160 heads distributed to survey participants, 44.4%, or 71 heads, were installed. This information can be seen in Table 59 along with gross and net savings estimates per unit distributed. Approximately 41% of households in the Carolinas use electric water heaters. This measure produces zero kW or kWh savings in households that use gas water heaters. As seen in Table 40, this measure has a higher spillover percentage than its freeridership percentage. This yields a positive net-to-gross ratio resulting in greater net savings than gross savings.

Table 59. Savings Estimates per Showerhead Distributed

Number Distributed	In Service Rate	Average Showers per Week	Electric Water Heating	Gross kWh per Head	Gross kW per Head	Net kWh per Head	Net kW per Head
160	44.4%	9.58	41%	70.08	0.00768	70.78	0.00776

Faucet Aerators

One kitchen and one bathroom faucet aerator were given out in each kit. Out of the 320 aerators distributed to survey participants, 24.7%, or 79 aerators were installed. This information can be seen in Table 60 along with gross and net savings estimates per unit distributed. This figure includes only those aerators that were installed on faucets that did not already have one. Aerators that replaced an existing aerator are ascribed zero savings. Approximately 41% of households in the Carolinas use electric water heaters. This measure produces zero kW or kWh savings in households that use gas water heaters.

[20] TecMarket Works and Building Metrics. "Duke Residential Smart $aver® CFL Program in North Carolina and South Carolina". February 15, 2011. Pg. 35.

Table 60. Savings Estimates per Aerator Distributed

Number Distributed	In Service Rate	Electric Water Heating	Gross kWh per Aerator	Gross kW per Aerator	Net kWh per Aerator	Net kW per Aerator
320	24.7%	41%	4.792	0.00006	4.318	0.00005

Outlet and Switch Gaskets

Four kitchen and eight outlet gaskets were given out in each kit. Out of the 1,920 gaskets distributed to survey participants, 15.3%, or 294 gaskets, were installed. This information can be seen in Table 61 along with gross and net savings estimates per unit distributed. This figure includes only those gaskets that were installed in exterior walls. Gaskets installed in interior walls are ascribed zero savings. As seen in Table 40, this measure has a higher spillover percentage than its freeridership percentage. This yields a positive net-to-gross ratio resulting in greater net savings than gross savings.

Table 61. Savings Estimates per Gasket Distributed

Number Distributed	In Service Rate	Gross kWh per Gasket	Gross kW per Gasket	Net kWh per Gasket	Net kW per Gasket
1920	15.3%	0.6062	0.00030	0.6153	0.00030

Weather Stripping

Each energy efficiency kit contained 17 feet of closed-cell foam weather stripping. Out of the 2,720 feet distributed to survey participants, 21.5%, or 585 feet, was installed. This information can be seen in Table 62 along with gross and net savings estimates per unit distributed.

Table 62. Savings Estimates per Foot of Weather Stripping Distributed

Amount Distributed (feet)	In Service Rate	Gross kWh per Foot	Gross kW per Foot	Net kWh per Foot	Net kW per Foot
2720	21.5%	0.2132	0.00010	0.1477	0.00007

Lifetime Kit Impacts

Figure 7 shows the estimated energy impacts over the lifetime of the kit measures. The steep drop off seen at year five occurs at the end of the effective useful life of the CFLs and the weather stripping. At this point, no further savings is accrued from those measures, however, because behavior taken is the best predictor of future actions, it is very likely that these savings continue well beyond these estimates as burnt out bulbs are replaced with additional CFLs. Again, our approach of counting savings for the actions taken directly as a result of the program, without adding market effects savings, provides a conservative estimate of savings. Since CFLs are the single largest contributor to overall electrical program savings, there is a significant drop in savings as the installed units burn out at the end of their EUL. The second, smaller drop off occurs at the end of the effective useful life of the faucet aerators and the low-flow showerheads. From year ten onward, the savings is comprised of outlet gaskets exclusively.

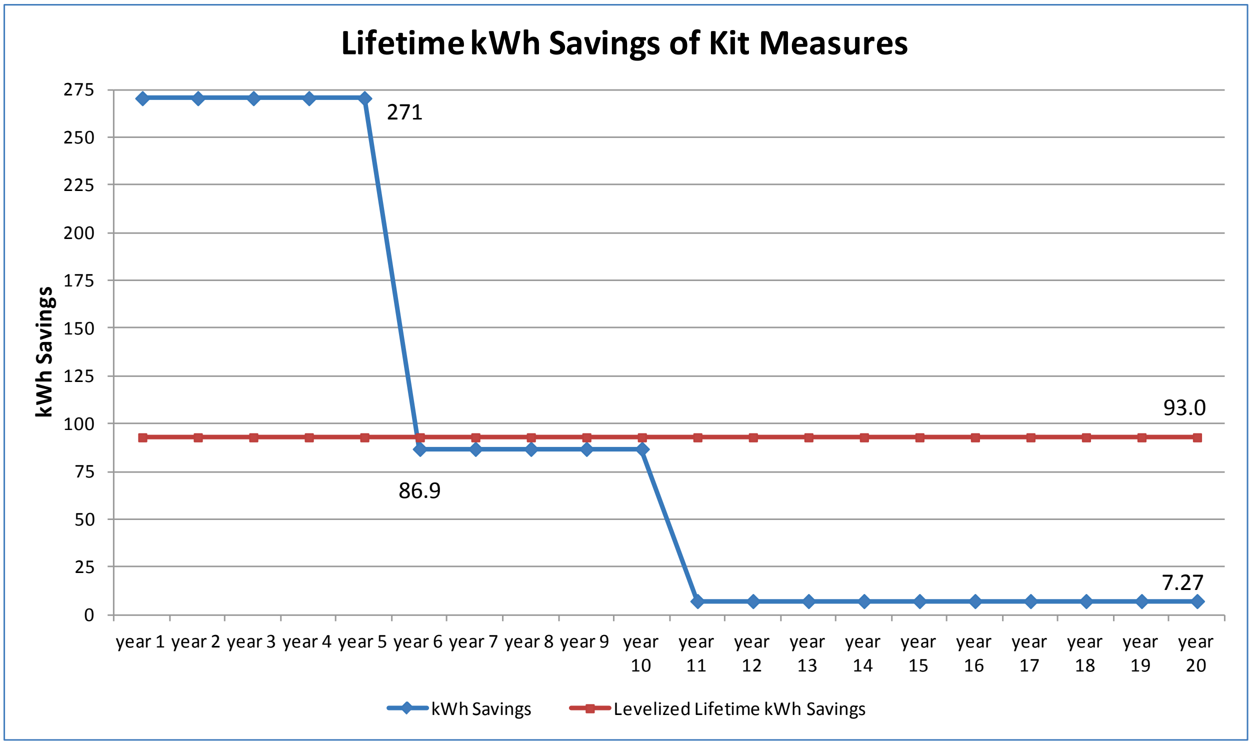

Figure 7. Lifetime kWh Savings of Kit Measures

Total Program Savings Extrapolation

There were a total of 10,935 participants that each received an energy efficiency kit from August 1, 2010 through August 31, 2012. This information is presented in Table 63. Multiplying the participation count by the savings per participant Table 50 produces the total annual program kW and kWh savings. Again, the engineering savings estimations exclude audit recommendations which are included in the billing analysis approach for estimating net savings.

Table 63. Total Program Gross Savings Extrapolation

Participation Count	Gross kWh	Gross kW
10,935	4,909,815	608

Appendix A: Management Interview Instrument

INSTRUMENT

Name: ____

Title: ____

Position description and general responsibilities:

____

____

We are conducting this interview to obtain your opinions about and experiences with the Home Energy House Call program. We'll talk about the program and its objectives, your thoughts on improving the program, and the technologies the program covers. The purpose of this study is to capture the program's current operations as well as help identify areas where the program might be improved. Your responses will feed into a report that will be shared with Duke Energy and the state regulatory agency. I want to assure you that the information you share with me will be kept confidential; we will not identify you by name. However, you may provide some information or opinions that could be attributed to you by virtue of your position and role in this program. If there is sensitive information you wish to share, please warn me and we can discuss how best to include that information in the report.

The interview will take about an hour to complete. Do you have any questions for me before we begin?

Program Background and Objectives (15 min)

1. Please describe your role and scope of responsibility in detail.
2. How long have you been involved with the REA program?
3. (PM only) Describe the evolution of the REA Program. Why was the program created, and has the program changed since it was it first started?
4. Have there been any recent changes been made to your duties since you started?
    a. If YES, please tell us what changes were made and why they were made. What are the results of the change?
5. In your own words, please describe the REA Program's objectives. (e.g. enrollment, energy savings, non-energy benefits)

6. (PM only) Can you please walk me through the program's implementation, starting with how the program is marketed and how you target your customers, through how the customer participates and finishing with how savings are verified?

    a. Marketing/Targeting: How & Who

    b. Enrollment/Participation

    c. Rebate processing

    d. Savings verification: How & Who

7. Of the program objectives you mentioned earlier, do you feel any of them will be particularly easy to meet, and why?

8. Which program objectives, if any, do you feel will be relatively difficult to meet, and why?

9. Are there any objectives you feel should be revised prior to the end of this program cycle? If yes, why?

Vendors (10 min)

10. (PM only) Do you use any vendors or contractors to help implement the program?

    a. What responsibilities do they have?

    b. Are there any areas in which think they can improve their services?

11. *(If not captured earlier)* Please explain how activities of the program's vendors, customers and Duke Energy are coordinated.

    a. Do you think methods for coordination should be changed in any way? If so, how and why?

Rebates (15 min)

12. (PM only) How do you determine which pieces of equipment are included in the program? For example, how do you determine what level of efficiency the rebated equipment should have?

    a. Do you use any outside vendors or experts to help with this process?

    b. What should be changed about this selection process?

13. Describe your quality control and process for tracking participants, rebates, and other program data.

14. Do you believe that the program currently offers rebates on enough energy efficient products to meet your customers' needs?
    a. If not, what products would you like to add? Are these currently being considered?
15. Is the program offering enough of a rebate to motivate your customers to participate?
    a. If not, which rebates do you think should be changed, and why?

Contractor Training (5 min)

16. Describe HEHC's contractor program orientation training and development approach.
    a. (PM and WECC only) How do you ensure that contractors are getting adequate program training and updated program information?
    b. Can we obtain training materials that are being used?
    c. Are there any new areas where you think contractors could be trained?
17. Do you have any suggestions for improving contractor effectiveness?

Improvements (10 min)

18. Are you currently considering any changes to the program's design or implementation?
    a. What are the changes?
    b. What is the process for deciding whether or not to make these changes?
19. Do you have suggestions for improvements to the program that would increase participation rates, or is Duke Energy happy with the current level of participation?
20. Do you have suggestions for increasing energy impacts *per participant*, given the same participation rates, or is Duke Energy happy with the current per participant impact?
21. Overall, what would you say about the Smart $aver® program is working really well?
    a. Is there anything in this program you could highlight as a best practice that other utilities might like to adopt?
22. What area needs the most improvement, if any?
    a. (If not mentioned before) What would you suggest can be done to improve this?
23. Are there any other issues or topics we haven't discussed that you feel should be included in this report?

24. Do you have any further questions for me about this study or anything else?
25. Thank you!

Appendix B: Participant Survey Instrument

The questions below require mostly short, scaled replies from the interviewee, and not all questions will be asked of all participants. This interview will take approximately 30 minutes.

Use four attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday.

Note: Only read words in bold type.

Info*

Surveyor Name: ___________________________

Survey ID: ___________________________

State*

( ) Kentucky

( ) Ohio

( ) North Carolina

( ) South Carolina

Recommendations*

[ ] A. Attic Insulation

[ ] B. Wall Cavity Insulation

[ ] C. Basement Walls Insulation

[ ] D. Floor / Perimeter Insulation

[ ] E. Seal Leaky Windows

[ ] F. Seal Leaky Doors

[ ] G. Seal Leaky Fireplaces

[ ] H. Seal Leaky Attic Access

[ ] I. Seal leaky plumbing, electrical, or other openings in shell.

[ ] J. Seal Other Major Source of Outside Infiltration

[ ] K. Attic Duct Insulation

[ ] L. Garage Duct Insulation

[ ] M. Crawlspace / Basement Duct Insulation

[ ] N. Attic Ducts Sealed

[ ] O. Garage Ducts Sealed

[ ] P. Major Duct Repair(s) Needed to Seal System

[ ] Q. HP Appears to be Acceptable Age But Needs to be Serviced

[ ] R. HP Appears to be Old or You Have No Heat Pump Now

[ ] S. Furnace Filter Needs Attention

[ ] T. Close Vents in Summer

[ ] U. Close Vents in Winter

[ ] V. Significant Crawl Space or Basement Sealing Repair is Needed

[ ] W. Window shades half-drawn

[ ] X. Shading rarely used

[ ] Y. Significant east/west, unshaded solar exposure

[ ] Z. System set to 'auto' all the time

[ ] AA. Reduce hot water temperature to 120 degrees

[ ] BB. Reduce temperature of wash loads

[ ] CC. Reduce temperature of rinse loads

[ ] DD. Consider unplugging extra refrigerator

Complete ALL of the above information fields BEFORE calling each customer.

Hello, my name is ______. I am calling on behalf of Duke Energy to conduct a customer survey about the Home Energy House Call Program. May I speak with ______________ please?

If person talking, proceed. If person is called to the phone, reintroduce. If not home, ask when would be a good time to call and schedule the call-back:

We are conducting this survey to obtain your opinions about the Home Energy House Call Program. Duke Energy's records indicate that you participated in the Home Energy House Call Program in [*month / year*]. We will send you a check for $20 for completing the survey. It will take about 30 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1. Do you recall participating in the Home Energy House Call Program?*

( ) Yes

( ) No

( ) DK/NS

1a. This program was provided through Duke Energy. In this program, you registered to receive a home energy audit. In return, the auditors provided you with custom energy-saving recommendations for you and your home, and you were provided with a free energy efficiency kit with 10 measures, such as a low flow showerhead, CFLs, and outlet gaskets. Do you remember participating in this program?*

( ) Yes

( ) No

( ) DK/NS

If No or DK/NS terminate interview and go to next participant.

2. How were you first made aware of the Home Energy House Call Program?*

( ) Saw an insert in monthly bill

( ) Saw information at the Duke Energy Website

( ) Saw/heard an advertisement on radio, TV, or in the newspaper *ask:* **Where?**: _________________*

( ) Friend/ Family Member/ Co-Worker

( ) Through a low-income program

( ) Through another energy audit program

( ) Other: _________________*

3. Before you heard about the Home Energy House Call Program from Duke Energy, had you already been considering getting a home energy audit?*

( ) Yes

( ) No

( ) DK/NS

4. If the audit from Duke Energy's Home Energy House Call Program had not been available, would you still have purchased an audit from another company?*

( ) Yes

( ) No

( ) DK/NS

4b. Would you have purchased the audit within the next year?*

( ) Yes

( ) No

( ) DK/NS

4c. How much would you have been willing to spend on an audit if you had not obtained one from Duke Energy?*

____

Do not read list, select "1" next to the first response. ask:

Were there any other reasons?

number responses above in the order they are provided - Repeat until 'no' response

5. Please think back to the time when you were deciding to participate in the Home Energy House Call program. What factor or factors motivated you to participate?*

_______The audit

_______The energy efficiency kit

_______The program incentives *(List specific incentive:)*

_______The technical assistance from the auditor

_______Recommendation of someone else *(Who?)*

_______Wanted to reduce energy costs

_______The information provided by the Program

_______Past experience with this program

_______Because of past experience with another Duke Energy program

_______Recommendation from other utility program *(What program?)*

_______Recommendation of family/friend/neighbor

_______Advertisement in newspaper *(For what program?)*

_______Radio advertisement *(For what program?)*

_______Other *(please specify...)*

_______DK/NS

if "The program incentives " ask:

5a. What specific incentives?

____

if "Recommendation of someone else" ask:

5b. Who?

____

if "Recommendation from other utility program " ask:

5c. What other utility program ?

____

if "Advertisement in newspaper " ask:

5d. For what Duke energy program?

____

if "Radio advertisement" ask:

5e. For what Duke energy program ?

____

if "Other" ask:

5f. Please specify ?

____

Arranging and Welcoming the HEHC

Now I am going to ask you some general satisfaction statements. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statements.

6. Scheduling the home energy audit was easy to do.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

6a. How could this be improved?

____

7. The interactions and communications I had with the energy auditor were satisfactory.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

( ) N/A

If 7 or less,

7a. How could this be improved?

____

8. The interactions and communications I had with Duke Energy staff were satisfactory.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

( ) N/A

If 7 or less,

8a. How could this be improved?

____

9. The energy auditor was helpful and knowledgeable.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

( ) N/A

If 7 or less,

9a. How could this be improved?

____

10. The audit report was easy to read and understand.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

10a. How could this be improved?

____

11. The recommendations in the audit report provided new ideas that I was not previously considering.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

11a. How could this be improved?

____

12. The recommendations in the audit report increased the likelihood that I would take the recommended actions.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

12a. How could this be improved?

____

13. The web site's form for getting the kit was easy to understand and complete.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

( ) NA

If 7 or less,

13a. How could this be improved?

____

14. The measures I installed from the energy efficiency kit were of satisfactory quality.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

14a. How could this be improved?

---

15. The audit report looked professional.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

15a. How could this be improved?

---

16. The audit report was trustworthy.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

16a. How could this be improved?

____

Details on Items from the Energy Efficiency Kit

Now I'd like to talk about the energy efficiency kit that you received for participating in the Home Energy House Call program. I'm going to read a list of the items included in the kit, and for each one, please tell me if you have installed the item, and if so, how you're using that item.

17. First, let's look at the Compact Fluorescent Light bulbs you received. Did you receive two CFLs?*
Note: Kit typically included one 13-watt CFL and one 18-watt CFL.

( ) Yes

( ) No *ask:* **How many?**: ____________________*

( ) DK/NS

18. Did you or the auditor install the 13-watt CFL ?*
( ) Yes, I installed

( ) Yes, auditor installed

( ) No

18a. Do you plan on using this CFL?*
( ) Yes

( ) No

( ) Maybe or DK/NS

If no to 18a, ask:

18b. Why Not?*

____

If yes to 18, 13 watt was installed, ask:

18c. How many watts was the old bulb that was replaced with the CFL?*
( ) 44 or less

( ) 45 to 70

( ) 71 to 99

( ) 100 or more

( ) DK/NS

If yes to 18, 13-watt was installed, ask:

18d. On average, approximately how many hours per day is this light used?*

( ) less than 1

( ) 1 to 2

( ) 3 to 4

( ) 5 to 10

( ) 11 to 12

( ) 13 to 24

( ) DK/NS

If yes to 18, 13-watt was installed, ask:

18e. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 13-watt CFL.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

19. Did you or the auditor install the 18-watt CFL ?*

( ) Yes, I installed

( ) Yes, auditor installed

( ) No

19a. Do you plan on using this CFL?*

( ) Yes

( ) No

( ) Maybe or DK/NS

If no to 19a, ask:

19b. Why Not?*

____

If yes to 19, 18-watt CFL was installed, ask:

19c. How many watts was the old bulb that was replaced with the CFL?*

( ) 44 or less

( ) 45 to 70

( ) 71 to 99

( ) 100 or more

( ) DK/NS

If yes to 19, 18-watt CFL was installed, ask:

19d. On average, approximately how many hours per day is this light used?*

( ) less than 1

( ) 1 to 2

( ) 3 to 4

( ) 5 to 10

( ) 11 to 12

( ) 13 to 24

( ) DK/NS

If yes to 19, 18-watt CFL was installed, ask:

19e. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 18-watt CFL.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If one or both CFLs were installed, ask:

20. Did you remove either of the CFLs provided through this program?*

( ) Yes

ask: **20a. How many did you remove?**: _________________*

( ) No

( ) DK/NS

If yes to 20,

20a. Why did you remove them?*

[ ] Not bright enough

[ ] too bright

[ ] did not like the light

[ ] too slow to start

[ ] mercury concerns

[ ] burned out

[ ] not working properly

[ ] other

21. Did you have any CFLs installed in your home before you requested the HEHC audit or received the kit from the program?*

( ) Yes

ask: **21a. How many?**: _________________*

( ) No

( ) DK/NS

22. Were you planning on buying CFLs for your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) Maybe

( ) DK

( ) No, already have them installed in all available sockets

If yes,

22a. How long do you think it would have been before you would have purchased additional CFLs had Duke not provided these to you?*

____

23. Have you purchased any CFLs since receiving the kit from Home Energy House Call?*

( ) Yes

ask: **23a. How many?**: _________________*

( ) No

( ) DK/NS

PLUMBING FIXTURES

Next, we'd like to look at the plumbing fixtures that were included in your kit.

24. Did you or the auditor install the Low flow showerhead?*

( ) Yes, I installed

( ) Yes, auditor installed

( ) No

if customer installed

24a. Was it easy to install?*

( ) Yes

( ) No

( ) DK/NS

if NOT installed

24b. Do you plan on using this item?*

( ) Yes

( ) No

( ) DK/NS

if NO, ask:

24c. Why not?*

____

If yes to 24,

24d. Typically how many showers per week are taken using this showerhead?*

( ) 0 to 4

( ) 5 to 10

( ) 11 to 15

( ) 16 to 20

( ) 21 or more

If yes to 24,

24e. Would you estimate that the water coming out of this showerhead is…*

( ) Less than the old unit

( ) About the same as the old unit

( ) More than the old unit

If yes to 24:

24f. Was the teflon tape included in the kit used when the showerhead was installed?*

( ) Yes

( ) No

( ) DK/NS

If yes to 24:

24g. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's low flow showerhead.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

24h. Did you have any low flow showerheads installed in your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) DK/NS

24i. Were you planning on buying a new low flow showerhead for your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) Maybe

( ) DK/NS

( ) No, already have them installed in all showers

24j. Have you purchased any additional low flow showerheads since receiving the kit from Home Energy House Call?*

( ) Yes

If YES, ask: **25k. How many?**: _________________

( ) No

( ) DK/NS

25. Did you or the auditor install the Kitchen faucet aerator?*

( ) Yes, I installed

( ) Yes, auditor installed

( ) No

if customer installed

25a. Was it easy to install?*

( ) Yes

( ) No

( ) DK/NS

if NOT installed

25b. Do you plan on using this item?*

( ) Yes

( ) No

( ) DK/NS

if NO

25c. Why not?*

____

If yes to 26,

25d. Was there an aerator already installed that you had to remove?*

( ) Yes

( ) No

( ) DK/NS

If yes to 25

25e. Would you estimate that the water coming out of this aerator is…*

( ) Less than the old unit

( ) About the same as the old unit

( ) More than the old unit

If yes to 25:

25f. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kitchen faucet aerators.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

25g. Did you have any faucet aerators installed in your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) DK/NS

25h. Were you planning on buying any faucet aerators for your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) Maybe

( ) DK/NS

( ) No, already have them installed in all available faucets

25i. Have you purchased any additional faucet aerators since receiving the kit from Home Energy House Call?*

( ) Yes

If YES, ask: **26j. How many?**: ___________________

( ) No

( ) DK/NS

26. Did you or the auditor install the Bathroom faucet aerator?*

( ) Yes, I installed

( ) Yes, auditor installed

( ) No

if customer installed

26a. Was it easy to install?*

( ) Yes

( ) No

( ) DK/NS

if NOT installed

26b. Do you plan on using this item?*

( ) Yes

( ) No

( ) DK/NS

if NO

26c. Why not?*

____

If yes to 26,

26d. Was there an aerator already installed that you had to remove?*

( ) Yes

( ) No

( ) DK/NS

If yes to 26,

26e. Would you estimate that the water coming out of this aerator is…*

( ) Less than the old unit

( ) About the same as the old unit

( ) More than the old unit

If yes to 26:

26f. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's bathroom faucet aerators.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

(skip 26g-j if 25g-j answered).

26g.Did you have any faucet aerators installed in your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) DK/NS

26h. Were you planning on buying any faucet aerators for your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) Maybe

( ) DK/NS

( ) No, already have them installed in all available faucets

26i. Have you purchased any additional faucet aerators since receiving the kit from Home Energy House Call?*
( ) Yes
If YES, ask: **27j. How many?**: _________________

( ) No

( ) DK/NS

GASKETS
27. Did you or the auditor install the Outlet gaskets?*
( ) Yes, I installed

( ) Yes, auditor installed

( ) No

if NOT installed

27a. Do you plan on using this item?*
( ) Yes

( ) No

( ) DK/NS

If yes to 27:

27b. How many did you install on the <u>interior</u> walls of your home?*
( ) 0

( ) 1 to 2

( ) 3 to 5

( ) 6 to 8

( ) 9 to 12

( ) DK

If yes to 27:

27c. How many did you install on the <u>exterior</u> walls on the inside of your home?*
( ) 0

( ) 1 to 2

( ) 3 to 5

( ) 6 to 8

( ) 9 to 12

( ) DK

If yes to 27:

27d. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's outlet gaskets.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

27e. Did you have any outlet gaskets installed in your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) DK/NS

27f. Were you planning on buying any outlet gaskets for your home before you received the kit from the Home Energy House Call program?*

( ) Yes

( ) No

( ) Maybe

( ) DK/NS

( ) No, already have them installed in all available outlets

27g. Have you purchased any additional outlet gaskets since receiving the kit from Home Energy House Call?*

( ) Yes

If YES, ask: **27h. How many?**: _________________

( ) No

( ) DK/NS

28. Did you or the auditor install the Switch gasket insulators?*

( ) Yes, I installed

( ) Yes, auditor installed

( ) No

if NOT installed

28a. Do you plan on using this item?*

( ) Yes

( ) No

( ) DK/NS

If yes to 28:

28b. How many did you install on the <u>interior</u> walls of your home?*

( ) 0

( ) 1 to 2

( ) 3 to 5

( ) 6 to 8

( ) 9 to 12

( ) DK

If yes to 28:

28c. How many did you install on the <u>exterior</u> walls on the inside of your home?*

( ) 0

( ) 1 to 2

( ) 3 to 5

( ) 6 to 8

( ) 9 to 12

( ) DK

If yes to 28:

28d. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's switch gaskets.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

28e. Did you have any switch gaskets installed in your home before you received the kit from the Home Energy House Call program?*
( ) Yes

( ) No

( ) DK/NS

28f. Were you planning on buying any switch gaskets for your home before you received the kit from the Home Energy House Call program?*
( ) Yes

( ) No

( ) Maybe

( ) DK/NS

( ) No, already installed on all available switch panels

28g. Have you purchased any additional switch gaskets since receiving the kit from Home Energy House Call?*
( ) Yes *If YES, ask:* **28h. How many?**: _________________

( ) No

( ) DK/NS

29. Did you or the auditor install the Weather-stripping?*
( ) Yes, I installed

( ) Yes, auditor installed

( ) No

if NOT installed

29a. Do you plan on using this item?*
( ) Yes

( ) No

( ) DK/NS

If yes to 29:

29b. How many feet did you install?*
( ) 1 to 5

( ) 6 to 10

( ) 11 to 17

( ) 18 or more

( ) DK

29c. Did you have any weather-stripping installed in your home before you received the kit from the Home Energy House Call program?*
( ) Yes

( ) No

( ) DK/NS

29d. Were you planning on buying any weather-stripping for your home before you received the kit from the Home Energy House Call program?*
( ) Yes

( ) No

( ) No, already have them installed around all available doors

( ) Maybe

( ) DK/NS

29e. Have you purchased any additional weather-stripping since receiving the kit from Home Energy House Call?*
( ) Yes
If YES, ask: **29f. For how many doors?**: _________________

( ) No

( ) DK/NS

(NOTE: question 30 was deleted, but the rest of the survey was not re-numbered.)

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - HOME SHELL INSULATION

Next, we're going to discuss the recommendations that were given to you in the audit. This would have been a sheet listing 11 areas where the auditor would have checked your home for possible improvements.

31. Do you recall getting this audit report?*
( ) Yes

( ) No

( ) DK/NS

Home Shell Insulation

If any of home shell insulation recommendations were provided...

According to our records, the auditor made one or more recommendations for your home shell insulation.

==

If ***Attic Insulation*** *recommended, ask:*

32a. Did you add insulation to your attic?*

( ) Yes

( ) No

( ) DK/NS

32a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

32a-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32a-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32a-RSd. We would like to know where you were in the process of taking this action, were you..*

Read answers in ***BOLD*** *aloud.*

( ) **Actively searching for someone to install the insulation,**

( ) Located an insulation installer, or had you

( ) Arranged for insulation to be installed OR decided to install insulation yourself

===

*If **Wall Cavity Insulation** recommended, ask:*

32b. Did you add insulation to your walls?*

( ) Yes

( ) No

( ) DK/NS

32b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

32b-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32b-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32b-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) Actively searching for someone to install the insulation in the walls,

( ) Located an insulation installer, or had you

( ) Arranged for insulation to be installed OR decided to install insulation yourself

===

If ***Basement Walls Insulation*** *recommended, ask:*

32c. Did you add insulation to your basement walls?*

( ) Yes

( ) No

( ) DK/NS

32c-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

32c-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32c-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32c-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) Actively searching for someone to install the insulation,

( ) Located an insulation installer, or had you

( ) Arranged for insulation to be installed OR decided to install insulation yourself

===
===================================

If ***Floor / Perimeter Insulation*** *recommended, ask:*

32d. Did you add insulation to your floors or perimeter?*

( ) Yes

( ) No

( ) DK/NS

32d-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

32d-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32d-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

32d-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) **Actively searching for someone to install the insulation,**

( ) **Located an insulation installer, or had you**

( ) **Arranged for insulation to be installed OR decided to install insulation yourself**

32e. Of the recommendations, what did you insulate?*

[ ] Attic

[ ] Walls

[ ] Basement walls

[ ] Floor/Perimeter

[ ] NONE

32f. Do you know what the R-value was before the insulation - ATTIC Insulation*

( ) Yes *ask:* **What was the R-value?**: _________________*

( ) No

( ) DK/NS

( ) Other: _________________*

32g. What was it after the insulation was added ? - ATTIC Insulation*

( ) R-value =: _________________*

( ) Contractor did it (assume to code)

( ) DK/NS

( ) Other: _________________*

32h. How many square feet were insulated in ATTIC ?*

( ) # of square feet: _________________*

( ) DK/NS

32i. Do you know what the R-value was before the insulation - WALLS Insulation*

( ) Yes *ask:* **What was the R-value?**: _________________*

( ) No

( ) DK/NS

( ) Other: _________________*

32j. What was it after the insulation was added ? - WALLS Insulation*

( ) R-value =: _________________*

( ) Contractor did it (assume to code)

( ) DK/NS

( ) Other: _________________*

32k. How many square feet were insulated in WALLS ?*
( ) # of square feet: _________________*

( ) DK/NS

32l. Do you know what the R-value was before the insulation - BASEMENT WALLS Insulation*
( ) Yes *ask:* **What was the R-value?**: _________________*

( ) No

( ) DK/NS

( ) Other: _________________*

32m. What was it after the insulation was added ? - BASEMENT WALLS Insulation*
( ) R-value =: _________________*

( ) Contractor did it (assume to code)

( ) DK/NS

( ) Other: _________________*

32n. How many square feet were insulated in BASEMENT WALLS ?*
( ) # of square feet: _________________*

( ) DK/NS

32o. Do you know what the R-value was before the insulation - FLOOR / PERIMETER Insulation*
( ) Yes *ask:* **What was the R-value?**: _________________*

( ) No

( ) DK/NS

( ) Other: _________________*

32p. What was it after the insulation was added ? - FLOOR / PERIMETER Insulation*
( ) R-value =: _________________*

( ) Contractor did it (assume to code)

( ) DK/NS

( ) Other: _________________*

32q. How many square feet were insulated in FLOOR / PERIMETER ?*
( ) # of square feet: _________________*

( ) DK/NS

32r. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Attic Insulation: ___________________________

Wall Insulation: ___________________________

Basement wall Insulation: ___________________________

Floor/perimeter Insulation: ___________________________

Other Insulation: ___________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - HOME SHELL AIR TIGHTNESS

Home Shell Air Tightness

According to our records, the auditor made one or more recommendations for your home shell air tightness.

==
==

If ***Seal Leaky Windows*** *recommended, ask:*

33a. Did you seal leaky windows?*

( ) Yes

( ) No

( ) DK/NS

33a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

32a-RSb. Were you considering taking this action prior to the audit?

( ) Yes

( ) No

( ) DK/NS

33a-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33a-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) Actively searching for someone to seal leaky windows,

( ) Located service provider to seal leaky windows, or had you

( ) Arranged for service to be provided OR decided to seal leaky windows yourself

===
====================================

*If **Seal Leaky Doors** recommended, ask:*

33b. Did you seal leaky doors?*

( ) Yes

( ) No

( ) DK/NS

33b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

33b-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33b-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33b-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) **Actively searching for someone to seal leaky doors,**

( ) **Located a service provider to seal leaky doors, or had you**

( ) **Arranged for service to be provided OR decided to seal leaky doors yourself**

==

If ***Seal Leaky Fireplaces*** *recommended, ask:*

33c. Did you seal leaky fireplaces?*

( ) Yes

( ) No

( ) DK/NS

33c-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

33c-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33c-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33c-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) **Actively searching for someone to seal leaky fireplaces,**

( ) **Located a service provider to seal leaky fireplaces, or had you**

( ) **Arranged for service to be provided OR decided to seal leaky fireplaces yourself**

===
=====================================

*If **Seal Leaky Attic Access** recommended, ask:*

33d. Did you seal leaky attic access?*

( ) Yes

( ) No

( ) DK/NS

33d-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

33d-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33d-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33d-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) Actively searching for someone to seal leaky attic access,

( ) Located a service provider to seal leaky attic access, or had you

( ) Arranged for service to be provided OR decided to seal leaky attic access yourself

===

*If **Seal Leaky Plumbing/Electrical/Ceiling Lights/Other Openings in a Shell** recommended, ask:*

33e. Did you seal leaky plumbing / electrical / ceiling lights / other openings in a shell?*

( ) Yes

( ) No

( ) DK/NS

33e-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

33e-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33e-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33e-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) Actively searching for someone to seal leaks in the shell,

( ) Located a service provider to seal leaks in the shell, or had you

( ) Arranged for service to be provided OR decided to seal leaks in the shell yourself

===
=================================

If ***Seal Other Major Source of Outside Infiltration*** *recommended, ask:*

33f. Did you seal other major sources of outside infiltration?*

( ) Yes

( ) No

( ) DK/NS

33f-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

33f-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33f-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

33f-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) **Actively searching for someone to seal other major source of outside infiltration,**

( ) **Located a service provider to seal other major source of outside infiltration, or had you**

( ) **Arranged for service to be provided OR decided to seal other major source of outside infiltration yourself**

33g. Is there anything else that you did or plan to do in response to this/these recommendation(s)?

ask **What?** *and* **When?**

Windows: ___________________________

Doors: ___________________________

Fireplaces: ___________________________

Attic access: ___________________________

Plumbing/ electrical/ ceiling lights: ___________________________

Other outside infiltration: ___________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - DUCT INSULATION

Duct Insulation

According to our records, the auditor made one or more recommendations for your home duct insulation.

34a. In which locations are the ducts in your home?*
(check all that apply)

[ ] Attic

[ ] Garage

[ ] Crawlspace

[ ] Basement

[ ] Walls

[ ] DK/NS

==
=====================================

(recommendation: Install insulation over ducts in attic to R-19 (6 inches of insulation).)

If ***Attic Duct Insulation*** *recommended, ask:*

34b. Did you insulate your attic ducts?*

( ) Yes

( ) No

( ) DK/NS

34b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

34b-RSb. Were you considering taking this action prior to the audit?*
( ) Yes
( ) No

( ) DK/NS

34b-RSc. Had you made a decision to take this action prior to the audit?*
( ) Yes

( ) No

( ) DK/NS

34b-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) **Actively searching for someone to insulate the attic ducts,**

( ) **Located a service provider to insulate the attic ducts, or had you**

( ) **Arranged for service to be provided OR decided to insulate the attic ducts yourself**

==

(NOTE: Install insulation around ducts in garage to R-19 (6 inches of insulation).)

If ***<u>Garage Duct Insulation</u>*** *recommended, ask:*

34c. Did you insulate your garage ducts?*
( ) Yes

( ) No

( ) DK/NS

34c-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

34c-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

34c-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

34c-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) Actively searching for someone to insulate the garage ducts,

( ) Located a service provider to insulate the garage ducts, or had you

( ) Arranged for service to be provided OR decided to insulate the garage ducts yourself

===
====================================

(NOTE: Ducts in crawl space or basement should be in a conditioned area for winter. Insulate perimeter walls and/or close up crawl space or basement for winter.)

If ***Crawlspace / Basement Duct Insulation*** *recommended, ask:*

34d. Did you insulate your crawlspace or basement ducts?*

( ) Yes

( ) No

( ) DK/NS

34d-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

34d-RSb. Were you considering taking this action prior to the audit?*
( ) Yes

( ) No

( ) DK/NS

34d-RSc. Had you made a decision to take this action prior to the audit?*
( ) Yes

( ) No

( ) DK/NS

34d-RSd. We would like to know where you were in the process of taking this action, were you..*
( ) **Actively searching for someone to insulate the crawlspace or basement ducts,**

( ) **Located a service provider to insulate the crawlspace or basement ducts, or had you**

( ) **Arranged for service to be provided OR decided to insulate the ducts yourself**

34f. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Attic Duct Insulation: _________________________

Garage Duct Insulation: _________________________

Crawlspace / Basement Duct Insulation: _________________________

Other Duct Insulation: _________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - DUCT AIR TIGHTNESS

<u>Duct Air Tightness</u>

According to our records, the auditor made one or more recommendations for your duct air tightness.

==
======================================

If ***<u>Attic Ducts Sealed</u>*** *recommended, ask:*

35a. Did you seal attic ducts?*
( ) Yes

( ) No

( ) DK/NS

35a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

35a-RSb. Were you considering taking this action prior to the audit?*
( ) Yes

( ) No

( ) DK/NS

35a-RSc. Had you made a decision to take this action prior to the audit?*
( ) Yes

( ) No

( ) DK/NS

35a-RSd. We would like to know where you were in the process of acquiring this service (or taking this action), were you..*
( ) Actively searching for someone to seal the attic ducts,

( ) Located a service provider to seal the attic ducts, or had you

( ) Arranged for service to be provided OR decided to seal the attic ducts yourself?

==

If ***Garage Ducts Sealed*** *recommended, ask:*

35b. Did you seal garage ducts?*
( ) Yes

( ) No

( ) DK/NS

35b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

35b-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

35b-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

35b-RSd. We would like to know where you were in the process of taking this action, were you..*

( ) Actively searching for someone to seal the garage ducts,

( ) Located a service provider to seal the garage ducts, or had you

( ) Arranged for service to be provided OR decided to seal the garage ducts yourself?

===
=====================================

*If **Major Duct Repair(s) Needed to Seal System** recommended, ask:*

35c. Did you make major duct repair(s) needed to seal the system?*

( ) Yes

( ) No

( ) DK/NS

35c-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

35c-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

35c-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

35c-RSd. We would like to know where you were in the process of acquiring this service (or taking this action), were you..*

( ) **Actively searching for someone to make major duct repairs,**

( ) **Located a service provider to make major duct repairs, or had you**

( ) **Arranged for service to be provided OR decided to make major duct repairs yourself?**

35d. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Attic Ducts Sealed: ___________________________

Garage Ducts Sealed: ___________________________

Major Duct Repair(s) Needed to Seal System: ________________________

Other Duct Sealing: ________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - HEAT PUMP CONDITION

Heat Pump Condition

According to our records, the auditor made one or more recommendations for your heat pump.

===

*If **HP Appears to be Acceptable Age But Needs to be Serviced** recommended, ask:*

36a. Did you have your heat pump serviced?*

( ) Yes

( ) No

( ) DK/NS

36a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

36a-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

36a-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

36a-RSd. We would like to know where you were in the process of acquiring this service, were you..*

( ) Actively searching for someone to service your heat pump,

( ) Located a service provider to service your heat pump, or had you

( ) Arranged for service to be provided

==

If ***HP Appears to be Old or You Have No Heat Pump Now*** *recommended, ask:*

36b. Did you install or replace your heat pump?*

( ) Yes

( ) No

( ) DK/NS

36b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

36b-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

36b-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

36b-RSd. We would like to know where you were in the process of acquiring this service (or taking this action), were you..*

( ) Actively searching for someone to install/replace your heat pump,

( ) Located service provider to install/replace your heat pump, or had you

( ) Arranged for service to be provided

36c. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Make heat pump operable: _________________________

Service heat pump: _________________________

Install/replace heat pump: _________________________

Other Heat pump action: _________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - FURNACE FILTER

Furnace Filter

According to our records, the auditor recommended that you clean, replace, or repair your furnace filter.

==
===================================

If Filter Needs Attention (cleaned/replaced; or filter area needs repair) recommended, ask:

37a. Did you clean, replace, or repair the furnace filter?*
( ) Yes

( ) No

( ) DK/NS

37a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

37a-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

37a-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

37a-RSd. We would like to know where you were in the process of acquiring this service (or taking this action), were you..*

( ) Actively searching for someone to replace or repair your furnace filter,

( ) Located a service provider to replace or repair your furnace filter, or had you

( ) Arranged for service to be provided OR decided to do it yourself?

37b. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Clean/replace filter: ___________________________

Repair filter area: ___________________________

Other furnace filter action: ___________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - CRAWL SPACE VENTS

Crawl Space Vents

According to our records, the auditor made one or more recommendations for your crawl space vents.

===
======================================

If ***Consider Closing Vents in Summer*** *recommended, ask:*

38a. Did you close vents in the summer?*
( ) Yes
( ) No

( ) DK/NS

38a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

38a-RSb. Were you considering taking this action prior to the audit?*
( ) Yes

( ) No

( ) DK/NS

===
======================================

If ***Close Vents in Winter*** *recommended, ask:*

38b. Did you close vents in the winter?*
( ) Yes

( ) No

( ) DK/NS

8b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

38b-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

==
====================================

*If **Significant Crawl Space or Basement Sealing Repair is Needed** recommended, ask:*

38d. Did you seal the crawl space or basement ?*

( ) Yes

( ) No

( ) DK/NS

38d-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

38d-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

38d-RSc. Had you made a decision to take this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

38d-RSd. We would like to know where you were in the process of acquiring this service (or taking this action), were you...*

( ) **Actively searching for someone to repair the crawl space or basement sealing,**

( ) **Located a service provider to do the repair, or had you**

( ) **Arranged for service to be provided or decided to do the repair yourself?**

38e. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Close vents in summer: _________________________

Close vents in winter: _________________________

Repair crawlspace/basement to allow proper sealing: _________________________

Other: _________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - SUMMER WINDOW SHADING

Summer Window Shading

According to our records, the auditor made one or more recommendations for your summer window shading.

===
=====================================

NOTE: In your home, window coverings are normally half drawn on air conditioning days. Fully block direct sunlight for even more air conditioning savings.

*If **Window shades half-drawn** recommended, ask:*

39a. Did you close the shades in summer?*

( ) Yes

( ) No

( ) DK/NS

39a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

39a-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

==
=====================================

NOTE: In your home, window coverings are rarely used on air conditioning days. Block direct sunlight for significant air conditioning savings.

If ***Shading rarely used*** *recommended, ask:*

39b. Did you close the shades in summer?*

( ) Yes

( ) No

( ) DK/NS

39b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to take this action?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

39b-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

===

NOTE: Your home has significant east or west, un-shaded solar exposure. Block the direct sunlight for significant air conditioning savings.

If ***Significant east/west, unshaded solar exposure*** *recommended, ask:*

39c. Did you install shades?*

( ) Yes

( ) No

( ) DK/NS

39c-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to install shades?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

39c-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

39c-RSc. We would like to know where you were in the process of taking action, were you..

( ) **Actively searching for someone to install shades,**

( ) **Located service provider to install shades, or had you**

( ) **Arranged for shades to be installed OR decided to install shades yourself.**

39c-RSd. On a scale of 1-10, with 0 being no influence and 10 being complete influence, how influential was the audit recommendation in your decision to install shades?

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

39d. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Close shades in summer: ___________________________

Purchase/install shades: ___________________________

Other: ___________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - FURNACE FAN RUN TIME

Furnace Fan Run Time

According to our records, the auditor made a recommendation for your furnace fan run times.

==
=====================================

*If **Set to furnace fan to 'auto'** ask:*

40a.. Did you change your furnace fan to 'Auto' ?*

( ) Yes

( ) No

( ) DK/NS

40a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to change your furnace fan to 'Auto'?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

40a-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

40c. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Use 'auto' setting whenever possible: _________________________

Purchase/install ECM fan: _________________________

Other: _________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - HOT WATER

Hot Water

According to our records, the auditor made one or more recommendations for your home's hot water.

==
=====================================

If ***Reduce hot water temperature to 120 degrees*** *recommended, ask:*

41a. Did you reduce the hot water temperature to 120 degrees?*

( ) Yes

( ) No

( ) DK/NS

41a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to reduce the hot water temperature to 120 degrees?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

41a-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

==
=====================================

If ***Change wash loads from hot to warm or cold*** *recommended, ask:*

41b. Did you change wash loads to warm or cold water?*

( ) Yes

( ) No

( ) DK/NS

41b-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to change wash loads to warm or cold?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

41b-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

==
=====================================

If ***Change rinse loads from hot or warm to cold*** *recommended, ask:*

41c.. Did you change rinse loads to cold water?*

( ) Yes

( ) No

( ) DK/NS

41c-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to change rinse loads to cold?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

41c-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

41d. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Reduce hot water temperature: ____________________________

Wash laundry in cold water: ____________________________

Rinse laundry in cold water: ____________________________

Other: ____________________________

DETAILS ON RECOMMENDATIONS FROM THE AUDIT - EXTRA REFRIGERATOR

Extra Refrigerator

According to our records, the auditor made a recommendation for you to unplug your home's second refrigerator.

==
=====================================

If ***Consider unplugging extra refrigerator*** *recommended, ask:*

42a. Did you unplug your extra refrigerator?*

( ) Yes

( ) No

( ) DK/NS

42a-RSa. On a scale of 1-10, with 1 being no influence and 10 being very influential, how influential was the audit recommendation in your decision to unplug your extra refrigerator?*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

42a-RSb. Were you considering taking this action prior to the audit?*

( ) Yes

( ) No

( ) DK/NS

42b. Is there anything else that you did or plan to do in response to this/these recommendation(s)?
ask **What?** *and* **When?**

Unplug/remove extra refrigerator: ____________________________

Other: ____________________________

OTHER ACTIONS TAKEN

43. Did you make other changes to your home, either directly or indirectly, as a result of the audit report?
ask ***What*** *and* ***When?***

44. If Duke Energy were to offer a follow-up program in which the auditor returned to your house and provided feedback on what you've done and/or further recommendations, would you be interested in this service*

( ) Yes

( ) No

( ) DK/NS

if YES to 44

44a. Would you be willing to pay $100 for this service?*

( ) Yes

( ) No

( ) DK/NS

if NO to 44a

44b. Would you be willing to pay $75 for this service?*

( ) Yes

( ) No

( ) DK/NS

if NO to 44b

44c. Would you be willing to pay $50?*

( ) Yes

( ) No

( ) DK/NS

44d. What amount would you be willing to pay?*

( ) Other: _________________

( ) Nothing

45. If you were rating your overall satisfaction with the Home Energy House Call Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?*

OHIO only

( ) Very Satisfied

( ) Somewhat Satisfied

( ) Neither Satisfied nor Dissatisfied

( ) Somewhat Dissatisfied

( ) Very Dissatisfied

( ) Refused

( ) DK/NS

45a. Why do you give it that rating?*

OHIO only

46. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please indicate your overall satisfaction with the program.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less

46a. How could this be improved?*

____

46b. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please indicate your overall satisfaction with Duke Energy.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less

46c. How could this be improved?*

____

OTHER ACTIONS TAKEN

I'm going to ask you some questions on other actions you may have taken, at least in part, as a result of the Home Energy House Call Program.

47. Did you read the "DOE Energy Savers" Booklet?*

( ) Yes

( ) No

( ) No, but I will

( ) DK/NS

If yes to 47,

47a. Did you read and discuss the book with your family?*

( ) Yes

( ) No

( ) No, but I will

( ) DK/NS

Have you taken any actions based on the advice in the booklet in the following areas?

48. Insulation/Air Leaks*

( ) Yes

If YES ask: **48a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

49. Heating and Cooling*

( ) Yes

If YES ask: **49a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

50. Water Heating*

( ) Yes

If YES ask: **50a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

51. Windows*
( ) Yes
If YES ask: **51a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

52. Lighting*
( ) Yes
If YES ask: **52a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

53. Appliances*
( ) Yes
If YES ask: **53a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

54. Home Office*
( ) Yes
If YES ask: **54a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

55. Home Electronics*
( ) Yes
If YES ask: **55a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

56. Driving/Car Maintenance*
( ) Yes
If YES ask: **56a. What did you do?**: __________________

( ) No

( ) No, but I plan to

( ) DK/NS

57. Renewable Energy*
( ) Yes
If YES ask: **57a. What did you do?**: _________________

( ) No

( ) No, but I plan to

( ) DK/NS

OVERALL PROGRAM SATISFACTION

We would like to ask you some general question about your overall feelings about the Home Energy House Call Program.

58. What additional services would you like the program to provide that it does not now provide?*

59. Are there any other things that you would like to see changed about the program?*

60. What do you think can be done to increase people's interest in participating in the Home Energy House Call Program?*

Response:1: _________________________

Response:2: _________________________

Response:3: _________________________

Response:4: _________________________

61. What do you like most about this program?*

62. What do you like least about this program?*

NOTE: Questions 63 to 69 are "Carolina Only".

63- Do you work in the I-277 Loop of Uptown Charlotte?*
( ) Yes

( ) No

If YES

63a. How many days a week do you work Uptown?*
( ) 5 days a week

( ) 3-4 days a week

( ) 1-2 days a week

( ) Office is Uptown, but telecommute full-time

( ) Other: _________________

If NO

63b. Does anyone in your household work in the I-277 Loop Uptown Charlotte?*

( ) Yes

( ) No

If YES to 63b

63c. How many days a week does that person work Uptown?*

( ) 5 days a week

( ) 3-4 days a week

( ) 1-2 days a week

( ) Office is Uptown, but telecommute full-time

( ) Other: _________________

64. Have you heard of "Envision Charlotte"?*

( ) Yes

( ) No

( ) DK/NS

64a. What do you know about it?*

65. Have you heard of "Smart Energy Now"?*

( ) Yes

( ) No

( ) DK/NS

65a. What do you know about it?*

If yes to either 64 or 65:

66. Have you participated in any of the Envision Charlotte or Smart Energy Now events or programs?*

( ) Yes

( ) No

( ) DK/NS

If YES

66a. In which events or programs have you participated?*

If yes to either 64 or 65:

67. Has your knowledge of or participation in any of the Smart Energy Now or Envision Charlotte events influenced your decision to participate in the Home Energy House Call program?*

( ) Yes

( ) No

( ) DK/NS

If yes to either 64 or 65, ask q68 and q69:

On a scale from 1-10, with 1 indicating that the factor was not at all influential, and 10 indicating that the factor was very influential, please rate the level of influence of the following factors on your decision to participate in Home Energy House Call.

68. Your involvement in or awareness of Envision Charlotte, the collaborative partnership among major employers, building owners and managers along with municipal and technology leaders. Its purpose is to create the most environmentally sustainable urban core in the nation by connecting numerous environmental programs and initiatives.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

69. Your involvement or awareness of Smart Energy Now, the program that allows you to see the energy usage of the building you work in in near-real time.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

69b: Has your knowledge of or participation in any Smart Energy Now or Envision Charlotte event influenced your energy usage at home?
( ) Yes
if Yes, ask: **How has your energy use changed at home?**: _________________

( ) No

( ) DK/NS

SPECIALTY BULBS
Please list the number of bulbs currently installed in your home that are specialty bulbs such as dimmable bulbs, three-way bulbs, recessed, flood or directional lights, candelabra lights or other non-standard bulbs…

s1. How many Dimmable bulbs do you have in your home?... how many Outdoor flood bulbs... etc...*
Dimmable bulbs: _________________________

Outdoor flood bulbs: _________________________

Three-way bulbs: _________________________

Spotlight bulbs: _________________________

Recessed bulbs: _________________________

Candelabra bulbs: _________________________

Other: _________________________

s2. For each of these specialty bulbs installed, how many are CFLs?*
Dimmable bulbs: _________________________

Outdoor flood bulbs: _________________________

Three-way bulbs: _________________________

Spotlight bulbs: _________________________

Recessed bulbs: _________________________

Candelabra bulbs: _________________________

Other: _________________________

s3. On a scale from 1-10, with 1 indicating not at all interested and 10 indicating very interested, please rate your interest in Duke Energy providing a direct mail specialty CFL program that shipped discounted specialty bulbs directly to your home:*
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

Please tell me if you would be interested in receiving the following types of CFLs if they were to be offered in the future…

s4. Dimmable CFLs*
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?**:

____

( ) No

( ) DK/NS

s5. Outdoor flood CFLs*
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?**:

____

( ) No

( ) DK/NS

s6. Three-way CFLs*
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?**:

____

( ) No

( ) DK/NS

s7. Spotlight CFLs*
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?**:

____

( ) No

( ) DK/NS

s8. Candelabra CFLs*
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?**:

____

( ) No

( ) DK/NS

(If responder indicated a different specialty bulb)

s9. {Other bulb}
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?**:

____

( ) No

( ) DK/NS

FULL DEMOGRAPHIC SERIES
Finally, we have some general demographic questions…

79. In what type of building do you live?*
( ) Single-family home, detached construction

( ) Single family home, factory manufactured/modular

( ) Single family, mobile home

( ) Row House

( ) Two or Three family attached residence-traditional structure

( ) Apartment (4 + families)---traditional structure

( ) Condominium---traditional structure

( ) Other: __________________

( ) Refused

( ) DK/NS

80. What year was your residence built?*
( ) 1959 and before

( ) 1960-1979

( ) 1980-1989

( ) 1990-1997

( ) 1998-2000

( ) 2001-2007

( ) 2008-present

( ) DK/NS

81. How many rooms are in your home (excluding bathrooms, but including finished basements)?*

( ) None

( ) 1-3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10 or more

( ) DK/NS

82. Which of the following best describes your home's heating system?*

( ) None

( ) Central forced air furnace

( ) Electric Baseboard

( ) Heat Pump

( ) Geothermal Heat Pump

( ) Other: _________________

83. How old is your heating system?*

( ) 0-4 years

( ) 5-9 years

( ) 10-14 years

( ) 15-19 years

( ) 19 years or older

( ) DK/NS

( ) Do not have

84. What is the primary fuel used in your heating system?*

( ) Electricity

( ) Natural Gas

( ) Oil

( ) Propane

( ) Other: _________________

85. What is the secondary fuel used in your primary heating system, if applicable?*
( ) Electricity

( ) Natural Gas

( ) Oil

( ) Propane

( ) Other: _________________

( ) None

86. Do you use one or more of the following to cool your home?*
(Mark all that apply)

[ ] None, do not cool the home

[ ] Heat pump for cooling

[ ] Central air conditioning

[ ] Through the wall or window air conditioning unit

[ ] Geothermal Heat pump

[ ] Other *(please specify?)*

87. How many window-unit or "through the wall" air conditioner(s) do you use?*
( ) None

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8 or more

88. What is the fuel used in your cooling system?*
[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] None

89. How old is your cooling system?*
( ) 0-4 years

( ) 5-9 years

( ) 10-14 years

( ) 15-19 years

( ) 19 years or older

( ) DK/NS

( ) Do not have

90. What is the fuel used by your water heater?*
(Mark all that apply)

[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] No water heater

91. How old is your water heater?*
( ) 0-4 years

( ) 5-9 years

( ) 10-14 years

( ) 15-19 years

( ) More than 19 years

( ) DK/NS

92. What type of fuel do you use for indoor cooking on the stovetop or range?
(Mark all that apply)

[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] No stovetop or range

93. What type of fuel do you use for indoor cooking in the oven?*
(Mark all that apply)

[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] No oven

94. What type of fuel do you use for clothes drying?*
(Mark all that apply)

[ ] Electricity

[ ] Natural Gas

[ ] Oil

[ ] Propane

[ ] Other

[ ] No clothes dryer

95. About how many square feet of living space are in your home?*
(Do not include garages or other unheated areas)

Note: A 10-foot by 12 foot room is 120 square feet

( ) Less than 500

( ) 500 – 999

( ) 1000 – 1499

( ) 1500 – 1999

( ) 2000 – 2499

( ) 2500 – 2999

( ) 3000 – 3499

( ) 3500 – 3999

( ) 4000 or more

( ) DK/NS

96. Do you own or rent your home?*
( ) Own

( ) Rent

97. How many levels are in your home (not including your basement)?*
( ) One

( ) Two

( ) Three

98. Does your home have a heated or unheated basement?*
( ) Heated

( ) Unheated

( ) No basement

99. Does your home have an attic?*
( ) Yes

( ) No

100. Are your central air/heat ducts located in the attic?*
( ) Yes

( ) No

( ) N/A

101. Does your house have cold drafts in the winter?*
( ) Yes

( ) No

102. Does your house have sweaty windows in the winter?*
( ) Yes

( ) No

103. Do you notice uneven temperatures between the rooms in your home?*
( ) Yes

( ) No

104. Does your heating system keep your home comfortable in winter?*
( ) Yes

( ) No

105. Does your cooling system keep your home comfortable in summer?*
( ) Yes

( ) No

106. Do you have a programmable thermostat?*
( ) Yes

( ) No

107. What temperature is your thermostat set to on a typical summer weekday afternoon?*
( ) Less than 69 degrees

( ) 69-72 degrees

( ) 73-78 degrees

( ) Higher than 78 degrees

( ) Off

( ) DK/NS

108. What temperature is your thermostat set to on a typical winter weekday afternoon?*
( ) Less than 67 degrees

( ) 67-70 degrees

( ) 71-73 degrees

( ) 74-77 degrees

( ) Higher than 78 degrees

( ) Off

( ) DK/NS

109. Do You Have a Swimming Pool or Spa?*
( ) Yes

( ) No

Read all answers until they reply

110. Would a two-degree increase in the summer afternoon temperature in your home affect your comfort..*
( ) **Not at all**

( ) **Slightly**

( ) **Moderately, or**

( ) **Greatly**

111. How many people live in this home?*
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8 or more

( ) Prefer not to answer

111a. How many of them are teenagers?*
(age 13-19)
If they ask why: Explain that teenagers are generally associated with higher energy use.

( ) 0

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8 or more

( ) Prefer not to answer

112. How many persons are usually home on a weekday afternoon?*

( ) 0
( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8 or more

( ) Prefer not to answer

113. Are you planning on making any large purchases to improve energy efficiency in the next 3 years?*
( ) Yes

( ) No

( ) NS/DK

The following questions are for classification purposes only and will not be used for any other purpose than to help Duke Energy continue to improve service.

114. What is your age group?*
( ) 18-34

( ) 35-49

( ) 50-59

( ) 60-64

( ) 65-74

( ) Over 74

( ) Prefer not to answer

115. Please indicate your annual household income.*
( ) Under $15,000

( ) $15,000-$29,999

( ) $30,000-$49,999

( ) $50,000-$74,999

( ) $75,000-$100,000

( ) Over $100,000

( ) Prefer Not to Answer

That completes our survey. As I mentioned at the start, we'd like to send you a check for $20 for your time. Should we send it to [name] at [address]?*
Name: ____________________________

Address: ____________________________

City: ____________________________

State: ____________________________

Zip: ____________________________

We have reached the end of the survey. Do you have any comments that you would like for me to pass on to Duke Energy?

OK, thank you for your time and feedback today!

Appendix C: Counts of Participant / Non-participants for Billing Analysis

This appendix presents the counts of participants and non-participants in each month. The first row is always the last month before the first participant, such that for Carolinas the first participant showed up in August 2011 with the first row started in July 2011 (and participant count in July being zero). The last row is the last month of billing data included in the billing analysis, and it may not be the last month of participation cut-off for this analysis. For example the cut-off month for Carolinas is August 2012 whereas the billing data goes through September 2012 such that the last 1 month with non-participant count being zero.

state	yearmonth	Participant_count	Non_participant_count
Carolinas	201007	0	7747
	201008	141	7551
	201009	446	7476
	201010	655	7272
	201011	866	7119
	201012	1067	6879
	201101	1230	6717
	201102	1473	6563
	201103	1722	6330
	201104	1883	6088
	201105	2013	5977
	201106	2169	5727
	201107	2490	5500
	201108	2884	5233
	201109	3315	4722
	201110	3990	4163
	201111	4599	3572
	201112	5155	2999
	201201	5538	2644
	201202	5805	2358
	201203	6116	2067
	201204	6467	1679
	201205	6759	1334
	201206	7075	1055
	201207	7422	767
	201208	7926	302
	201209	1556	0

Appendix D: Estimated Model

This appendix presents the estimated statistical models used in the impact evaluation. The dependent variable is daily usage (monthly billed kWh divided by number of usage days) for the period the period August. 2010 through August 2012. The independent variables in the model are:

- An indicator variable that is equal to one for all months after participating in HEHC, broken out by Carolinas, Ohio and Kentucky.
- Monthly indicator variables, denoted in the tables as yearmonth terms. These variables are equal to 1 if the observation is for that month, and zero otherwise. They are included in the model as interaction with area (mid west or south east) controlling for state specific monthly macro economic conditions.
- Weather terms, specifically interaction of temperature and humidity vs. monthly indicator, which correspond to the weather conditions for the month. They are included in the model as interaction with area (mid west or south east) controlling for state specific weather responses.
- Other Duke offers, including CFL, PER, K12, Low income weatherization and smart saver;
- The number of observations are the total number of monthly billing data records used in the model.

Number of Observations Read	260204
Number of Observations Used	260204

Dependent Variable: kwhd

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12203	160296368.8	13135.8	49.32	<.0001
Error	248000	66055318.1	266.4		
Corrected Total	260203	226351686.9			

R-Square	Coeff Var	Root MSE	kwhd Mean
0.708174	35.37925	16.32030	46.12957

Source	DF	Type I SS	Mean Square	F Value	Pr > F
acct_id	11999	127410864.6	10618.5	39.87	<.0001
yearmonth*area	64	28355029.9	443047.3	1663.39	<.0001
avg_tem*yearmon*area	66	4175046.9	63258.3	237.50	<.0001
avg_hum*yearmon*area	66	188593.3	2857.5	10.73	<.0001
PER	1	30593.7	30593.7	114.86	<.0001
K12	1	1348.3	1348.3	5.06	0.0245
LowInc	1	610.8	610.8	2.29	0.1299
SS	1	31714.0	31714.0	119.07	<.0001
CFL	1	2.2	2.2	0.01	0.9282
part*state	3	102565.1	34188.4	128.36	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
yearmonth*area	64	2420110.734	37814.230	141.97	<.0001

avg_tem*yearmon*area	66	3913217.624	59291.176	222.60	<.0001
avg_hum*yearmon*area	66	189170.277	2866.216	10.76	<.0001
PER	1	26723.288	26723.288	100.33	<.0001
K12	1	1640.264	1640.264	6.16	0.0131
LowInc	1	672.581	672.581	2.53	0.1120
SS	1	30716.535	30716.535	115.32	<.0001
CFL	1	1753.698	1753.698	6.58	0.0103
part*state	3	102565.107	34188.369	128.36	<.0001

Parameter			Estimate	Standard Error	t Value	Pr > |t|
yearmonth*area	200909	SE	-127.166	61.69955	-2.06	0.0393
yearmonth*area	200910	SE	5.487348	42.3488	0.13	0.8969
yearmonth*area	200911	SE	90.86326	43.45294	2.09	0.0365
yearmonth*area	200912	SE	136.4848	39.27679	3.47	0.0005
yearmonth*area	201001	SE	153.5312	39.44996	3.89	<.0001
yearmonth*area	201002	SE	139.566	39.39715	3.54	0.0004
yearmonth*area	201003	SE	136.2848	38.68175	3.52	0.0004
yearmonth*area	201004	SE	76.50166	39.15349	1.95	0.0507
yearmonth*area	201005	MW	123.7739	150.0508	0.82	0.4094
yearmonth*area	201005	SE	-37.2003	39.23019	-0.95	0.343
yearmonth*area	201006	MW	36.92354	149.0937	0.25	0.8044
yearmonth*area	201006	SE	-142.18	39.72447	-3.58	0.0003
yearmonth*area	201007	MW	140.8406	157.517	0.89	0.3713
yearmonth*area	201007	SE	-189.829	42.52219	-4.46	<.0001
yearmonth*area	201008	MW	149.4894	152.6022	0.98	0.3273
yearmonth*area	201008	SE	-217.178	43.11856	-5.04	<.0001
yearmonth*area	201009	MW	90.07959	146.3173	0.62	0.5381
yearmonth*area	201009	SE	-120.719	39.42757	-3.06	0.0022
yearmonth*area	201010	MW	109.7595	146.256	0.75	0.453
yearmonth*area	201010	SE	-50.0533	38.80015	-1.29	0.197
yearmonth*area	201011	MW	178.5809	146.1971	1.22	0.2219
yearmonth*area	201011	SE	84.74321	38.61739	2.19	0.0282
yearmonth*area	201012	MW	190.8893	146.3916	1.3	0.1922
yearmonth*area	201012	SE	126.1736	38.43822	3.28	0.001
yearmonth*area	201101	MW	150.651	146.3377	1.03	0.3033
yearmonth*area	201101	SE	99.55442	38.62061	2.58	0.0099
yearmonth*area	201102	MW	124.4535	145.9546	0.85	0.3938
yearmonth*area	201102	SE	99.06065	38.58451	2.57	0.0102
yearmonth*area	201103	MW	182.3719	145.7189	1.25	0.2107
yearmonth*area	201103	SE	110.883	38.44385	2.88	0.0039
yearmonth*area	201104	MW	185.8266	145.6932	1.28	0.2021
yearmonth*area	201104	SE	67.49399	38.47872	1.75	0.0794

yearmonth*area	201105	MW	158.5207	145.8374	1.09	0.2771
yearmonth*area	201105	SE	-58.0499	38.70893	-1.5	0.1337
yearmonth*area	201106	MW	95.84066	145.8385	0.66	0.5111
yearmonth*area	201106	SE	-130.262	38.91441	-3.35	0.0008
yearmonth*area	201107	MW	82.5033	145.9193	0.57	0.5718
yearmonth*area	201107	SE	-135.557	39.23788	-3.45	0.0006
yearmonth*area	201108	MW	12.33631	145.9721	0.08	0.9326
yearmonth*area	201108	SE	-143.67	39.51896	-3.64	0.0003
yearmonth*area	201109	MW	106.8932	145.9678	0.73	0.464
yearmonth*area	201109	SE	-137.417	38.99125	-3.52	0.0004
yearmonth*area	201110	MW	138.3386	145.7731	0.95	0.3426
yearmonth*area	201110	SE	-17.792	38.46576	-0.46	0.6437
yearmonth*area	201111	MW	180.3579	145.7746	1.24	0.216
yearmonth*area	201111	SE	97.95199	38.52411	2.54	0.011
yearmonth*area	201112	MW	211.5267	145.7334	1.45	0.1467
yearmonth*area	201112	SE	144	38.68287	3.72	0.0002
yearmonth*area	201201	MW	378.2478	145.6941	2.6	0.0094
yearmonth*area	201201	SE	148.7057	38.59533	3.85	0.0001
yearmonth*area	201202	MW	230.8445	145.8432	1.58	0.1135
yearmonth*area	201202	SE	116.5138	38.57052	3.02	0.0025
yearmonth*area	201203	MW	195.2161	145.6356	1.34	0.1801
yearmonth*area	201203	SE	97.28093	38.35183	2.54	0.0112
yearmonth*area	201204	MW	148.2201	145.8409	1.02	0.3095
yearmonth*area	201204	SE	20.1109	38.73128	0.52	0.6036
yearmonth*area	201205	MW	148.5053	145.6544	1.02	0.3079
yearmonth*area	201205	SE	2.298369	38.39815	0.06	0.9523
yearmonth*area	201206	MW	79.25571	145.9838	0.54	0.5872
yearmonth*area	201206	SE	-88.7682	39.24441	-2.26	0.0237
yearmonth*area	201207	MW	49.20898	146.0819	0.34	0.7362
yearmonth*area	201207	SE	-100.779	38.71222	-2.6	0.0092
yearmonth*area	201208	MW	48.201	145.9864	0.33	0.7413
yearmonth*area	201208	SE	-152.632	39.45352	-3.87	0.0001
avg_tem*yearmon*area	200909	SE	2.594309	0.479795	5.41	<.0001
avg_tem*yearmon*area	200910	SE	0.601436	0.169484	3.55	0.0004
avg_tem*yearmon*area	200911	SE	-1.05328	0.303636	-3.47	0.0005
avg_tem*yearmon*area	200912	SE	-1.77116	0.130751	-13.55	<.0001
avg_tem*yearmon*area	201001	SE	-3.07882	0.258071	-11.93	<.0001
avg_tem*yearmon*area	201002	SE	-2.80742	0.243252	-11.54	<.0001
avg_tem*yearmon*area	201003	SE	-1.8383	0.091913	-20	<.0001
avg_tem*yearmon*area	201004	SE	-0.69076	0.119271	-5.79	<.0001
avg_tem*yearmon*area	201005	MW	-0.16941	0.882648	-0.19	0.8478

avg_tem*yearmon*area	201005	SE	1.111307	0.154308	7.2	<.0001
avg_tem*yearmon*area	201006	MW	1.870235	0.323078	5.79	<.0001
avg_tem*yearmon*area	201006	SE	2.406083	0.112985	21.3	<.0001
avg_tem*yearmon*area	201007	MW	0.812907	0.761179	1.07	0.2855
avg_tem*yearmon*area	201007	SE	2.887002	0.212144	13.61	<.0001
avg_tem*yearmon*area	201008	MW	0.86552	0.542449	1.6	0.1106
avg_tem*yearmon*area	201008	SE	3.18268	0.210189	15.14	<.0001
avg_tem*yearmon*area	201009	MW	1.343111	0.239041	5.62	<.0001
avg_tem*yearmon*area	201009	SE	2.137997	0.120513	17.74	<.0001
avg_tem*yearmon*area	201010	MW	0.816001	0.143772	5.68	<.0001
avg_tem*yearmon*area	201010	SE	1.296026	0.072415	17.9	<.0001
avg_tem*yearmon*area	201011	MW	-0.41539	0.150705	-2.76	0.0058
avg_tem*yearmon*area	201011	SE	-0.78458	0.075342	-10.41	<.0001
avg_tem*yearmon*area	201012	MW	-0.9996	0.083555	-11.96	<.0001
avg_tem*yearmon*area	201012	SE	-1.90891	0.050237	-38	<.0001
avg_tem*yearmon*area	201101	MW	-2.1416	0.351975	-6.08	<.0001
avg_tem*yearmon*area	201101	SE	-1.83231	0.135457	-13.53	<.0001
avg_tem*yearmon*area	201102	MW	-0.02936	0.116903	-0.25	0.8017
avg_tem*yearmon*area	201102	SE	-1.32212	0.072919	-18.13	<.0001
avg_tem*yearmon*area	201103	MW	-1.07929	0.086326	-12.5	<.0001
avg_tem*yearmon*area	201103	SE	-1.24476	0.074708	-16.66	<.0001
avg_tem*yearmon*area	201104	MW	-0.75044	0.101328	-7.41	<.0001
avg_tem*yearmon*area	201104	SE	-0.54437	0.06161	-8.84	<.0001
avg_tem*yearmon*area	201105	MW	0.224101	0.18528	1.21	0.2265
avg_tem*yearmon*area	201105	SE	1.390493	0.10766	12.92	<.0001
avg_tem*yearmon*area	201106	MW	1.165598	0.108085	10.78	<.0001
avg_tem*yearmon*area	201106	SE	2.05744	0.072538	28.36	<.0001
avg_tem*yearmon*area	201107	MW	1.366362	0.126557	10.8	<.0001
avg_tem*yearmon*area	201107	SE	2.338902	0.108967	21.46	<.0001
avg_tem*yearmon*area	201108	MW	2.423762	0.136039	17.82	<.0001
avg_tem*yearmon*area	201108	SE	2.409525	0.113733	21.19	<.0001
avg_tem*yearmon*area	201109	MW	1.306141	0.11926	10.95	<.0001
avg_tem*yearmon*area	201109	SE	2.376639	0.076644	31.01	<.0001
avg_tem*yearmon*area	201110	MW	0.514416	0.132312	3.89	0.0001
avg_tem*yearmon*area	201110	SE	0.797174	0.059846	13.32	<.0001
avg_tem*yearmon*area	201111	MW	-0.36766	0.129065	-2.85	0.0044
avg_tem*yearmon*area	201111	SE	-0.92738	0.076631	-12.1	<.0001
avg_tem*yearmon*area	201112	MW	-0.96246	0.106912	-9	<.0001
avg_tem*yearmon*area	201112	SE	-1.67682	0.10382	-16.15	<.0001
avg_tem*yearmon*area	201201	MW	-4.89841	0.129666	-37.78	<.0001
avg_tem*yearmon*area	201201	SE	-1.89466	0.124807	-15.18	<.0001

avg_tem*yearmon*area	201202	MW	-1.58661	0.217256	-7.3	<.0001
avg_tem*yearmon*area	201202	SE	-1.26372	0.132291	-9.55	<.0001
avg_tem*yearmon*area	201203	MW	-0.65017	0.043952	-14.79	<.0001
avg_tem*yearmon*area	201203	SE	-0.86906	0.037225	-23.35	<.0001
avg_tem*yearmon*area	201204	MW	0.222183	0.156835	1.42	0.1566
avg_tem*yearmon*area	201204	SE	0.153259	0.102093	1.5	0.1333
avg_tem*yearmon*area	201205	MW	0.304482	0.077226	3.94	<.0001
avg_tem*yearmon*area	201205	SE	0.572241	0.065158	8.78	<.0001
avg_tem*yearmon*area	201206	MW	1.315131	0.146473	8.98	<.0001
avg_tem*yearmon*area	201206	SE	1.728605	0.107887	16.02	<.0001
avg_tem*yearmon*area	201207	MW	1.853199	0.139115	13.32	<.0001
avg_tem*yearmon*area	201207	SE	1.921978	0.076679	25.07	<.0001
avg_tem*yearmon*area	201208	MW	1.868197	0.11862	15.75	<.0001
avg_tem*yearmon*area	201208	SE	2.50853	0.102684	24.43	<.0001
avg_tem*yearmon*area	201209	MW	1.637961	1.931631	0.85	0.3965
avg_tem*yearmon*area	201209	SE	0.672197	0.432909	1.55	0.1205
avg_hum*yearmon*area	200909	SE	-0.14941	0.244301	-0.61	0.5408
avg_hum*yearmon*area	200910	SE	-0.05829	0.173692	-0.34	0.7372
avg_hum*yearmon*area	200911	SE	0.090989	0.134244	0.68	0.4979
avg_hum*yearmon*area	200912	SE	-0.00987	0.10569	-0.09	0.9256
avg_hum*yearmon*area	201001	SE	0.487547	0.090648	5.38	<.0001
avg_hum*yearmon*area	201002	SE	0.506299	0.085945	5.89	<.0001
avg_hum*yearmon*area	201003	SE	0.024653	0.071213	0.35	0.7292
avg_hum*yearmon*area	201004	SE	0.049988	0.066194	0.76	0.4501
avg_hum*yearmon*area	201005	MW	0.62418	0.494481	1.26	0.2068
avg_hum*yearmon*area	201005	SE	0.062799	0.061679	1.02	0.3086
avg_hum*yearmon*area	201006	MW	0.019664	0.416693	0.05	0.9624
avg_hum*yearmon*area	201006	SE	0.233359	0.071177	3.28	0.001
avg_hum*yearmon*area	201007	MW	-0.24778	0.224023	-1.11	0.2687
avg_hum*yearmon*area	201007	SE	0.400711	0.068429	5.86	<.0001
avg_hum*yearmon*area	201008	MW	-0.40873	0.181779	-2.25	0.0245
avg_hum*yearmon*area	201008	SE	0.397821	0.072626	5.48	<.0001
avg_hum*yearmon*area	201009	MW	-0.19102	0.134191	-1.42	0.1546
avg_hum*yearmon*area	201009	SE	0.230731	0.044916	5.14	<.0001
avg_hum*yearmon*area	201010	MW	0.030556	0.154348	0.2	0.8431
avg_hum*yearmon*area	201010	SE	0.079164	0.050009	1.58	0.1134
avg_hum*yearmon*area	201011	MW	0.054689	0.114684	0.48	0.6335
avg_hum*yearmon*area	201011	SE	0.000508	0.043808	0.01	0.9907
avg_hum*yearmon*area	201012	MW	0.231981	0.189572	1.22	0.2211
avg_hum*yearmon*area	201012	SE	0.230014	0.050299	4.57	<.0001
avg_hum*yearmon*area	201101	MW	1.207676	0.163291	7.4	<.0001

avg_hum*yearmon*area	201101	SE	0.56696	0.05344	10.61	<.0001
avg_hum*yearmon*area	201102	MW	0.755071	0.115017	6.56	<.0001
avg_hum*yearmon*area	201102	SE	0.248097	0.054007	4.59	<.0001
avg_hum*yearmon*area	201103	MW	0.473102	0.08708	5.43	<.0001
avg_hum*yearmon*area	201103	SE	-0.03711	0.047544	-0.78	0.4351
avg_hum*yearmon*area	201104	MW	0.236303	0.087144	2.71	0.0067
avg_hum*yearmon*area	201104	SE	0.06718	0.067869	0.99	0.3223
avg_hum*yearmon*area	201105	MW	-0.15162	0.086225	-1.76	0.0787
avg_hum*yearmon*area	201105	SE	0.101741	0.046873	2.17	0.03
avg_hum*yearmon*area	201106	MW	-0.09416	0.060751	-1.55	0.1212
avg_hum*yearmon*area	201106	SE	0.484379	0.054677	8.86	<.0001
avg_hum*yearmon*area	201107	MW	-0.07247	0.065482	-1.11	0.2684
avg_hum*yearmon*area	201107	SE	0.228939	0.048603	4.71	<.0001
avg_hum*yearmon*area	201108	MW	-0.21423	0.068323	-3.14	0.0017
avg_hum*yearmon*area	201108	SE	0.271109	0.046803	5.79	<.0001
avg_hum*yearmon*area	201109	MW	-0.36679	0.073099	-5.02	<.0001
avg_hum*yearmon*area	201109	SE	0.210256	0.049561	4.24	<.0001
avg_hum*yearmon*area	201110	MW	-0.11756	0.086605	-1.36	0.1746
avg_hum*yearmon*area	201110	SE	0.080279	0.045737	1.76	0.0792
avg_hum*yearmon*area	201111	MW	0.01364	0.066156	0.21	0.8367
avg_hum*yearmon*area	201111	SE	-0.07824	0.043879	-1.78	0.0746
avg_hum*yearmon*area	201112	MW	0.00423	0.059399	0.07	0.9432
avg_hum*yearmon*area	201112	SE	-0.14976	0.041557	-3.6	0.0003
avg_hum*yearmon*area	201201	MW	-0.10272	0.052682	-1.95	0.0512
avg_hum*yearmon*area	201201	SE	-0.09819	0.04538	-2.16	0.0305
avg_hum*yearmon*area	201202	MW	0.034713	0.059361	0.58	0.5587
avg_hum*yearmon*area	201202	SE	-0.08137	0.050701	-1.6	0.1085
avg_hum*yearmon*area	201203	MW	0.038765	0.054941	0.71	0.4804
avg_hum*yearmon*area	201203	SE	-0.09131	0.051533	-1.77	0.0764
avg_hum*yearmon*area	201204	MW	-0.01294	0.059622	-0.22	0.8281
avg_hum*yearmon*area	201204	SE	0.127515	0.051735	2.46	0.0137
avg_hum*yearmon*area	201205	MW	-0.07232	0.056346	-1.28	0.1993
avg_hum*yearmon*area	201205	SE	0.036209	0.045597	0.79	0.4271
avg_hum*yearmon*area	201206	MW	0.001771	0.059549	0.03	0.9763
avg_hum*yearmon*area	201206	SE	0.212003	0.051106	4.15	<.0001
avg_hum*yearmon*area	201207	MW	-0.11986	0.073403	-1.63	0.1025
avg_hum*yearmon*area	201207	SE	0.225731	0.041183	5.48	<.0001
avg_hum*yearmon*area	201208	MW	-0.12616	0.070064	-1.8	0.0718
avg_hum*yearmon*area	201208	SE	0.263612	0.050618	5.21	<.0001
avg_hum*yearmon*area	201209	MW	0.813001	0.463348	1.75	0.0793
avg_hum*yearmon*area	201209	SE	0.089185	0.120873	0.74	0.4606

PER		-3.59725	0.359132	-10.02	<.0001
K12		2.513425	1.012831	2.48	0.0131
LowInc		-1.92329	1.210319	-1.59	0.112
SS		-4.13858	0.385383	-10.74	<.0001
CFL		0.317636	0.123789	2.57	0.0103
part*state	KY	-2.1244	0.474111	-4.48	<.0001
part*state	OH	-1.72817	0.241594	-7.15	<.0001
part*state	SE	-2.54313	0.139757	-18.2	<.0001

Appendix E: Estimated Statistical Models for Additional CFLs

Number of Observations Read	259435
Number of Observations Used	259435

Dependent Variable: kwhd

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12174	159964807.1	13139.9	49.28	<.0001
Error	247260	65924595.6	266.6		
Corrected Total	259434	225889402.7			

R-Square	Coeff Var	Root MSE	kwhd Mean
0.708155	35.38905	16.32852	46.14004

Source	DF	Type I SS	Mean Square	F Value	Pr > F
acct_id	11968	127169635.2	10625.8	39.85	<.0001
yearmonth*area	64	28272926.7	441764.5	1656.90	<.0001
avg_tem*yearmon*area	66	4164175.9	63093.6	236.64	<.0001
avg_hum*yearmon*area	66	189152.3	2865.9	10.75	<.0001
PER	1	30639.9	30639.9	114.92	<.0001
K12	1	1344.8	1344.8	5.04	0.0247
LowInc	1	609.0	609.0	2.28	0.1307
SS	1	31836.3	31836.3	119.41	<.0001
CFL	1	2.7	2.7	0.01	0.9196
part*state	3	102949.0	34316.3	128.71	<.0001
part*AddBulbs*state	2	1535.3	767.6	2.88	0.0562

Source	DF	Type III SS	Mean Square	F Value	Pr > F
yearmonth*area	64	2412730.679	37698.917	141.40	<.0001
avg_tem*yearmon*area	66	3903341.843	59141.543	221.82	<.0001
avg_hum*yearmon*area	66	189713.377	2874.445	10.78	<.0001
PER	1	26890.930	26890.930	100.86	<.0001
K12	1	1620.487	1620.487	6.08	0.0137
LowInc	1	702.620	702.620	2.64	0.1045
SS	1	30831.262	30831.262	115.64	<.0001
CFL	1	1483.446	1483.446	5.56	0.0183
part*state	3	82955.665	27651.888	103.71	<.0001
part*AddBulbs*state	2	1535.275	767.638	2.88	0.0562

Parameter			Estimate	Standard Error	t Value	Pr > |t|
yearmonth*area	200909	SE	-126.874	61.85324	-2.05	0.0402
yearmonth*area	200910	SE	4.908066	42.44501	0.12	0.9079
yearmonth*area	200911	SE	90.94417	43.54025	2.09	0.0367
yearmonth*area	200912	SE	134.6139	39.34785	3.42	0.0006
yearmonth*area	201001	SE	152.6333	39.52217	3.86	0.0001

yearmonth*area	201002	SE	137.181	39.48113	3.47	0.0005
yearmonth*area	201003	SE	135.5024	38.75114	3.5	0.0005
yearmonth*area	201004	SE	75.8453	39.22355	1.93	0.0532
yearmonth*area	201005	MW	126.7191	150.1314	0.84	0.3986
yearmonth*area	201005	SE	-38.0868	39.30094	-0.97	0.3325
yearmonth*area	201006	MW	39.9378	149.1741	0.27	0.7889
yearmonth*area	201006	SE	-143.025	39.79332	-3.59	0.0003
yearmonth*area	201007	MW	145.2854	157.6151	0.92	0.3566
yearmonth*area	201007	SE	-189.753	42.59239	-4.46	<.0001
yearmonth*area	201008	MW	144.9037	152.747	0.95	0.3428
yearmonth*area	201008	SE	-217.193	43.19716	-5.03	<.0001
yearmonth*area	201009	MW	91.2028	146.3991	0.62	0.5333
yearmonth*area	201009	SE	-120.633	39.49888	-3.05	0.0023
yearmonth*area	201010	MW	112.5786	146.3357	0.77	0.4417
yearmonth*area	201010	SE	-50.5726	38.86905	-1.3	0.1932
yearmonth*area	201011	MW	182.0004	146.2766	1.24	0.2134
yearmonth*area	201011	SE	84.06758	38.68625	2.17	0.0298
yearmonth*area	201012	MW	193.6925	146.4706	1.32	0.186
yearmonth*area	201012	SE	125.196	38.5068	3.25	0.0011
yearmonth*area	201101	MW	153.2445	146.4183	1.05	0.2953
yearmonth*area	201101	SE	98.76012	38.6903	2.55	0.0107
yearmonth*area	201102	MW	127.1775	146.0328	0.87	0.3838
yearmonth*area	201102	SE	98.44363	38.65344	2.55	0.0109
yearmonth*area	201103	MW	185.2691	145.7967	1.27	0.2038
yearmonth*area	201103	SE	110.355	38.51236	2.87	0.0042
yearmonth*area	201104	MW	188.2876	145.7708	1.29	0.1965
yearmonth*area	201104	SE	66.83166	38.54632	1.73	0.083
yearmonth*area	201105	MW	161.1026	145.915	1.1	0.2696
yearmonth*area	201105	SE	-58.9094	38.77649	-1.52	0.1287
yearmonth*area	201106	MW	98.61496	145.9162	0.68	0.4991
yearmonth*area	201106	SE	-130.835	38.98278	-3.36	0.0008
yearmonth*area	201107	MW	85.03129	145.9969	0.58	0.5603
yearmonth*area	201107	SE	-135.887	39.30665	-3.46	0.0005
yearmonth*area	201108	MW	14.21949	146.0509	0.1	0.9224
yearmonth*area	201108	SE	-144.085	39.58847	-3.64	0.0003
yearmonth*area	201109	MW	109.0433	146.0456	0.75	0.4553
yearmonth*area	201109	SE	-138.071	39.06181	-3.53	0.0004
yearmonth*area	201110	MW	141.2587	145.8513	0.97	0.3328
yearmonth*area	201110	SE	-18.1977	38.53461	-0.47	0.6368
yearmonth*area	201111	MW	182.9097	145.852	1.25	0.2098
yearmonth*area	201111	SE	97.63059	38.59311	2.53	0.0114

yearmonth*area	201112	MW	214.7511	145.8115	1.47	0.1408
yearmonth*area	201112	SE	143.5569	38.75195	3.7	0.0002
yearmonth*area	201201	MW	381.1372	145.772	2.61	0.0089
yearmonth*area	201201	SE	147.9417	38.66434	3.83	0.0001
yearmonth*area	201202	MW	233.7745	145.9209	1.6	0.1091
yearmonth*area	201202	SE	116.0179	38.639	3	0.0027
yearmonth*area	201203	MW	198.1229	145.7136	1.36	0.1739
yearmonth*area	201203	SE	96.54943	38.4203	2.51	0.012
yearmonth*area	201204	MW	150.4893	145.918	1.03	0.3024
yearmonth*area	201204	SE	19.37775	38.80026	0.5	0.6175
yearmonth*area	201205	MW	151.3729	145.7323	1.04	0.2989
yearmonth*area	201205	SE	1.530422	38.466	0.04	0.9683
yearmonth*area	201206	MW	81.98964	146.0621	0.56	0.5746
yearmonth*area	201206	SE	-89.5743	39.31371	-2.28	0.0227
yearmonth*area	201207	MW	51.65049	146.1599	0.35	0.7238
yearmonth*area	201207	SE	-101.602	38.78016	-2.62	0.0088
yearmonth*area	201208	MW	50.92629	146.0643	0.35	0.7273
yearmonth*area	201208	SE	-154.019	39.52641	-3.9	<.0001
avg_tem*yearmon*area	200909	SE	2.579611	0.481099	5.36	<.0001
avg_tem*yearmon*area	200910	SE	0.598442	0.170057	3.52	0.0004
avg_tem*yearmon*area	200911	SE	-1.06222	0.304305	-3.49	0.0005
avg_tem*yearmon*area	200912	SE	-1.76828	0.131361	-13.46	<.0001
avg_tem*yearmon*area	201001	SE	-3.10277	0.258615	-12	<.0001
avg_tem*yearmon*area	201002	SE	-2.78442	0.244454	-11.39	<.0001
avg_tem*yearmon*area	201003	SE	-1.84302	0.092079	-20.02	<.0001
avg_tem*yearmon*area	201004	SE	-0.69219	0.11946	-5.79	<.0001
avg_tem*yearmon*area	201005	MW	-0.17803	0.8831	-0.2	0.8402
avg_tem*yearmon*area	201005	SE	1.113864	0.154667	7.2	<.0001
avg_tem*yearmon*area	201006	MW	1.869352	0.323242	5.78	<.0001
avg_tem*yearmon*area	201006	SE	2.406831	0.113143	21.27	<.0001
avg_tem*yearmon*area	201007	MW	0.795549	0.761616	1.04	0.2962
avg_tem*yearmon*area	201007	SE	2.876658	0.21244	13.54	<.0001
avg_tem*yearmon*area	201008	MW	0.949873	0.544899	1.74	0.0813
avg_tem*yearmon*area	201008	SE	3.172534	0.210618	15.06	<.0001
avg_tem*yearmon*area	201009	MW	1.368802	0.239634	5.71	<.0001
avg_tem*yearmon*area	201009	SE	2.128158	0.120795	17.62	<.0001
avg_tem*yearmon*area	201010	MW	0.814023	0.1441	5.65	<.0001
avg_tem*yearmon*area	201010	SE	1.294531	0.072583	17.84	<.0001
avg_tem*yearmon*area	201011	MW	-0.42673	0.150985	-2.83	0.0047
avg_tem*yearmon*area	201011	SE	-0.78414	0.075513	-10.38	<.0001
avg_tem*yearmon*area	201012	MW	-1.0019	0.083617	-11.98	<.0001

avg_tem*yearmon*area	201012	SE	-1.90576	0.050354	-37.85	<.0001
avg_tem*yearmon*area	201101	MW	-2.14496	0.352303	-6.09	<.0001
avg_tem*yearmon*area	201101	SE	-1.83611	0.135819	-13.52	<.0001
avg_tem*yearmon*area	201102	MW	-0.03198	0.11708	-0.27	0.7847
avg_tem*yearmon*area	201102	SE	-1.32644	0.073134	-18.14	<.0001
avg_tem*yearmon*area	201103	MW	-1.08096	0.086427	-12.51	<.0001
avg_tem*yearmon*area	201103	SE	-1.24593	0.074919	-16.63	<.0001
avg_tem*yearmon*area	201104	MW	-0.74829	0.10139	-7.38	<.0001
avg_tem*yearmon*area	201104	SE	-0.54459	0.061774	-8.82	<.0001
avg_tem*yearmon*area	201105	MW	0.227996	0.1854	1.23	0.2188
avg_tem*yearmon*area	201105	SE	1.393572	0.107907	12.91	<.0001
avg_tem*yearmon*area	201106	MW	1.159586	0.108261	10.71	<.0001
avg_tem*yearmon*area	201106	SE	2.057257	0.072694	28.3	<.0001
avg_tem*yearmon*area	201107	MW	1.367256	0.126637	10.8	<.0001
avg_tem*yearmon*area	201107	SE	2.335817	0.109219	21.39	<.0001
avg_tem*yearmon*area	201108	MW	2.429014	0.136218	17.83	<.0001
avg_tem*yearmon*area	201108	SE	2.407811	0.113916	21.14	<.0001
avg_tem*yearmon*area	201109	MW	1.311669	0.119415	10.98	<.0001
avg_tem*yearmon*area	201109	SE	2.375841	0.076799	30.94	<.0001
avg_tem*yearmon*area	201110	MW	0.511638	0.132427	3.86	0.0001
avg_tem*yearmon*area	201110	SE	0.792741	0.059961	13.22	<.0001
avg_tem*yearmon*area	201111	MW	-0.3644	0.129146	-2.82	0.0048
avg_tem*yearmon*area	201111	SE	-0.93263	0.076806	-12.14	<.0001
avg_tem*yearmon*area	201112	MW	-0.96745	0.107044	-9.04	<.0001
avg_tem*yearmon*area	201112	SE	-1.68056	0.104013	-16.16	<.0001
avg_tem*yearmon*area	201201	MW	-4.89739	0.129784	-37.73	<.0001
avg_tem*yearmon*area	201201	SE	-1.89392	0.125056	-15.14	<.0001
avg_tem*yearmon*area	201202	MW	-1.5873	0.217431	-7.3	<.0001
avg_tem*yearmon*area	201202	SE	-1.26912	0.132526	-9.58	<.0001
avg_tem*yearmon*area	201203	MW	-0.65075	0.043999	-14.79	<.0001
avg_tem*yearmon*area	201203	SE	-0.8686	0.037316	-23.28	<.0001
avg_tem*yearmon*area	201204	MW	0.231753	0.156983	1.48	0.1399
avg_tem*yearmon*area	201204	SE	0.154702	0.102348	1.51	0.1307
avg_tem*yearmon*area	201205	MW	0.304193	0.077352	3.93	<.0001
avg_tem*yearmon*area	201205	SE	0.57468	0.065318	8.8	<.0001
avg_tem*yearmon*area	201206	MW	1.313683	0.146635	8.96	<.0001
avg_tem*yearmon*area	201206	SE	1.730589	0.108085	16.01	<.0001
avg_tem*yearmon*area	201207	MW	1.855748	0.139214	13.33	<.0001
avg_tem*yearmon*area	201207	SE	1.924069	0.076865	25.03	<.0001
avg_tem*yearmon*area	201208	MW	1.867784	0.118693	15.74	<.0001
avg_tem*yearmon*area	201208	SE	2.514254	0.102919	24.43	<.0001

avg_tem*yearmon*area	201209	MW	1.675816	1.932669	0.87	0.3859
avg_tem*yearmon*area	201209	SE	0.663979	0.433777	1.53	0.1258
avg_hum*yearmon*area	200909	SE	-0.1482	0.244914	-0.61	0.5451
avg_hum*yearmon*area	200910	SE	-0.05733	0.174114	-0.33	0.742
avg_hum*yearmon*area	200911	SE	0.087343	0.134695	0.65	0.5167
avg_hum*yearmon*area	200912	SE	0.004087	0.106054	0.04	0.9693
avg_hum*yearmon*area	201001	SE	0.50438	0.091011	5.54	<.0001
avg_hum*yearmon*area	201002	SE	0.518396	0.086205	6.01	<.0001
avg_hum*yearmon*area	201003	SE	0.030096	0.071375	0.42	0.6733
avg_hum*yearmon*area	201004	SE	0.050997	0.066415	0.77	0.4426
avg_hum*yearmon*area	201005	MW	0.626451	0.494733	1.27	0.2054
avg_hum*yearmon*area	201005	SE	0.063444	0.061778	1.03	0.3044
avg_hum*yearmon*area	201006	MW	0.015122	0.416909	0.04	0.9711
avg_hum*yearmon*area	201006	SE	0.234861	0.07131	3.29	0.001
avg_hum*yearmon*area	201007	MW	-0.2548	0.224634	-1.13	0.2567
avg_hum*yearmon*area	201007	SE	0.401695	0.068492	5.86	<.0001
avg_hum*yearmon*area	201008	MW	-0.40161	0.182051	-2.21	0.0274
avg_hum*yearmon*area	201008	SE	0.400193	0.072704	5.5	<.0001
avg_hum*yearmon*area	201009	MW	-0.19749	0.13431	-1.47	0.1415
avg_hum*yearmon*area	201009	SE	0.230869	0.045008	5.13	<.0001
avg_hum*yearmon*area	201010	MW	0.029203	0.154462	0.19	0.85
avg_hum*yearmon*area	201010	SE	0.078761	0.050095	1.57	0.1159
avg_hum*yearmon*area	201011	MW	0.05125	0.114759	0.45	0.6552
avg_hum*yearmon*area	201011	SE	0.000439	0.043915	0.01	0.992
avg_hum*yearmon*area	201012	MW	0.230714	0.189713	1.22	0.2239
avg_hum*yearmon*area	201012	SE	0.233054	0.050432	4.62	<.0001
avg_hum*yearmon*area	201101	MW	1.209709	0.163553	7.4	<.0001
avg_hum*yearmon*area	201101	SE	0.571896	0.053664	10.66	<.0001
avg_hum*yearmon*area	201102	MW	0.75516	0.115171	6.56	<.0001
avg_hum*yearmon*area	201102	SE	0.250814	0.054168	4.63	<.0001
avg_hum*yearmon*area	201103	MW	0.470563	0.087242	5.39	<.0001
avg_hum*yearmon*area	201103	SE	-0.0379	0.047633	-0.8	0.4262
avg_hum*yearmon*area	201104	MW	0.23739	0.087218	2.72	0.0065
avg_hum*yearmon*area	201104	SE	0.067725	0.067987	1	0.3192
avg_hum*yearmon*area	201105	MW	-0.15376	0.086329	-1.78	0.0749
avg_hum*yearmon*area	201105	SE	0.101869	0.046975	2.17	0.0301
avg_hum*yearmon*area	201106	MW	-0.09019	0.060824	-1.48	0.1381
avg_hum*yearmon*area	201106	SE	0.483472	0.054841	8.82	<.0001
avg_hum*yearmon*area	201107	MW	-0.07154	0.065532	-1.09	0.275
avg_hum*yearmon*area	201107	SE	0.227969	0.048775	4.67	<.0001
avg_hum*yearmon*area	201108	MW	-0.20921	0.068413	-3.06	0.0022

avg_hum*yearmon*area	201108	SE	0.269993	0.046939	5.75	<.0001
avg_hum*yearmon*area	201109	MW	-0.36494	0.073169	-4.99	<.0001
avg_hum*yearmon*area	201109	SE	0.211398	0.049688	4.25	<.0001
avg_hum*yearmon*area	201110	MW	-0.11856	0.086682	-1.37	0.1714
avg_hum*yearmon*area	201110	SE	0.081006	0.045848	1.77	0.0773
avg_hum*yearmon*area	201111	MW	0.013045	0.066209	0.2	0.8438
avg_hum*yearmon*area	201111	SE	-0.07855	0.043979	-1.79	0.0741
avg_hum*yearmon*area	201112	MW	2.15E-05	0.0595	0	0.9997
avg_hum*yearmon*area	201112	SE	-0.14961	0.04166	-3.59	0.0003
avg_hum*yearmon*area	201201	MW	-0.10596	0.052763	-2.01	0.0446
avg_hum*yearmon*area	201201	SE	-0.09649	0.045487	-2.12	0.0339
avg_hum*yearmon*area	201202	MW	0.031759	0.059461	0.53	0.5933
avg_hum*yearmon*area	201202	SE	-0.07951	0.050843	-1.56	0.1178
avg_hum*yearmon*area	201203	MW	0.035728	0.055015	0.65	0.5161
avg_hum*yearmon*area	201203	SE	-0.08995	0.051635	-1.74	0.0815
avg_hum*yearmon*area	201204	MW	-0.01505	0.059692	-0.25	0.8009
avg_hum*yearmon*area	201204	SE	0.127769	0.051825	2.47	0.0137
avg_hum*yearmon*area	201205	MW	-0.07497	0.05645	-1.33	0.1842
avg_hum*yearmon*area	201205	SE	0.03599	0.045687	0.79	0.4308
avg_hum*yearmon*area	201206	MW	0.002071	0.059602	0.03	0.9723
avg_hum*yearmon*area	201206	SE	0.212546	0.051198	4.15	<.0001
avg_hum*yearmon*area	201207	MW	-0.11972	0.073464	-1.63	0.1032
avg_hum*yearmon*area	201207	SE	0.226158	0.041259	5.48	<.0001
avg_hum*yearmon*area	201208	MW	-0.12672	0.07013	-1.81	0.0708
avg_hum*yearmon*area	201208	SE	0.267789	0.050744	5.28	<.0001
avg_hum*yearmon*area	201209	MW	0.811927	0.463582	1.75	0.0799
avg_hum*yearmon*area	201209	SE	0.088889	0.121102	0.73	0.4629
PER			-3.60914	0.359375	-10.04	<.0001
K12			2.498478	1.013444	2.47	0.0137
LowInc			-1.96602	1.211085	-1.62	0.1045
SS			-4.14759	0.385697	-10.75	<.0001
CFL			0.29358	0.124462	2.36	0.0183
part*state	KY		-2.13655	0.474415	-4.5	<.0001
part*state	OH		-1.51861	0.257991	-5.89	<.0001
part*state	SE		-2.5168	0.153003	-16.45	<.0001
part*AddBulbs*state	OH		-0.05861	0.025083	-2.34	0.0195
part*AddBulbs*state	SE		-0.00924	0.01664	-0.55	0.5789

Appendix F: Impact Algorithms

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW = ISR \times units \times \left[\frac{Watts_{base} - Watts_{ee}}{1000}\right] \times CF \times (1 + HVAC_d)$$

Gross Annual Energy Savings

$$\Delta kWh = ISR \times units \times \left[\frac{(Watts \times HOU)_{base} - (Watts \times HOU)_{ee}}{1000}\right] \times 365 \times (1 + HVAC_c)$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of units installed under the program
$Watts_{ee}$	= connected load of energy-efficient unit = 16.35
$Watts_{base}$	= connected (nameplate) load of baseline unit(s) displaced
HOU	= Average daily hours of use (based on connected load)
CF	= coincidence factor = 0.123
$HVAC_c$	= HVAC system interaction factor for annual electricity consumption = -0.037
$HVAC_d$	= HVAC system interaction factor for demand = 0.168

The coincidence factor for this analysis was taken from Duke Energy's Residential Smart $aver lighting logger study performed in North Carolina with participants from the 2010 CFL campaigns.

$HVAC_c$ - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The weights were determined through appliance saturation data from the Home Profile Database supplied by Duke Energy.

Charlotte, NC

Heating Fuel	Heating System	Cooling System	Weight	HVACc
Other	Any except Heat Pump	Any except Heat Pump	0.0042	0.069
		None	0.0004	0

Any	Heat Pump	Heat Pump	0.2782	-0.1
Gas Propane Oil	Central Furnace	None	0.0067	0
		Room/Window	0.5508	0.069
		Central AC		0.069
Electricity	Electric baseboard/ central furnace	None	0.0030	-0.43
		Room/Window	0.1493	-0.31
		Central AC		-0.31
None	None	Any	0.0074	0
Total Weighted Average			1	-0.037

$HVAC_d$ - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Charlotte, NC

Cooling System	HVACd
None	0
Room/Window	.17
Central AC	.17
Heat Pump	.17

Weather Stripping and Outlet Gaskets

Gross Summer Coincident Demand Savings

$\Delta kW_S = \text{units} \times (\Delta cfm/unit) \times (kW / cfm) \times DF_S \times CF_S$

Gross Annual Energy Savings

$\Delta kWh = \text{units} \times (\Delta cfm/unit) \times (kWh / cfm)$

$$\Delta therm = units \times (\Delta cfm / unit) \times (therm / cfm)$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of buildings sealed under the program
Δcfm/unit	= unit infiltration airflow rate (ft^3/min) reduction for each measure
DF	= demand diversity factor = 0.8
CF	= coincidence factor = 1.0
kW/cfm	= demand savings per unit cfm reduction
kWh/cfm	= electricity savings per unit cfm reduction
therm/cfm	= gas savings per unit cfm reduction

Unit cfm savings per measure

The cfm reductions for each measure were estimated from equivalent leakage area (ELA) change data taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001). The equivalent leakage area changes were converted to infiltration rate changes using the Sherman-Grimsrud equation:

$$Q = ELA \text{ x } \sqrt{A \times \Delta T + B \times v^2}$$

where:

A = stack coefficient (ft^3/min-in^4-°F)
= 0.015 for one-story house

ΔT = average indoor/outdoor temperature difference over the time interval of interest (°F)

B = wind coefficient (ft^3/min-in^4-mph^2)
= 0.0065 (moderate shielding)

v = average wind speed over the time interval of interest measured at a local weather station at a height of 20 ft (mph)

The location specific data are shown below:

Location	Average outdoor temp	Average indoor/outdoor temp difference	Average wind speed (mph)	Specific infiltration rate (cfm/in^2)
Charlotte	60	8	19	1.57

Measure ELA impact and cfm reductions are as follows:

Measure	Unit	ELA change (in^2/unit)	ΔCfm/unit (NC)
Outlet gaskets	Each	0.357	0.56
Weather strip	Foot	0.089	0.14

Unit energy and demand savings

The energy and peak demand impacts of reducing infiltration rates were calculated from infiltration rate parametric studies conducted using the DOE-2 residential building prototype models, as described at the end of this Appendix. The savings per cfm reduction by heating and cooling system type are shown below:

Heating Fuel	Heating System	Cooling System	kWh/cfm	kW/cfm	therm/cfm
Other	Any except Heat Pump	Any except Heat Pump	2.48	0.00248	0
Any	Heat Pump	Heat Pump	10.37	0.00248	0
Gas Propane	Central Furnace	None	0	0	0.0743
		Room/Window	2.48	0.00248	0.0743

Oil		Central AC	2.48	0.00248	0.0743
	Other	None	0	0	0.0743
		Room/Window	2.48	0.00248	0.0743
		Central AC	2.48	0.00248	0.0743
Electricity	Central furnace	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000
	Electric baseboard	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000
	Other	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000

Low-Flow Showerhead

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413_s} \times DF_x \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413} \times 365$$

$$\Delta therm = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{365}{100000}$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of units installed under the program
GPD_{base}	= daily hot water consumption before installation
GPD_{ee}	= daily hot water consumption after flow reducing measure installation
ΔT	= average difference between entering cold water temperature and the shower use temperature
DF	= demand diversity factor for electric water heating
CF	= coincidence factor
8.33	= conversion factor (Btu/gal-°F)

3413	= conversion factor (Btu/kWh)
24	= conversion factor (hr/day)
365	= conversion factor (days/yr)
100000	= conversion factor (Btu/therm)

Showerhead

GPD_{base} = showers/week / 7 x 3.1 gpm x 5 minutes/shower

GPD_{ee} = showers/week / 7 x 1.5 gpm x 5 minutes/shower

ΔT

City	Average cold water temperature	Shower use temperature	Average ΔT
Charlotte	60.3 °F	100°F	39.7°F

Water heater efficiency

Combustion efficiency for residential gas water heater = 0.70

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Faucet Aerators

This measure used the Efficiency Vermont deemed savings (Efficiency Vermont, 2003) adjusted for entering water temperature:

Demand Savings
$\Delta kW = 0.0171\ kW \times \Delta T / \Delta T_{VT} \times DF \times CF$

Energy Savings
$\Delta kWh_i = 57\ kWh \times \Delta T / \Delta T_{VT}$
$\Delta therms = 2.0 \times \Delta T / \Delta T_{VT\ i}$

City	Average cold water temperature	Hot water use temperature	Average ΔT
Charlotte	60.3 °F	100°F	39.7°F

Burlington VT	44.5	100°F	55.5

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype “model” in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 8.

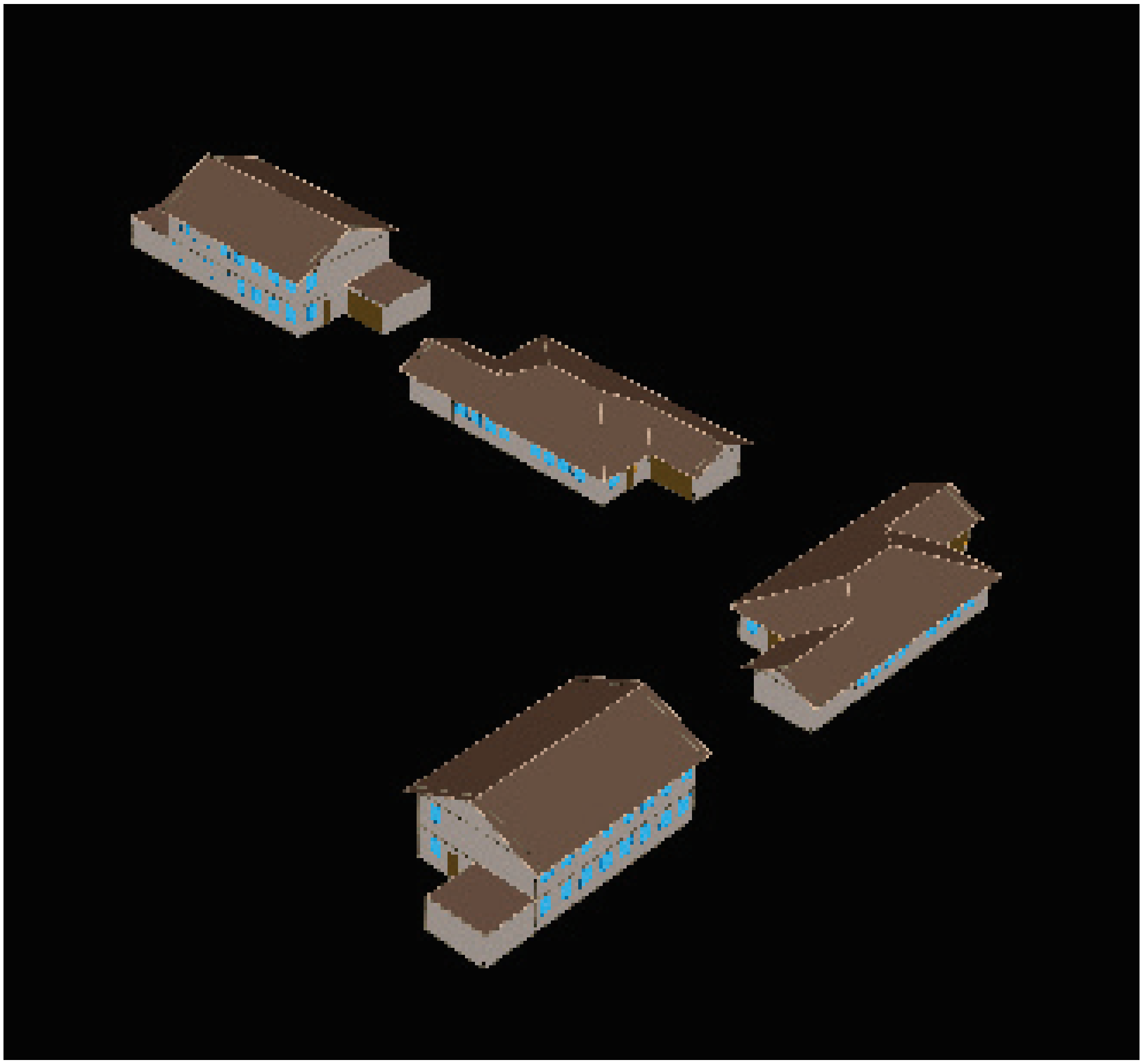

Figure 8. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F

Characteristic	Value
Duct location	Attic (unconditioned space)
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	26%; evenly distributed between supply and return
Cooling season	Charlotte – April 17th to October 6th
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix G: Demographics and Household Information

In what type of building do you live?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Apartment (4 + families)---traditional structure	1	.6	.6	.6
	Condominium---traditional structure	2	1.3	1.3	1.9
	DK/NS	1	.6	.6	2.5
	Other	3	1.9	1.9	4.4
	Row House	1	.6	.6	5.0
	Single-family home, detached construction	145	90.6	90.6	95.6
	Single family home, factory manufactured/modular	6	3.8	3.8	99.4
	Two or Three family attached residence-traditional structure	1	.6	.6	100.0
	Total	160	100.0	100.0	

OTHER SPEC In what type of building do you live?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		157	98.1	98.1	98.1
	Rental house	1	.6	.6	98.8
	Town House	1	.6	.6	99.4
	Upstair/downstair apartments that was converted from a single family home	1	.6	.6	100.0
	Total	160	100.0	100.0	

What year was your residence built?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1959 and before	26	16.3	16.3	16.3
	1960-1979	41	25.6	25.6	41.9
	1980-1989	22	13.8	13.8	55.6
	1990-1997	14	8.8	8.8	64.4
	1998-2000	11	6.9	6.9	71.3
	2001-2007	33	20.6	20.6	91.9
	2008-present	7	4.4	4.4	96.3
	DK/NS	6	3.8	3.8	100.0
	Total	160	100.0	100.0	

How many rooms are in your home (excluding bathrooms, but including finished basements)?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 to 3	1	.6	.6	.6
	10 or more	24	15.0	15.0	15.6
	4	5	3.1	3.1	18.8
	5	21	13.1	13.1	31.9
	6	33	20.6	20.6	52.5
	7	33	20.6	20.6	73.1
	8	26	16.3	16.3	89.4
	9	16	10.0	10.0	99.4
	DK/NS	1	.6	.6	100.0
	Total	160	100.0	100.0	

Which of the following best describes your home's heating system?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Central forced air furnace	65	40.6	40.6	40.6
	Electric Baseboard	4	2.5	2.5	43.1
	Geothermal Heat Pump	1	.6	.6	43.8
	Heat Pump	66	41.3	41.3	85.0
	Other	24	15.0	15.0	100.0
	Total	160	100.0	100.0	

OTHER SPEC Which of the following best describes your home's heating system?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		138	86.3	86.3	86.3
	DK/NS	4	2.5	2.5	88.8
	Electric - Forced air - might be HP	1	.6	.6	89.4
	Gas F/A	1	.6	.6	90.0
	Gas fireplace insert heater	1	.6	.6	90.6
	Gas furnace/central air (1st floor); Heat Pump/forced air (2nd floor)	1	.6	.6	91.3
	gas pack	2	1.3	1.3	92.5
	Gas Pack	1	.6	.6	93.1
	Gas pack and electric heaters	1	.6	.6	93.8
	Gas pack or heat pump	1	.6	.6	94.4
	gas wall heater	1	.6	.6	95.0
	Heat Pump / Forced Air	2	1.3	1.3	96.3

	Heat pump / forced air hybrid	1	.6	.6	96.9
	heat pump, baseboard heater, and room heater	1	.6	.6	97.5
	Heat pump/forced air	1	.6	.6	98.1
	Heat Pump/Forced Air	1	.6	.6	98.8
	oil furnace that heats water that goes through baseboards and wood heat	1	.6	.6	99.4
	Propane Logs	1	.6	.6	100.0
	Total	160	100.0	100.0	

How old is your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-4 years	46	28.8	28.8	28.8
	10-14 years	36	22.5	22.5	51.3
	15-19 years	9	5.6	5.6	56.9
	19 years or older	15	9.4	9.4	66.3
	5-9 years	42	26.3	26.3	92.5
	DK/NS	11	6.9	6.9	99.4
	Do not have	1	.6	.6	100.0
	Total	160	100.0	100.0	

What is the primary fuel used in your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electricity	86	53.8	53.8	53.8
	Natural Gas	64	40.0	40.0	93.8
	Oil	3	1.9	1.9	95.6
	Other	2	1.3	1.3	96.9
	Propane	5	3.1	3.1	100.0
	Total	160	100.0	100.0	

OTHER SPEC What is the primary fuel used in your heating system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		158	98.8	98.8	98.8
	DK/NS	1	.6	.6	99.4
	Gas furnace/forced air	1	.6	.6	100.0
	Total	160	100.0	100.0	

What is the secondary fuel used in your primary heating system, if applicable?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Electricity	33	20.6	20.6	20.6
	Natural Gas	3	1.9	1.9	22.5
	None	109	68.1	68.1	90.6
	Oil	1	.6	.6	91.3
	Other	11	6.9	6.9	98.1
	Propane	3	1.9	1.9	100.0
	Total	160	100.0	100.0	

OTHER SPEC What is the secondary fuel used in your primary heating system, if applicable?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		149	93.1	93.1	93.1
	2 natural gas fireplaces	1	.6	.6	93.8
	DK/NS	1	.6	.6	94.4
	Fireplace (oil)	1	.6	.6	95.0
	gas logs	1	.6	.6	95.6
	Gas logs	1	.6	.6	96.3
	Gas logs; wood stove in emergency	1	.6	.6	96.9
	N/A	1	.6	.6	97.5
	wood	1	.6	.6	98.1
	Wood	1	.6	.6	98.8
	Wood in fireplace	1	.6	.6	99.4
	wood stove	1	.6	.6	100.0
	Total	160	100.0	100.0	

NONE DO NOT COOL Do you use one or more of the following to cool your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	1	.6	100.0	100.0
Missing	System	159	99.4		
Total		160	100.0		

HP FOR COOL Do you use one or more of the following to cool your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	68	42.5	100.0	100.0
Missing	System	92	57.5		
Total		160	100.0		

CAC Do you use one or more of the following to cool your home?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	89	55.6	100.0	100.0
Missing	System	71	44.4		
Total		160	100.0		

WALL-WINDOW AC Do you use one or more of the following to cool your home?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	9	5.6	100.0	100.0
Missing	System	151	94.4		
Total		160	100.0		

GEO HP Do you use one or more of the following to cool your home?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	1	.6	100.0	100.0
Missing	System	159	99.4		
Total		160	100.0		

OTHER Do you use one or more of the following to cool your home?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	6	3.8	100.0	100.0
Missing	System	154	96.3		
Total		160	100.0		

OTHER SPEC Do you use one or more of the following to cool your home?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		156	97.5	97.5	97.5
	DK/NS	1	.6	.6	98.1
	Gas pack	1	.6	.6	98.8
	Gas Pack	1	.6	.6	99.4
	Overhead fans	1	.6	.6	100.0
	Total	160	100.0	100.0	

How many window-unit or "through the wall" air conditioner(s) do you use?					
		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	0	145	90.6	91.2	91.2
	1	6	3.8	3.8	95.0
	2	5	3.1	3.1	98.1
	3	2	1.3	1.3	99.4
	6	1	.6	.6	100.0
	Total	159	99.4	100.0	
Missing	System	1	.6		
Total		160	100.0		

ELECTRIC What is the fuel used in your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	147	91.9	100.0	100.0
Missing	System	13	8.1		
Total		160	100.0		

NATL GAS What is the fuel used in your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	10	6.3	100.0	100.0
Missing	System	150	93.8		
Total		160	100.0		

OIL What is the fuel used in your cooling system?

		Frequency	Percent
Missing	System	160	100.0

PROPANE What is the fuel used in your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	1	.6	100.0	100.0
Missing	System	159	99.4		
Total		160	100.0		

OTHER What is the fuel used in your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	2	1.3	100.0	100.0

Missing	**System**	158	98.8		
Total		160	100.0		

NONE What is the fuel used in your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**checked**	1	.6	100.0	100.0
Missing	**System**	159	99.4		
Total		160	100.0		

OTHER SPEC What is the fuel used in your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		158	98.8	98.8	98.8
	DK/NS	1	.6	.6	99.4
	no idea	1	.6	.6	100.0
	Total	160	100.0	100.0	

How old is your cooling system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**0-4 years**	46	28.8	28.8	28.8
	10-14 years	40	25.0	25.0	53.8
	15-19 years	10	6.3	6.3	60.0
	19 years or older	8	5.0	5.0	65.0
	5-9 years	47	29.4	29.4	94.4
	DK/NS	8	5.0	5.0	99.4
	Do not have	1	.6	.6	100.0
	Total	160	100.0	100.0	

ELECTRIC What is the fuel used by your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**checked**	111	69.4	100.0	100.0
Missing	**System**	49	30.6		
Total		160	100.0		

NATL GAS What is the fuel used by your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent

Valid	**checked**	42	26.3	100.0	100.0
Missing	**System**	118	73.8		
Total		160	100.0		

OIL What is the fuel used by your water heater?

		Frequency	Percent
Missing	**System**	160	100.0

PROPANE What is the fuel used by your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**checked**	2	1.3	100.0	100.0
Missing	**System**	158	98.8		
Total		160	100.0		

OTHER What is the fuel used by your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**checked**	7	4.4	100.0	100.0
Missing	**System**	153	95.6		
Total		160	100.0		

NO HEATER What is the fuel used by your water heater?

		Frequency	Percent
Missing	**System**	160	100.0

OTHER SPEC What is the fuel used by your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		153	95.6	95.6	95.6
	DK/NS	7	4.4	4.4	100.0
	Total	160	100.0	100.0	

How old is your water heater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**0-4 years**	41	25.6	25.6	25.6
	10-14 years	44	27.5	27.5	53.1
	15-19 years	11	6.9	6.9	60.0

	5-9 years	44	27.5	27.5	87.5
	DK/NS	9	5.6	5.6	93.1
	More than 19 years	11	6.9	6.9	100.0
	Total	160	100.0	100.0	

ELECTRIC What type of fuel do you use for indoor cooking on the stovetop or range?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	138	86.3	100.0	100.0
Missing	System	22	13.8		
Total		160	100.0		

NATL GAS What type of fuel do you use for indoor cooking on the stovetop or range?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	18	11.3	100.0	100.0
Missing	System	142	88.8		
Total		160	100.0		

OIL What type of fuel do you use for indoor cooking on the stovetop or range?

		Frequency	Percent
Missing	System	160	100.0

PROPANE What type of fuel do you use for indoor cooking on the stovetop or range?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	3	1.9	100.0	100.0
Missing	System	157	98.1		
Total		160	100.0		

OTHER What type of fuel do you use for indoor cooking on the stovetop or range?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	1	.6	100.0	100.0
Missing	System	159	99.4		
Total		160	100.0		

DO NOT HAVE What type of fuel do you use for indoor cooking on the stovetop or range?

		Frequency	Percent

Missing	System	160	100.0

OTHER SPEC What type of fuel do you use for indoor cooking on the stovetop or range?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		159	99.4	99.4	99.4
	DK/NS	1	.6	.6	100.0
	Total	160	100.0	100.0	

ELECTRIC What type of fuel do you use for indoor cooking in the oven?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	140	87.5	100.0	100.0
Missing	System	20	12.5		
Total		160	100.0		

NATL GAS What type of fuel do you use for indoor cooking in the oven?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	16	10.0	100.0	100.0
Missing	System	144	90.0		
Total		160	100.0		

OIL What type of fuel do you use for indoor cooking in the oven?

		Frequency	Percent
Missing	System	160	100.0

PROPANE What type of fuel do you use for indoor cooking in the oven?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	3	1.9	100.0	100.0
Missing	System	157	98.1		
Total		160	100.0		

OTHER What type of fuel do you use for indoor cooking in the oven?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	1	.6	100.0	100.0
Missing	System	159	99.4		
Total		160	100.0		

DO NOT HAVE What type of fuel do you use for indoor cooking in the oven?

		Frequency	Percent
Missing	System	160	100.0

OTHER SPEC What type of fuel do you use for indoor cooking in the oven?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		159	99.4	99.4	99.4
	DK/NS	1	.6	.6	100.0
	Total	160	100.0	100.0	

ELECTRIC What type of fuel do you use for clothes drying?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	150	93.8	100.0	100.0
Missing	System	10	6.3		
Total		160	100.0		

NATL GAS What type of fuel do you use for clothes drying?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	8	5.0	100.0	100.0
Missing	System	152	95.0		
Total		160	100.0		

OIL What type of fuel do you use for clothes drying?

		Frequency	Percent
Missing	System	160	100.0

PROPANE What type of fuel do you use for clothes drying?

		Frequency	Percent
Missing	System	160	100.0

OTHER What type of fuel do you use for clothes drying?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	2	1.3	100.0	100.0
Missing	System	158	98.8		

Total	160	100.0		

DO NOT HAVE What type of fuel do you use for clothes drying?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	checked	2	1.3	100.0	100.0
Missing	System	158	98.8		
Total		160	100.0		

OTHER SPEC What type of fuel do you use for clothes drying?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		158	98.8	98.8	98.8
	Clothes line	1	.6	.6	99.4
	DK/NS	1	.6	.6	100.0
	Total	160	100.0	100.0	

About how many square feet of living space are in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1000: 1499	18	11.3	11.3	11.3
	1500: 1999	34	21.3	21.3	32.5
	2000: 2499	30	18.8	18.8	51.3
	2500: 2999	14	8.8	8.8	60.0
	3000: 3499	17	10.6	10.6	70.6
	3500: 3999	8	5.0	5.0	75.6
	4000 or more	6	3.8	3.8	79.4
	500: 999	2	1.3	1.3	80.6
	DK/NS	31	19.4	19.4	100.0
	Total	160	100.0	100.0	

Do you own or rent your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	.6	.6	.6
	Own	156	97.5	97.5	98.1
	Rent	3	1.9	1.9	100.0
	Total	160	100.0	100.0	

How many levels are in your home (not including your basement)?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	.6	.6	.6
	One	97	60.6	60.6	61.3
	Three	8	5.0	5.0	66.3
	Two	54	33.8	33.8	100.0
	Total	160	100.0	100.0	

Does your home have a heated or unheated basement?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	.6	.6	.6
	Heated	20	12.5	12.5	13.1
	No basement	113	70.6	70.6	83.8
	Unheated	26	16.3	16.3	100.0
	Total	160	100.0	100.0	

Does your home have an attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	.6	.6	.6
	No	14	8.8	8.8	9.4
	Yes	145	90.6	90.6	100.0
	Total	160	100.0	100.0	

Are your central air/heat ducts located in the attic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	N/A	14	8.8	8.8	8.8
	No	75	46.9	46.9	55.6
	Yes	71	44.4	44.4	100.0
	Total	160	100.0	100.0	

Does your house have cold drafts in the winter?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	.6	.6	.6
	No	125	78.1	78.1	78.8
	Yes	34	21.3	21.3	100.0
	Total	160	100.0	100.0	

Does your house have sweaty windows in the winter?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**DK/NS**	1	.6	.6	.6
	No	137	85.6	85.6	86.3
	Yes	22	13.8	13.8	100.0
	Total	160	100.0	100.0	

Do you notice uneven temperatures between the rooms in your home?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**DK/NS**	1	.6	.6	.6
	No	83	51.9	51.9	52.5
	Yes	76	47.5	47.5	100.0
	Total	160	100.0	100.0	

Does your heating system keep your home comfortable in winter?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**DK/NS**	1	.6	.6	.6
	No	8	5.0	5.0	5.6
	Yes	151	94.4	94.4	100.0
	Total	160	100.0	100.0	

Does your cooling system keep your home comfortable in summer?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**DK/NS**	1	.6	.6	.6
	No	11	6.9	6.9	7.5
	Yes	148	92.5	92.5	100.0
	Total	160	100.0	100.0	

Do you have a programmable thermostat?					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**DK/NS**	1	.6	.6	.6
	No	60	37.5	37.5	38.1
	Yes	99	61.9	61.9	100.0
	Total	160	100.0	100.0	

What temperature is your thermostat set to on a typical summer weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	69-72 degrees	29	18.1	18.1	18.1
	73-78 degrees	100	62.5	62.5	80.6
	DK/NS	5	3.1	3.1	83.8
	Higher than 78 degrees	18	11.3	11.3	95.0
	Less than 69 degrees	3	1.9	1.9	96.9
	Off	5	3.1	3.1	100.0
	Total	160	100.0	100.0	

What temperature is your thermostat set to on a typical winter weekday afternoon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	67-70 degrees	54	33.8	33.8	33.8
	71-73 degrees	38	23.8	23.8	57.5
	74-77 degrees	29	18.1	18.1	75.6
	DK/NS	10	6.3	6.3	81.9
	Higher than 78 degrees	12	7.5	7.5	89.4
	Less than 67 degrees	14	8.8	8.8	98.1
	Off	3	1.9	1.9	100.0
	Total	160	100.0	100.0	

Do You Have a Swimming Pool or Spa?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	.6	.6	.6
	No	142	88.8	88.8	89.4
	Yes	17	10.6	10.6	100.0
	Total	160	100.0	100.0	

Would a two-degree increase in the summer afternoon temperature in your home affect your comfort..

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	1	.6	.6	.6
	Greatly	25	15.6	15.6	16.3
	Moderately	53	33.1	33.1	49.4
	Not at all	40	25.0	25.0	74.4
	Slightly	41	25.6	25.6	100.0
	Total	160	100.0	100.0	

How many people live in this home?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	41	25.6	25.6	25.6
	2	64	40.0	40.0	65.6
	3	25	15.6	15.6	81.3
	4	20	12.5	12.5	93.8
	5	7	4.4	4.4	98.1
	6	1	.6	.6	98.8
	7	1	.6	.6	99.4
	Prefer not to answer	1	.6	.6	100.0
	Total	160	100.0	100.0	

How many of them are teenagers?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	133	83.1	83.1	83.1
	1	17	10.6	10.6	93.8
	2	8	5.0	5.0	98.8
	3	1	.6	.6	99.4
	Prefer not to answer	1	.6	.6	100.0
	Total	160	100.0	100.0	

How many persons are usually home on a weekday afternoon?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	17	10.6	10.6	10.6
	1	61	38.1	38.1	48.8
	2	53	33.1	33.1	81.9
	3	16	10.0	10.0	91.9
	4	6	3.8	3.8	95.6
	5	4	2.5	2.5	98.1
	Prefer not to answer	3	1.9	1.9	100.0
	Total	160	100.0	100.0	

Are you planning on making any large purchases to improve energy efficiency in the next 3 years?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	DK/NS	20	12.5	12.5	12.5

	No	99	61.9	61.9	74.4
	Yes	41	25.6	25.6	100.0
	Total	160	100.0	100.0	

What is your age group?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**18-34**	10	6.3	6.3	6.3
	35-49	24	15.0	15.0	21.3
	50-59	29	18.1	18.1	39.4
	60-64	27	16.9	16.9	56.3
	65-74	41	25.6	25.6	81.9
	Over 74	24	15.0	15.0	96.9
	Prefer not to answer	5	3.1	3.1	100.0
	Total	160	100.0	100.0	

Please indicate your annual household income.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**$15,000-$29,999**	18	11.3	11.3	11.3
	$30,000-$49,999	24	15.0	15.0	26.3
	$50,000-$74,999	22	13.8	13.8	40.0
	$75,000-$100,000	12	7.5	7.5	47.5
	Over $100,000	14	8.8	8.8	56.3
	Prefer Not to Answer	59	36.9	36.9	93.1
	Under $15,000	11	6.9	6.9	100.0
	Total	160	100.0	100.0	

Appendix H: Verbatim comments about improving aspects of the program

Respondents were asked to rate eleven aspects of the Home Energy House Call program, and if they rated an aspect a "7" or lower on a 10-point satisfaction scale, they were then asked what could be done to improve that aspect of the program. Overall satisfaction ratings are shown in Table 64, followed by verbatim comments about approving each aspect of the program.

Table 64. Mean Satisfaction with Program Components (n=160)

Metric	Average Rating	Valid N (not including don't know)	Percentage of ratings at or below 7
Audit report was trustworthy	9.70	152	0.7%
Audit report looked professional	9.67	145	3.4%
Web Site usability	9.62	47	0.0%
Knowledge and helpfulness of auditor	9.58	159	2.5%
Scheduling audit	9.56	154	3.2%
Interactions with Duke Staff	9.55	138	1.4%
Interactions with auditor	9.54	157	2.5%
Energy efficiency kit quality	9.45	155	7.1%
Audit report easy to understand	9.35	147	5.4%
Likelihood of using recommendations	9.05	149	10.7%
New ideas from recommendations	8.19	147	24.5%
Overall Satisfaction	9.27	160	5.6%

Audit report was trustworthy:

- "*Don't know*"

Audit report looked professional:

- "*Create the report on a laptop rather than filling it out manually by hand.*"
- "*Duke needs to design the report to be understandable from the home-owner's perspective.*"
- "*It was just one sheet of stuff all smushed together that didn't really make sense.*"
- "*Make the report easier to read and understand.*"
- "*Don't know*"

Website usability:

- No respondents rated this aspect of the program a "7" or less.

Knowledge and helpfulness of auditor:

- "*I could have used help installing the items from the kit*."
- "*The auditor didn't leave weather-stripping or outlet/switch gaskets*."
- "*The auditor was not helpful, but he was knowledgeable*."
- "*The auditor was only here long enough to drop off the kit. He never did a walk through inspection of our home*."

Scheduling the audit:

- "*Duke could reduce the amount of time between scheduling the audit and the actual audit itself*."
- "*Scheduling the audit was easy enough*."
- "*Setting up the appointment took time. We had to play phone tag to get it set up*."
- "*There was limited availability and we had to wait for someone to be able to come out*."
- "*We had to wait for the appointment--about 6 weeks from the call date*."

Interactions with Duke Energy staff:

- "*I did not get good advice. I pay the whole year at full price. I have also had problems transferring and activating my account at a new address where I have now lived for six months*."
- "*They were OK*."
- "*Don't know*"

Interactions with auditor:

- "*Duke could have included incentives for home energy upgrades*."
- "*He was rude and used cuss words*."
- "*I was expecting more recommendations specific to our home. The auditor was only here for 5-10 minutes and never did a walk through*."
- "*The auditor could have installed some of the items from the kit*."

Energy efficiency kit quality:

- "*Both of the CFLs I received were 13-watt CFLs*."
- "*I liked what I got, but I didn't receive everything that was supposed to come in the kit*."
- "*One of the CFLs burned out right away. The quality of other items was fine, but I would prefer to receive items made in the USA*."
- "*The CFLs aren't bright enough*."
- "*The CFLs don't last as long as they state they do, and I don't like the disposal of them because they contain mercury. I think that is worse for the environment*."
- "*The fixtures were made in China. I did not enjoy them*."
- "*The items in the kit seemed somewhat shoddy, quality-wise. Better-quality items would be appreciated*."
- "*The kit's quality appeared to be OK. I'm not sure what could be done to improve upon it*."
- "*The light bulbs didn't last*."
- "*The low flow showerhead was less than satisfactory*."
- "*The quality is fine, but I hate CFLs because they take too long to warm up*."

Audit report was easy to understand:

- "*I'd like to see more detail added to the auditor's recommendations*."
- "*I don't understand what I should do about the recommendations. Also I don't know where the audit report is*."
- "*I never received an audit report*."
- "*It wasn't clear about the recommendations for our house*."
- "*The report could have provided more information about how to get the recommendations done*."
- "*The report could use more specific, detailed suggestions*."
- "*The report was a bit too technical for me*."
- "*The verbal discussion with the auditor was better than the report itself: the print version could have better organization: colored highlights: and an easier-to-read format. The sections need to be clearly separated*."
- "*Don't know*"

Likelihood of using recommendations:

- "*Again, it would be better if Duke had offered incentives*."
- "*Again, the audit mostly just found things we had already thought of*."
- "*Duke could add more specificity to the suggestions in the report*."
- "*I'm not sure that it can be improved. The recommendation that we get shades for the wall-to-wall window in the living room is not feasible*."
- "*I don't understand the audit report*."
- "*I just couldn't afford to have them done*."
- "*I might be more inclined to take action if the report were easier to understand and included more instructions*."
- "*I will do most of what was recommended. It's just a matter of cost right now*."
- "*I would have liked to do more of the recommendations but I cannot afford them. I guess financial assistance would help me get these things done*."
- "*It can't be improved. I'm just not going to take the recommendations that were made because I built this home to be extremely energy efficient and the auditor is pointing out dumb things for me to do*."
- "*Many of the actions require substantial financial commitments. This can be hard to do on a limited budget*."
- "*Some of the things listed were too expensive*."
- "*The auditor suggested that I replace all my windows, which was ridiculous*."
- "*The program could provide financial incentives*."
- "*The things the report suggested were things I couldn't do at the time*."
- "*Don't know*"

New ideas from recommendations:

- "*Again, if Duke had offered financial incentives for energy upgrades, I would have done that*."
- "*Home owners are pretty handy otherwise. I had expected some of the ideas to emerge.*"

- "*I already had considered energy efficiency when building the house, so there wasn't much that I hadn't previously considered*."
- "*I already had most of the recommendations in mind, but the audit confirmed them and helped me to prioritize them*."
- "*I believe I already did all I could to save energy*."
- "*I had already been considering certain actions before the auditor came*."
- "*I had already done some of the things that were recommended*."
- "*I had already done the things that the report recommended*."
- "*I knew that certain things should be done*."
- "*I knew that CFLs would help and I knew that insulation was questionable*."
- "*I pretty much knew all that was recommended from previous experience*."
- "*I was already considering some of the measures suggested (like installing switch/outlet gaskets), but there were some suggestions that I wasn't thinking about (like installing weather-stripping)*."
- "*I was already considering some of the recommendations*."
- "*I was already considering these recommendations*."
- "*I was aware of most of the things in the recommendations*."
- "*I was considering some things that the auditor mentioned*."
- "*Our house is brand new and already energy efficient, so there is not much more we can improve*."
- "*The audit just confirmed what I knew needed to be done*."
- "*The audit mostly just found things we had already thought of*."
- "*The audit report didn't have many recommendations for us, and some we had been already considering*."
- "*The auditor really did not have any recommendations*."
- "*The recommendations included quite a few ideas that I was already considering*."
- "*The recommendations included some things that we were already considering*."
- "*The recommendations provided no information on solar energy*."
- "*The report could include more new information and fresh ideas, less generality*."
- "*The report did provide some new ideas, but most were things we already knew about*."
- "*The report didn't really have many recommendations for us*."
- "*The report recommended things that we were already doing*."
- "*The report seemed rather obvious rather than insightful*."
- "*There really weren't any recommendations*."
- "*There were suggestions that we were already considering, but since we just bought the house, it was great to have a professional look over the house for us*."
- "*Don't know*" (3 respondents)

Appendix I: Verbatim comments: actions inspired by DOE booklet

Respondents were asked what actions they took based on the DOE Energy Savers booklet provided with the HEHC program's energy efficiency kit. Figure 9 shows the distribution of different activity categories, which is followed by verbatim comments from participants describing their actions.

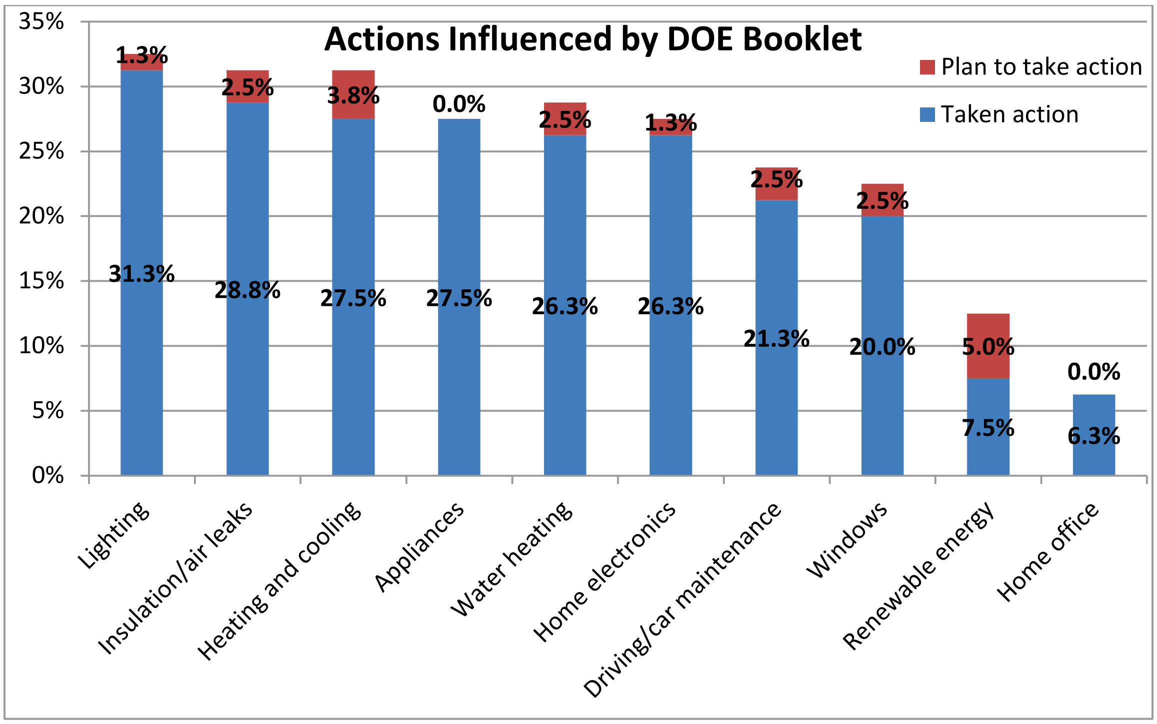

Figure 9. Participants who took energy efficient actions based on the DOE booklet (n=80 respondents who read the booklet)

Lighting:

- "*All the fixtures in the house have been replaced.*"
- "*CFL bulbs*"
- "*I added sky lights and sun tunnels.*"
- "*I am changing my entire house to CFLs.*"
- "*I am gradually changing to CFLs as the standard bulbs burn out.*"
- "*I am using CFLs.*"
- "*I have added more CFLs.*"
- "*I have CFLs in most available sockets.*"
- "*I have changed over to CFLs.*"
- "*I have changed remaining standard bulbs to CFLs.*"
- "*I have installed more CFLs.*"
- "*I have installed more energy efficient light bulbs. I think all the bulbs in my*

house are now CFLs."

- "*I have purchased and installed CFLs, and I make sure everyone turns off lights when not in use*."
- "*I have replaced all standard bulbs with CFLs*."
- "*I installed CFLs in my home*."
- "*I mostly use CFLs now*."
- "*I replace bulbs with CFLs*."
- "*I replace standard bulbs with CFLs when standard bulbs burn out*."
- "*I turn off lights when I am not using them*."
- "*I use only CFLs*."
- "*I use the CFLs Duke gave me*."
- "*We are switching over to CFLs*."
- "*We have installed CFLs in every part of the house*."

Insulation and air leaks:

- "*Added R30 insulation*."
- "*Caulked windows and around fireplace in June 2012*."
- "*Door to crawlspace. That was taken care of*."
- "*Further tips on purchasing insulation products*."
- "*I added insulation around the attic and fixed some door leaks*."
- "*I added insulation around the attic*."
- "*I added insulation in attic, roof, and water heater, and caulked windows*."
- "*I added insulation to the attic and perimeter*."
- "*I added spray foam*."
- "*I checked and repaired the insulation in the garage and sun room*."
- "*I fixed leaks by doors. I added weather stripping. I put insulation around hoses from my heat pump. I put up boards overhead vents*."
- "*I fixed leaks under the house with insulation and around doors*."
- "*I installed a new roof*."
- "*I insulated my attic steps*."
- "*I put seals around the windows*."
- "*I repaired my attic and fireplace*."
- "*I sealed up the attic stair access panel. I put weather-stripping around the frame*."
- "*I weather-stripped the doorways*."
- "*If I see an air leak, I will take care of it*."
- "*We added insulation around our stairwell to our attic*."
- "*We added some caulking around the windows. I grew up in a colder climate, so I already am aware of potential air-leak problems*."
- "*Windows/doors, and crawlspace repair to insulation*."

Heating and cooling:

- "*I just installed a new heat pump*."

- "*I've recently installed a new heating and AC unit*."
- "*I adjust the thermostat*."
- "*I changed my temperature to over 78 for summer and lowered the winter level to 65*."
- "*I changed my thermostat in the summer to 78, and in the winter to 65 or 66*."
- "*I had my A/C cleaned, serviced and evaluated*."
- "*I had the water heater serviced and A/C serviced*."
- "*I installed a new heat pump*."
- "*I make sure to set my thermostat at the appropriate temperatures*."
- "*I planted a tree in the summer of 2012*."
- "*I purchased a new furnace and air conditioner*."
- "*I replaced whole units*."
- "*I set my thermostat and leave. I don't adjust it*."
- "*I try to set my thermostat lower in the winter and higher in the summer*."
- "*I try to use as little energy as possible to stay comfortable*."
- "*New AC and furnace*"
- "*Raised to higher temps in summer (78), cooler temps in winter.*"
- "*Scheduled programmable thermostat*."
- "*We raised our thermostat setting for the summer*."
- "*When no one is home I adjust the thermostat so I am not cooling or heating the house unnecessarily*."

Appliances:

- "*All my appliances are Energy Star rated*."
- "*All of our appliances are energy-saving*."
- "*Already had purchased Energy Star refrigerator, washer, and dryer before audit*."
- "*I'm buying a new Energy Star dishwasher*."
- "*I'm pretty sure that since the house is only 45 years old that the appliances are Energy Star*."
- "*I bought an Energy Star-rated refrigerator*."
- "*I buy Energy Star appliances when there is a need to replace an appliance*."
- "*I have unplugged two freezers and one fridge. I have raised the temperature on the fridge I still use*."
- "*I purchase Energy Star appliances*."
- "*I purchased a toaster oven instead of using the oven*."
- "*I purchased an Energy Star washer and dryer and refrigerator*."
- "*I purchased an induction stove-top oven*."
- "*I unplug appliances when I am not using them*."
- "*I use energy-efficient appliances*."
- "*I use my oven less*."
- "*Replaced dishwasher, refrigerator, microwave, stove. The recommendations helped my husband realize value of changing*."

- “*We got an Energy Star dishwasher*.”
- “*When there is a need to replace an appliance, I will look for Energy Star*.”

Water heating:

- “*I bought an insulation blanket for my water heater but my plumber recommended against using it*.”
- “*I got a blanket to put around the water heater that I haven't put on it yet but I will*.”
- “*I got pipe covers to keep them from freezing in May 2012*.”
- “*I had a plumber add insulation around my water heater*.”
- “*I have a tankless water heater*.”
- “*I keep the water heater turned off when I am away from the house for a few weeks at a time*.”
- “*I lowered the temperature*.”
- “*I perform annual maintenance on the water heater*.”
- “*I put a blanket around the water heater*.”
- “*I put a blanket over the water heater*.”
- “*I reduced the temperature to 120 degrees*.”
- “*I replaced the heating elements*.”
- “*I replaced the water heater last summer*.”
- “*I turned the temperature down to 120. I thought about a newer crossover water system that I saw on ‘This Old House,’ but it won't work in my current house because I have crimp-on plastic tube water lines*.”
- “*I upgraded to an Energy Star-rated water heater*.”
- “*I wash my laundry in cooler water*.”
- “*I wash my laundry in cold water*.”

Home electronics:

- “*I bought a new computer*.”
- “*I have been turning things off when I am not using them and unplugging them before I go to bed*.”
- “*I have started using power strips*.”
- “*I learned that electronic devices draw power even when they appear to be off*.”
- “*I purchased a flat screen TV that uses less energy*.”
- “*I purchased a new computer*.”
- “*I purchased an Energy Star TV*.”
- “*I seem to recall some information about unplugging cell-phone chargers*.”
- “*I shut off my computer more often*.”
- “*I turn my TV off when I leave*.”
- “*I turn off my 24/7 high energy computer. I also have my new TV on a power strip to avoid ‘sleep’ mode*.”
- “*I turn off my computer when not in use*.”
- “*I turn off my DV-R when I am not using it*.”

- "*I turn stuff off when it's not in use and unplug stuff when we rarely use it*."
- "*I unplug appliances when I am not using them*."
- "*I unplug phone chargers*."
- "*I use a power strip to turn things off, including my computer*."
- "*I was using power strips previously*."
- "*Unplug*."

Driving and car maintenance:

- "*I am frugal and always keep my car maintained*."
- "*I consolidate trips*."
- "*I drive less to conserve gas*."
- "*I drive the speed limit*."
- "*I had major repairs done to my auto*."
- "*I had my car serviced. I get regular maintenance and I have new brakes*."
- "*I have always done kept tires inflated, etc*."
- "*I have purchased a more fuel efficient car*."
- "*I keep my car maintained at top level*."
- "*I log the MPG with my car*."
- "*I maintain my vehicle well and get frequent oil changes*."
- "*I make sure my tires are inflated. I make sure the oil and filter are good. The mechanic says the car is well-maintained*."
- "*I perform regular oil changes every 3000 miles*."
- "*I put air in my tires, the cars are leased, and I don't leave cars idle*."
- "*I reduce my driving speed when possible to save gas*."
- "*We're on a strict schedule for car use*."
- "*We keep up constantly on our car maintenance*."

Windows:

- "*I caulked windows in June 2012. I got curtains for the windows in April 2012*."
- "*I caulked windows*."
- "*I had new windows installed*."
- "*I installed a window fan which cools the house. It is one with metal blades*."
- "*I installed new shades. Already had energy efficient window before reading the book or getting the audit*."
- "*I installed new windows*."
- "*I installed solar screens in the summer of 2012*."
- "*I put sealant on some windows*."
- "*I sealed the windows in May 2012*."
- "*I sealed windows*."
- "*We had one window repaired but I do not know specifically what was done*."
- "*We installed new windows*."
- "*We installed some weather stripping*."

- "*We replaced all our windows*."

Renewable energy:

- "*I have a solar powered light for the front yard*."
- "*I have been looking at geothermal energy, but it is not cheap*."
- "*I installed solar screen panels a few months ago*."
- "*I recycle bottles and cans*."
- "*I tried schedule a contractor to come out to my house to speak to me about solar energy panels*."
- "*I use wood heating whenever possible*."

Home office:

- "*I purchased an Energy Star printer when my old printer broke*."
- "*I turn off my computer when I am not using it. I purchased power saver strips*."
- "*I use a power strip and turn it off at times*."
- "*I use a small low wattage light rather than the larger overhead light*."

Appendix J: Verbatim comments: actions inspired by audit report

Respondents were asked if they had made any changes to their homes which were either directly or indirectly inspired by the home audit report. The verbatim comments of the 51 respondents who said they took further actions are listed below.

- "*Attic barriers, insulation and ventilation are on my to-do list*."
- "*Before I had the energy audit done I had called Duke to see if there was a way I could lower my energy bill and someone the recommended that I put siding on the house and get energy efficient windows, which I had done before the audit (2009 and 2010)*."
- "*Caulked around some windows and doors outside of the house*."
- "*Do laundry late at night during off peak times*."
- "*Fixed a gas leak in 2010. Added more ceiling fans in 2011. Got a new water heater, washer and dryer in 2012*."
- "*Found that the boost in energy usage came from internal energy use--specifically, teenager leaving a computer on 24/7 (drawing 350w to 400w)*."
- "*I'm having an expert assess our crawlspace for odor and mildew in September 2012*."
- "*I am building a screen porch on the east side of the house, which will prevent sunlight hitting the house directly*."
- "*I am changing from gas to propane soon*."
- "*I am mostly just fixing up the home and haven't got to everything yet. In the future I will have more things done to improve efficiency. The audit did affect my decision-making*."
- "*I bounced a lot of ideas off of the auditor in making decisions. He was very helpful. He stopped me from making some mistakes - things that would not work. For example, having removable windows in the Florida Room be replaced with screens in hot months. The auditor recommended creating a 3-season porch. He recommended getting solar tubes rather than sky lights which create too much heat*."
- "*I got some fans that bring the warm air down to me in winter. My living and dining rooms and kitchen are all connected with high ceilings. I had it done in summer of 2011*."
- "*I had all the windows replaced and sealed. I got the doorways reconstructed and new doors put in*."
- "*I installed a programmable thermostat*."
- "*I make sure that the small appliances are unplugged when not in use*."
- "*I plan to eventually insulate the entire house and replace windows*."
- "*I planted a tree to provide more shade*."

- "*I purchased storm doors, added insulation, changed light bulbs to CFLs and tightened up insulation under the house. While doing repair work found a leak which was letting air flow from house so he fixed that with insulation tape*."
- "*I put a blanket around water heater in April of 2011*."
- "*I put a blanket over the water heater*."
- "*I re-roofed the house. There had been 'daylight' visible around the vents. I had this done in spring 2012*."
- "*I recommended CFLs to my kids, but they were already using CFLs*."
- "*I replaced my refrigerator, washer, dryer, stove, roof, AC system, and furnace*."
- "*I replaced my roof, and added attic insulation*."
- "*I turned my AC up and my heating down*."
- "*In January of 2012 there was work done in the kitchen. Energy Star stove was put in and closed of fan vent. New fridge is also Energy Star*."
- "*Installed an automatic attic fan for the heat*."
- "*Installed new double pane windows*."
- "*Just added insulation to the 'outdoors basement room' and the plastic over the dirt floor the summer of 2011*."
- "*My new refrigerator, dishwasher, washer and dryer, microwave and stove, all are energy efficient*."
- "*New appliances (dishwasher, fridge, and stove replaced) in 2011 with Energy Star ratings*."
- "*New ceiling fans, new doors in the hallway, new washer and dryer that's energy efficient*."
- "*New roof*."
- "*New windows, insulated walls*."
- "*Raised summer temperature and lowered winter temperature settings on thermostat*."
- "*Replaced 17 windows, replaced 3 doors, added vinyl siding and metal roof, last year. Added a car port in January. Added rain gutters*."
- "*Replaced an old dishwasher, washer and dryer with new energy efficient ones*."
- "*Replaced some light fixtures with fluorescent instead of incandescent. Reinstalling duct work under the house. Water saving valve on toilets*."
- "*Under the house sealed in because Terminex came in and found black mold. And new windows put in. Sun tunnels and sky light put in*."
- "*We've done a lot of remodeling, which coincided time-wise with the audit report. We added new low flow toilets and faucets, all within the last 2 years*."

- "*We added another layer of R30 insulation to our attic in February 2011*."
- "*We are using more power strips and we unplug them to save energy*."
- "*We caulked our windows and around the fireplace in June 2012. We got a pipe cover to keep them from freezing in May 2012. We got curtains for the windows in April 2012*."
- "*We installed high efficiency windows in March of 2011*."
- "*We make sure to shut off stuff like the TV when no one is watching and turning off lights*."
- "*We put a new roof on but we needed to do that to maintain the house*."
- "*We put a Sunsetter retractable awning on back deck which keeps the sun off the back door*."
- "*We put in ceiling fans in spring of 2011*."
- "*We unplug appliances and electronics when not in use*."
- "*Windows tinted in the summer of 2012. The energy auditor got my mother to use a dishwasher by convincing her that it will save energy*."
- "*Wrapped water heater*."

Appendix K: Prior Methodology and Updated Approach

Prior to this change in the evaluation approach, impact evaluations employed four different strategies for estimating impacts. These are:

1. **The Experimental Design Approach** in which customers are randomly sorted into a test and control group. In this design savings are based on the difference between the consumption of these two groups over the same period of time. The mathematics of this approach is called the "difference of differences approach". This approach provides net savings because it segregates the two groups independently as a function of their random assignment. Only the test group receives exposure to the program, while the randomly assigned non-participants are used as a control group. When these two groups are compared, in a difference of differences approach, the findings are net savings because the savings are already adjusted for what would have happened without the program by subtracting out the savings from the control group. In this approach, subtracting or adding the differences in the energy use of the control group adjusts the gross savings (pre vs. post consumption of the test group) to compensate for the change in consumption of the non-program-exposed control group. This savings produced from this approach are net.

2. **The Quasi-Experimental Approach** is similar to the experimental design approach. However, the construction of the control group is not based on random assignment. In this approach the evaluation experts purposefully and systematically selects subjects to use as a control group. However, because this type of analysis uses a non-random approach to represent the control group, the term "control group" is not used because it can be confused with a random assignment approach. In the use of the quasi-experimental design the evaluation experts selects the comparison group so that it is as closely matched to the test group (participants) as possible. The term used to represent the group that is used to adjust savings for what would have occurred is the "*comparison group*". Assignments to the comparison group population are carefully considered by the evaluation expert in order to develop a comparison group that is as identical as possible to the test group, except for the participation in the program. The characteristics of the test group that are used for matching are typically demographic characteristics (age, housing type, location, income, etc.), energy use characteristics (amount of energy they use and when they use it) and in some cases psychographic characteristics (attitudes and behaviors). While the match is not as reliable as a true experimental design the results provided from this difference of differences approach are net savings. That is, the savings are already adjusted for what would have occurred without the program via the use of the matched comparison group and the use of the differences of differences analytical approach.

3. **The Pre versus Post with Net Adjustment Approach** is a simpler approach than the experimental or quasi-experimental approach in that the energy savings are based not on the use of the comparison or control groups, but instead are based on the difference

between the pre-program and post-program periods of the test group. This approach is a differences approach in that gross savings are estimated as the difference between the pre and post program periods. To convert gross savings to net of freerider savings (what would have occurred without the program), the savings that would have been achieved without the program are subtracted from the gross savings. The estimation of the savings that would have occurred without the program is typically calculated via the use of a freeridership battery of questions asked of the participants. These questions essentially get at what actions the participants would have taken without the program. Then the estimates of savings that would have occurred are then subtracted from the gross savings to provide net savings that are adjusted for freeridership.

4. **The Engineering Based with Net Adjustment Approach** is another standard energy savings estimation approach using an engineering estimation approach in which savings are estimated via the use of engineering calculations rather than billing or consumption records. In this approach, the actions taken are identified via interviews, surveys or inspections. Then a trained energy evaluation expert calculates the expected savings under the installation and use conditions of the participant's facilities. These are estimated savings based on known conditions about the energy use of the equipment that was going to be in use without the program and the consumption of the program-induced equipment. In this case the savings are gross and need to be adjusted by what the participant would have done without the program. As in the previous approach, the estimation of the savings that would have occurred without the program is typically calculated via the use of a freeridership battery of questions asked of the participants.

The above 4 approaches have been used as the standard approaches in the field of energy program evaluation for over 30 years. The approaches presented above are presented in descending order of their reliability. The approach with the highest level of reliability is the experimental design approach. The least reliable is the engineering based approach. The experimental design approach, when done well, is typically reliable to a couple of percent. The engineering approach, even when done well, is typically reliable to within 20% to 30%. In order to develop an approach that is more reliable than the pre versus post or the engineering approach, but is not as costly as the experimental or quasi experimental approaches, the field of evaluation developed the controlled fixed effects net billing analysis approach. This approach delivers net energy savings at a level of reliability that is similar to the experimental or quasi-experimental design but does not include the costs to form and use an independent control or comparison group.

5. **The Controlled Fixed Effects Billing Analysis with and without Net Adjustment** approach has been developed to provide savings estimates when a control or comparison group is not available or advisable because of cost considerations. In this approach, the participant's energy use data is used to econometrically model the energy savings for the participant by employing a rolling comparison time period using the time before customers participated in a program as the comparison period, forming a proxy comparison group. Because customers come into a program at a specific time, the time before that enrollment is grouped with other pre-program periods of all participants. Because the customer's pre-program period is used to control for normal energy changes

> over time at the population level, it is more reliable than the use of a comparison group. That is, the participants are exactly matched to the comparison group because they are the same individuals. There is no selection bias because there is no selection into a control or comparison group. This strengthens the study. Because only the pre-program energy use is used as the proxy comparison group, there is no program influence on that period of time that is used for the savings estimation. Because people come into the program at different periods of time, essentially providing a full analytical period (timeline) of non-participating energy consumption, the entire pre-program period can be used as the comparison group over the pre and post analytical program period. This analytical approach can also control for the effects of participating in other energy efficiency programs so that the savings achieved via multiple program participation is only counted once and credited to only one program. In cases in which there are multiple program participants, the savings associated with participants who have participated in multiple programs is subtracted from the savings identified within the billing analysis approach by subtracting out the typical savings associated with the typical installation in proportion of their occurrence in the participating population.

This approach has gained considerable use within the evaluation community and has been adopted as standard practice by several of the leading evaluation firms in the United States. The approach has also been peer reviewed within the evaluation community and accepted as one of the more reliable evaluation approaches that is not as reliable as the experimental design approach, but is probably more reliable than the quasi-experimental design because it reduces the bias associated with comparison group selection. When this approach has been used in the past, typically net savings were estimated by conducting a freeridership questionnaire and then subtracting out the savings associated with freeridership. This is the approach that was used in the Duke Energy Home Energy House Call 2011 impact evaluation reports. However, recent developments in the field of evaluation has indicated that when a program is assessing standard market consumable measures that are inexpensive and have low purchase barriers, there is no need to adjust for freeriders because their market practices are already in the pre-program billing data. These measures that are typically readily available in the market and typically cost well under $5 each do not rise to the level that they pose a significant financial or technical barrier once an adoption decision has been made. As a result there is no need to adjust for freeriders when a program focuses on low-cost and readily available measures. Thus the field of evaluation is now moving away from adjusting for freeriders for minor low-cost, readily available measures (CFLs, pipe wrap, aerators, shower heads, etc.) when a billing analysis approach is used that employs a rolling pre-program period as the comparison group. However, when the program offers measures that have significant adoption barriers, such as a high cost or technical uncertainty (air-conditioners, major Energy Star appliances, motors, chillers, pumps compressors, etc.), then this approach must also include a freerider analysis to estimate net effect. Because major measures are not a standard market consumable product, the savings from these measures would not typically be net savings from the use of a rolling comparison period consisting of the pre-program period for all enrolling participants.

TecMarket Works adopted the controlled fixed effects billing analysis with and without net adjustment approach as a standard practice in 2012. With this adoption, TecMarket Works acknowledges that the 2011 Home Energy House Call evaluation studies that subtracted the savings of self-expressed freeriders for minor measures essentially double-counted freerider adjustments and provided a net savings estimate that is lower than what the program achieved. While that study was conducted using the industry's standard best-practice analysis approaches of 2011, the field has since changed in its acceptance of this practice and TecMarket Works agrees with this change. As with all fields, the field of energy efficiency program evaluation is evolving. Our field is establishing protocols that reflect improvements in the ability to estimate net energy impacts. As the evaluation field develops and adopts more reliable net energy analysis approaches, these approaches will be incorporated into our industry's protocols and standard practices. For example, the state of Indiana has (in 2012) adopted the approach that recognizes standard market operational practices (such as the pre-program period for participants) as the baselines for conducting energy impact analysis in which the results are net savings without the need for freerider adjustments. This protocol is included in the Indiana and Delaware[21] Evaluation Frameworks and is now being used as a standard practice in other states. TecMarket Works has abandoned the practice of adjusting minor or low-cost standard market products to account for freeriders when pre-program energy use practices are set as the net baseline analysis platform.

[21] The Delaware Evaluation Framework is pending final approval. When it is made public, it will be available at: http://www.dnrec.delaware.gov/energy/information/otherinfo/Pages/Evaluation.aspx.

Appendix L: DSMore Table

Per Measure Impacts Summary for Home Energy House Call

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (customer peak/unit)	EM&V gross kW (coincident peak/unit)	Unit of measure	Combined spillover less freeridership adjustment	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
HEHC		Carolinas	928	0.9341	0.1149	home		928	0.9341	0.1149	no	11
Program wide		**Carolinas**	**928**	**0.9341**	**0.1149**	**home**		**928**	**0.9341**	**0.1149**	**no**	**11**

*The evaluation methodology provided net savings only. By design, gross savings are excluded from this methodological approach. The controlled quasi-experimental

**There is no Freeridership value provided in this table due to the evaluation methodology employed

Final Report

Impact Evaluation of the Residential Smart $aver® HVAC Program in the Carolina System

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

February 28, 2013

Submitted By:

Nick Hall and Brian Evans

TecMarket Works
165 West Netherwood Road
Oregon, Wisconsin 53575
(608) 835-8855

Pete Jacobs
BuildingMetrics, Inc

Michael Ozog and May Wu
Integral Analytics

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Executive Summary

Key Findings and Recommendations

An overview of the key findings identified through this evaluation is presented in this section.

Significant Impact Evaluation Findings

Table 1 presents the gross unit kWh and kW savings per ton associated with the Residential Smart $aver HVAC program. These results are obtained based on a model which uses the results of the engineering analysis within a statistical billing data analysis (the SAE approach).

Table 1. Energy Savings per Ton Associated with the Residential Smart $aver Program in the Carolina System

Measure	Asheville		Charlotte		Greenville	
	kWh/ton	kW/ton	kWh/ton	kW/ton	kW/ton	kW/ton
AC_seer14	41.5	0.040	48.3	0.068	46.2	0.056
AC_seer15	53.3	0.024	82.2	0.079	73.6	0.057
AC_seer16	65.6	0.038	124.8	0.118	105.9	0.071
AC_seer17	103.2	0.074	173.0	0.141	149.3	0.107
AC_seer18	111.0	0.102	193.6	0.175	164.9	0.145
AC_seer19	138.6	0.124	232.1	0.201	200.2	0.170
AC_seer20	107.5	0.126	200.3	0.196	171.2	0.160
AC_seer21	122.1	0.205	256.7	0.255	205.5	0.274
Hp_seer14	84.2	0.048	98.7	0.056	86.5	0.055
Hp_seer15	197.5	0.134	227.8	0.115	206.1	0.133
Hp_seer16	270.2	0.100	282.8	0.145	274.4	0.128
Hp_seer17	198.9	0.116	261.2	0.160	235.9	0.151
Hp_seer18	329.2	0.126	359.1	0.163	342.4	0.153

Program participation by HVAC system type, size, SEER, and location were applied to the savings per ton estimates from Table 1 above to compute the program savings, as shown in Table 2.

Table 2. Summary of Program Gross and Net Savings by Measure

Metric	Air Conditioner	Heat Pump
Participation Count	2,075	3,588
Gross kW per unit	0.260	0.335
Gross kWh per unit	270.6	636.5
Freeridership rate	32.1%	32.1%
Spillover rate	0%	0%
NTG ratio	67.9%	67.9%
Net kW per unit	0.177	0.227
Net kWh per unit	184	432

Measure Life (years)[1]	15	15
EUL net kWh per unit	2760	6480

- Engineering modeling revealed energy and demand savings that are not proportional to the difference in SEER. The SEER, which is based on a standardized laboratory test, is not a reliable predictor of annual energy consumption under the more realistic operating conditions included in the building energy simulation models. Higher SEER air conditioners and heat pumps typically rely on multiple compressors to improve part-load performance, but may not provide proportional improvements in full-load efficiency. The results seen in this evaluation are consistent with results in other states.
- The billing analysis indicates that the participants realized 94.71% and 104.4% of the savings estimated by the engineering analysis for air conditioners and heat pumps, respectively.
- The 2012 Carolinas Residential Smart $aver HVAC report recommended calibration of the DOE-2 models to direct metering of the full HVAC system at a sample of sites. Although the 2012 report was based on the best available information at the time, the inclusion of the full HVAC end-use metering improved the agreement between the engineering models and the billing analysis.
- The end-use calibrated DOE-2 models produced lower cooling loads per square foot of floor space, and primary data collection on HVAC unit sizing produced more cooling capacity per square foot of floor area than the previous study. These results, combined with updates to the DOE-2 HVAC performance maps produced lower kWh savings per installed ton relative to the 2012 report.
- Participating dealers should record the make and model number of the replaced air conditioner and provide an assessment of the condition of the unit as part of the rebate application process. These data will allow the evaluation team to improve the estimate of the early replacement baseline efficiency.

[1] Effective Useful Life (EUL) taken from 2011 Database for Energy Efficiency Resources (DEER) update study. See www.deeresources.com

Description of Program

The Duke Energy Residential Smart $aver program provides rebates for installations of higher efficiency heating and cooling measures in new or existing homes. Qualified purchases by residential customers are eligible for rebates of $200 to the homeowner, and $100 to the HVAC contractor/dealer. Home builders who install qualified equipment are eligible for rebates of $300 that they may choose to pass on to the home buyers.

There are two types of measures for which rebates are available: central air conditioners (CAC) with electronically commutated fan motors (ECM)s, and heat pumps with ECMs. Duke Energy provides rebates for measures that have higher efficiency performance levels that are above current federal standards.

To participate, Duke Energy customers work directly with a participating HVAC contractor, select the eligible equipment, and provide their Duke Energy account number. The contractor completes the application for the rebate, providing the necessary AHRI certificates. Duke Energy has contracted with a third party, program administrator (Wisconsin Energy Conservation Corporation, WECC) who then processes the rebates and sends incentives to the customer and/or the contactor.

Program Participation

The evaluation covers participants in the program spanning July 5, 2011 through February 14, 2012, with post customer data through September 2012. Engineering estimates were prepared for each program participant. The billing analysis included a near census of participants, as shown below:

Program	Impact Type	*Participation Count
Residential Smart Saver – Carolinas	Engineering	5,311
Residential Smart Saver – Carolinas	Billing	5,246

* There is a difference in the participation counts between the engineering and billing analyses (5,311 – 5,245 = 65), with 60 accounts being geothermal systems, which were not included in the billing analysis, and 5 accounts being outliers (monthly usage was too low or too high in all months).

Methodology

The impact evaluation used an engineering approach combined with a statistical billing analysis in a Statistically Adjusted Engineering (SAE) model framework. The engineering-based approach to estimating program savings consisted of the following steps:

1. Analysis of program participation tracking system data
2. Short-term monitoring of HVAC systems
3. On-site survey of homes where short-term metering was conducted.
4. Development and calibration of prototypical building energy simulation models
5. Simulation of measure energy savings assuming existing equipment as the baseline.
6. True-up of engineering estimates with billing data using a Statistically Adjusted Engineering (SAE) approach
7. Calculation of gross program energy and demand savings assuming standard efficiency new equipment as the baseline.

This approach differs from most of the other evaluations of similar programs in that it combines both engineering and billing analyses. Other evaluations have either used one or the other. Those evaluations that use only engineering analysis (even if they calibrated using billing data), ignore changes in customer HVAC usage associated with the installation of higher efficiency units and other behavior changes.[2] Evaluations that depend only upon a billing analysis can only capture the early replacement of equipment – they cannot capture the natural replacement savings (i.e., the baseline is not the actual efficiency of the existing HVAC system, but the current HVAC efficiency standards).

The Residential Smart $aver HVAC program is designed as a time of replacement program. Incentives are offered to encourage customers to upgrade from a standard efficiency new air conditioner or heat pump to a higher efficiency new system when the existing system is at the end of its service life. This is commonly referred to a “normal replacement” scenario. The baseline efficiency assumed for the program is a SEER 13 minimally code-compliant air conditioner or heat pump. In some cases, the customer may be encouraged by the program to replace their existing air conditioner or heat pump before the existing system is at the end of its service life. This is commonly referred to as an “early replacement” scenario. Under an early replacement scenario, the existing HVAC system is the baseline, and the life cycle savings accrue using the existing system baseline for the remaining useful life of the existing system. Once the existing system reaches the end of its service life, the baseline reverts to the normal replacement baseline, and the life cycle savings accrue until the end of the service life of the new equipment. This is commonly referred to as the “dual baseline” approach, which is shown in the equation below:

$$\text{Life cycle kWh savings} = (kWh_{ER} - kWh_{EE}) \times RUL + (kWh_{NR} - kWh_{EE}) \times (EUL - RUL)$$

where:

[2] For example, the 2009 EM&V Report for the Home Energy Improvement Program for Progress Energy.

kWh_{ER} = kWh consumption of the existing system
kWh_{EE} = kWh consumption of the efficient (rebated) system
kWh_{NR} = kWh consumption of a minimally code compliant system
RUL = remaining useful life of the existing system
EUL = effective useful life of the efficient (rebated) system

Under the normal replacement scenario, the savings are simply:

Life cycle kWh savings = (kWh_{NR} – kWh_{EE}) x EUL

As discussed above, it is reasonable for the program to claim the savings associated with early replacement, these savings can only be claimed for the remaining life of the replaced unit, after which the claimed savings revert to the normal replacement level. However, it is extremely difficult and expensive to derive accurate estimates of the replaced unit's remaining life, so this evaluation takes the conservative approach, where all replacements were considered to be normal replacements.

To convert the early replacement savings estimate obtained from the billing analysis, the estimated realization rate (using engineering estimates with a 10 SEER early replacement baseline), was applied to the same analysis assuming a 13 SEER (the normal replacement baseline). This represents approximately a 70% reduction in savings.

Data collection methods, sample sizes, and sampling methodology

Engineering Estimates

Smart $aver program participation records for all participants covering the period from July 5, 2011 through February 14, 2012 were obtained from Duke Energy.

Billing Analysis

The results from the billing analysis represent the entire population of participants with usable billing data, so no sample design was necessary.

Number of completes and sample disposition for each data collection effort

Engineering Estimates

Smart $aver program participation records for all participants covering the period from July 5, 2011 through February 14, 2012 were obtained from Duke Energy. Engineering estimates were prepared for all participants for which records were provided.

Billing Analysis

Program tracking data was used to pull billing data from all participants in the Carolina System. The billing data was combined with information on participation date and in turn linked to weather data (temperature) to form the dataset used in the regression analysis.

Expected and achieved precision

Engineering Estimates

Not applicable. Census of participants used in the study.

Billing Analysis

All savings estimates from the billing analysis were statistically significant at the 95% confidence level.

Description of baseline assumptions, methods and data sources

Engineering Estimates

Baseline assumptions are incorporated into the prototypical simulation models derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study, with adjustments made for local building practices and climate. A detailed description can be seen in Table 3.

Description of measures and selection of methods by measure(s) or market(s)

Engineering Estimates

DOE-2.2 simulations calibrated to end-use metered data were used to estimate savings from central air conditioners and heat pumps ranging from SEER 14 to SEER 21.

Billing Analysis

The billing analysis was used to true up the engineering estimates. The realization rate from the SAE model was used to adjust the engineering estimates of savings for air conditioners and heat pumps ranging from SEER 14 to SEER 21.

Threats to validity, sources of bias and how those were addressed

Engineering Estimates

Any potential for bias in the engineering estimates is minimized through the use of building energy simulation models, which are considered to be state of the art for HVAC system analysis. Seasonality in heating and cooling energy use, and the use of natural ventilation during mild weather in the cooling season is incorporated to reduce upward bias in the engineering estimates. The engineering models are calibrated to short-term metered data on the HVAC system and trued up to the billing analysis described below.

Billing Analysis

The specification of the model used in the billing analysis was designed specifically to avoid the potential of omitted variable bias by including monthly variables that capture any non-program effects that affect energy usage. The model did not correct for self-selection bias because there is no reason to as long as the program remains voluntary.

Evaluation Date Ranges

Evaluation Component	Dates of Analysis

Engineering Estimates	October through December, 2012
Billing Analysis	October through December, 2012

Snapback and Persistence

The theoretical additional energy and capacity used by customers that may occur from implementing an energy efficiency product, often called "snapback" if it occurs[3], is by design already captured in the impact evaluation through the billing analysis approach. The billing analysis approach uses actual energy use between the pre and post condition compared to what would occur without the program. All market or program effects conditions, including snapback, are already accounted for in this evaluation method. This is contrasted to evaluations that primarily rely upon engineering calculations.

The billing data analysis, by using usage data from customers who participated as long as over two years ago, indicates that the impacts of the Smart $aver program are likely to persist for at least two years. However, the evaluation did not address how long these savings are likely to persist over time because the time span of the available data was not sufficient to address this issue. Both persistence and technical degradation are included in the calculation of each measure's effective useful life shown in Appendix D: DSMore Table.

[3] TecMarket Works is not aware of any creditable research that confirms the existence of snapback that is associated with energy efficiency programs and is unaware of any creditable impact evaluation that has documented this existence. The billing analysis however will capture snapback if it has occured.

Gross Energy Impact Analysis

Program Tracking System Analysis

Smart $aver program participation records covering the period from July 5, 2011 through February 14, 2012 were obtained from Duke Energy. The data, delivered as an Excel spreadsheet, contained customer name and address, installing vendor contact information, system type and efficiency, unit make and model number, rebate amounts, and other information. These data were examined to identify the number and types of customers and HVAC systems in the program.

The distribution of equipment type listed in the program tracking database is shown in Figure 1.

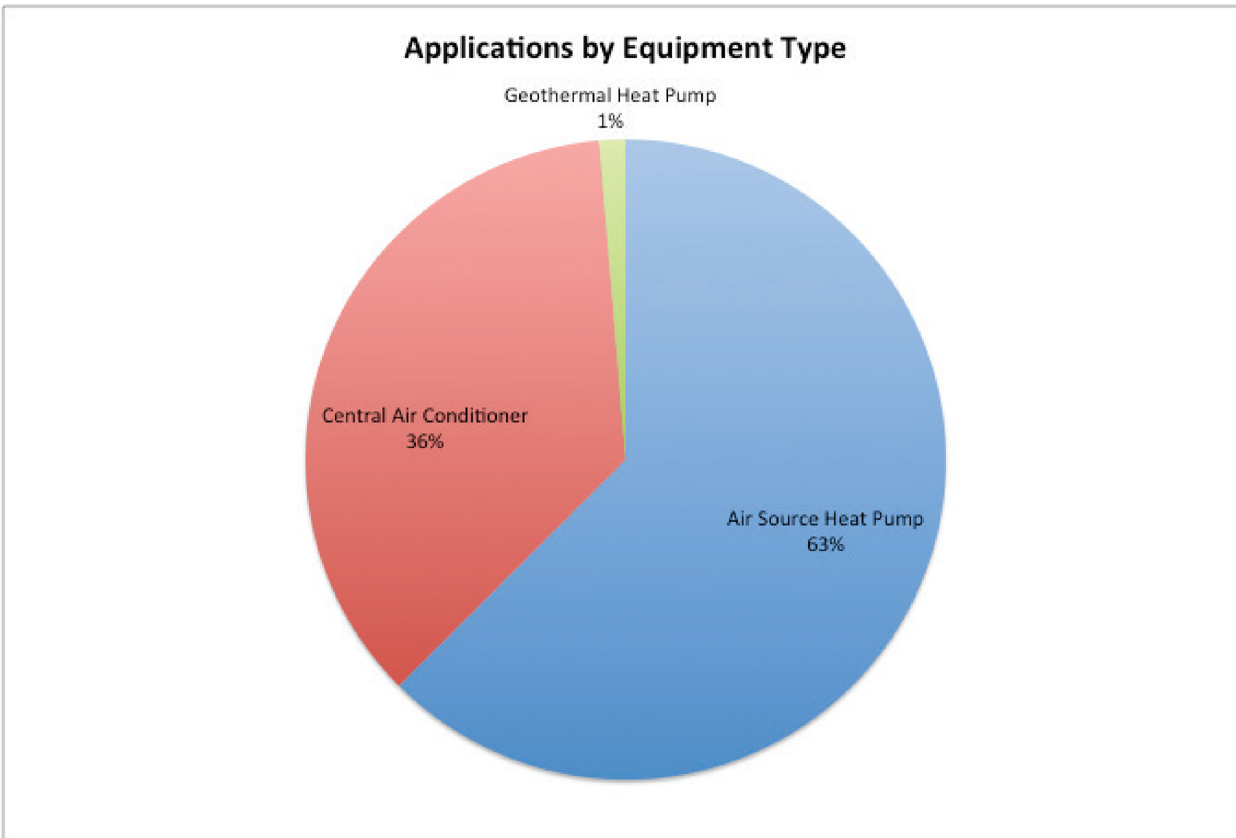

Figure 1. Applications by Equipment Type

Air source heat pump applications outnumbered central air conditioners by about a 2:1 ratio. A negligible number of geothermal heat pump applications were recorded. The frequency of rebated units and their efficiency is shown below.

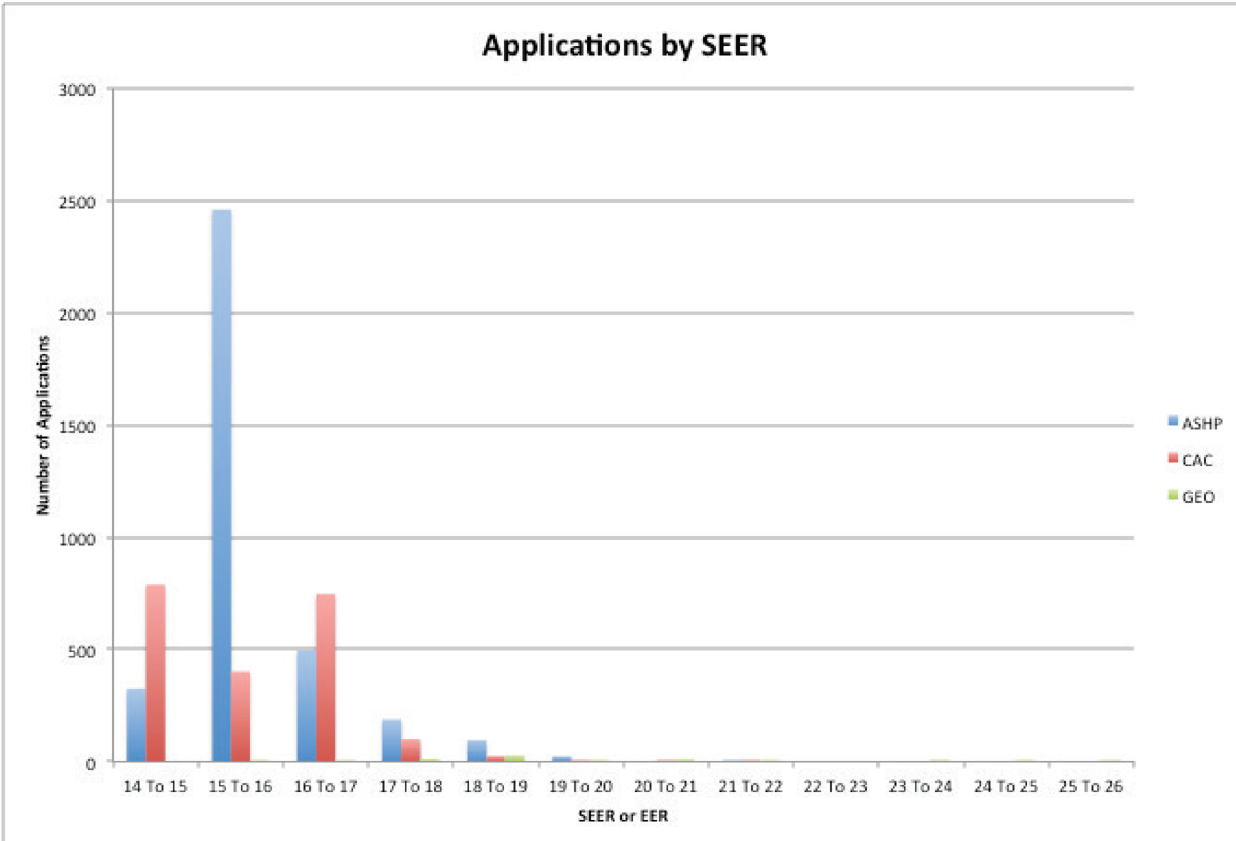

Figure 2. Heat Pump and Air Conditioner Applications by SEER[4]

Units in the rage of SEER 14 to SEER 17 were most popular in the program. A very small number of air conditioners and heat pump with SEER 19 or higher; or geothermal heat pumps with EER 19 or higher were observed.

Engineering-Based Analysis

The impact analysis for the Residential Smart $aver program is based on a combination of engineering estimates and billing data analysis. The engineering estimates are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study, with adjustments made for local building practices and climate. The prototype “model” in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. Each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 3.

[4] Note: Geothermal heat pumps are rated by EER

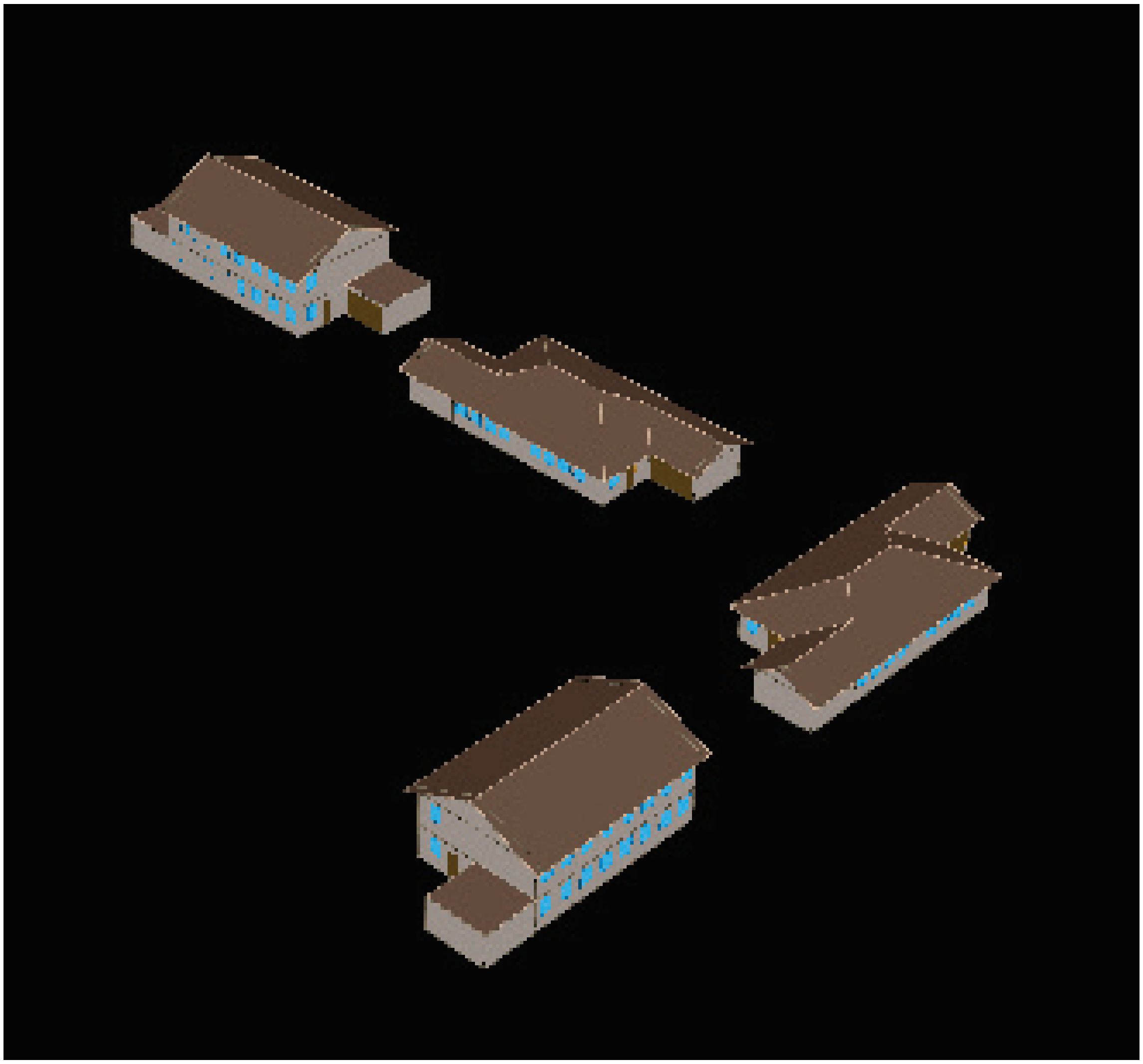

Figure 3. Computer Rendering of Residential Building Prototype Model

For this study, we added a basement or a crawlspace to each building to create another set of 8 buildings, allowing us to simulate the impact of the energy efficiency measures on buildings with slab on grade, basement or crawlspace foundation types. The general characteristics of the residential building prototype model are summarized in Table 3.

Table 3. Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF (not including basement) 2 story house: 2930 SF (not including basement)
Wall construction and R-value	Wood frame with siding, R-11 insulation
Roof construction and R-value	Wood frame with asphalt shingles, R-30 insulation
Basement and crawlspace wall	Uninsulated concrete
Glazing type	SHGC = 0.44; U-value = 0.8
Infiltration rate	0.5 ACH
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Central split system AC or heat pump
HVAC system size	579 SF/ton two story and 500 SF/ton single story based on observed cooling capacity per conditioned floor area from on-site surveys of homes in metering sample.
HVAC system efficiency	Baseline SEER = 13 for normal replacement; SEER = 10 for early replacement Furnace efficiency = 0.78 AFUE
Thermostat setpoints	Heating setpoint = 70, cooling setpoint =73. No night setback.
Duct location	Slab on Grade: Unconditioned attic Crawl Space: crawl space Basement: basement
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct leakage	20% total, evenly distributed between supply and return
Duct insulation	R-4.2 insulation on supply and return ducts
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

Model Calibration

The DOE-2 models were refined using monitored data on residential central air conditioners and heat pumps in the Carolina System. Dent Elite Pro true electric power meters were installed on the condensing unit, and current loggers were installed on the furnace or air handler fan. An outdoor temperature and humidity monitoring station was also installed at each site. The loggers collected data for approximately 3 weeks during the months of August and September. Monitoring was conducted at a random sample of 37 HVAC units at 33 sites. Building characteristics data collected at each site are shown in Table 4.

Table 4. Summary of Calibration Sample Building Characteristics

Unit	Year Built	Floors	Duct Location	Climate	SEER	Fan Operation	Tstat type[5]
1	1979	1	Basement	Asheville	16	intermittent	NSB
2	1947	1	Crawl	Asheville	16	intermittent	NSB
3	1993	1	Attic	Charlotte	16	intermittent	SB
4	1999	2	Attic & Crawl	Charlotte	15	continuous	NSB

[5] NSB = no setback; SB = setback

Unit	Year Built	Floors	Duct Location	Climate	SEER	Fan Operation	Tstat type[5]
5	1985	2	Attic & Crawl	Charlotte	15	intermittent	NSB
6	1993	2	Attic & Crawl	Charlotte	15	intermittent	NSB
7	1993	2	Attic & Crawl	Charlotte	15	intermittent	NSB
8	1979	1	Crawl	Charlotte	15	intermittent	NSB
9	1988	1	Crawl	Charlotte	15	intermittent	NSB
10	1986	1	Crawl	Charlotte	19	intermittent	SB
11	1969	1	Attic	Charlotte	16	intermittent	NSB
12	1944	1	Basement	Charlotte	16	continuous	NSB
13	1969	1	Basement	Charlotte	19	intermittent	NSB
14	1952	1	Basement	Charlotte	15	intermittent	SB
15	1974	2	Basement	Charlotte	15	continuous	NSB
16	1962	2	Basement	Charlotte	16	intermittent	NSB
17	1951	1	Crawl	Charlotte	15	intermittent	NSB
18	1969	1	Crawl	Charlotte	16	intermittent	NSB
19	1956	1	Crawl	Charlotte	14	No data	NSB
20	1965	2	Crawl	Charlotte	14	continuous	NSB
21	No data	No data	Crawl	Charlotte	15	intermittent	No data
22	2000	2	Attic	Greenville	15	intermittent	NSB
23	1992	2	Attic	Greenville	16	intermittent	NSB
24	1990	2	Attic	Greenville	17	intermittent	NSB
25	1988	2	Attic	Greenville	16	intermittent	SB
26	1994	2	Attic	Greenville	17	No data	NSB
27	2002	2	Basement	Greenville	15	intermittent	NSB
28	1997	1	Crawl	Greenville	15	intermittent	NSB
29	1990	1	Crawl	Greenville	15	No data	SB
30	1997	2	Crawl	Greenville	15	intermittent	NSB
31	1988	2	Crawl	Greenville	16	intermittent	NSB
32	1990	2	Crawl	Greenville	17	intermittent	NSB
33	1994	2	Crawl	Greenville	17	intermittent	NSB
34	2011	1	Attic	Greenville	15	intermittent	SB
35	1952	1	Crawl	Greenville	17	intermittent	NSB
36	1952	1	Crawl	Greenville	15	intermittent	SB
37	1969	2	Crawl	Greenville	15	No data	NSB

The majority of the units in the sample were operated with intermittent fans and no thermostat setback. The sites were evenly split between 1 story and 2 story homes. About 19% of the units had ductwork in a basement, 48% had ductwork in the crawlspace, and 33% had ductwork in the attic. These data were used to develop weighting factors to average the results from individual simulation runs.

The monitored data were analyzed to determine the unit consumption as a function of outdoor temperature. Daily total kWh per ton of air conditioning cooling capacity were tabulated as a function of average daily outdoor temperature. Sample plots obtained from the monitoring activity are shown in Figure 4 and Figure 5.

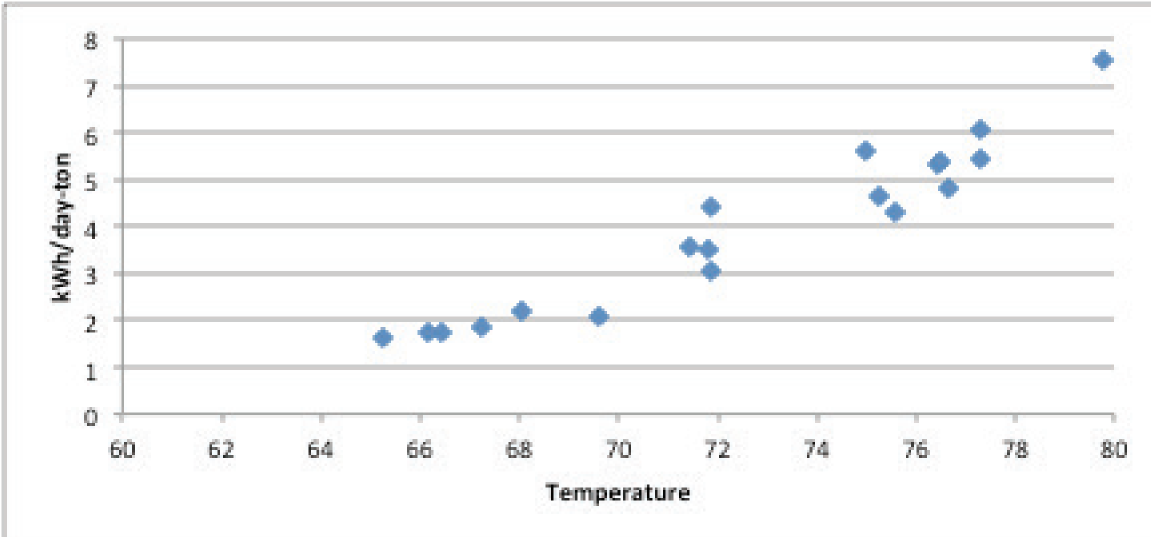

Figure 4. Typical Cooling Load Curve – Strong Correlation with Outdoor Temperature

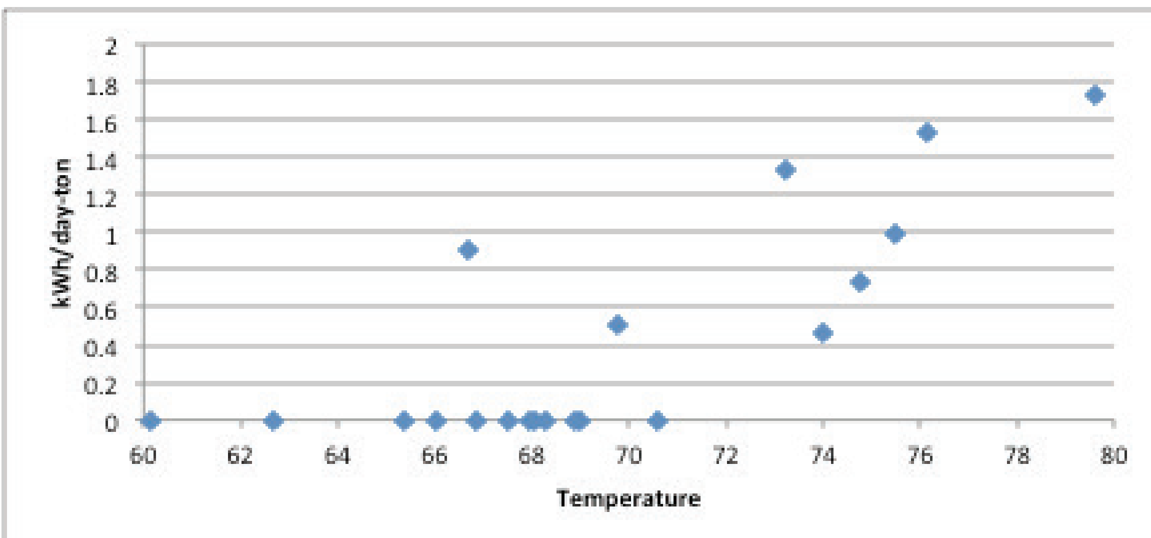

Figure 5. Typical Cooling Load Curve – Weak Correlation with Outdoor Temperature

Note, the monitored data show a wide variety of responses due to variations in building cooling requirements and occupant behavior relative to the HVAC system. Some sites displayed a strong correlation between cooling load and temperature, while other sites displayed a weak correlation. Intermittent use of the cooling equipment by building occupants is likely responsible for the weak correlation observed at some sites.

Data for all sites were compiled to establish an average load curve for the monitored sample in terms of kWh/day-ton as a function of outdoor temperature. The average load curve was used to calibrate the DOE-2 model.

A series of modifications to the DOE-2 model inputs were made to calibrate the model to the monitored data. Model inputs affected by the calibration process included wall and roof R-values, infiltration rates, window properties, internal loads from lighting and appliances, and thermostat setpoints. A separate calibration was done on weekday and weekend/holiday daytypes. The weekday and weekend/holiday load curves for the calibrated model are compared to the monitored data in Figure 6 and Figure 7.

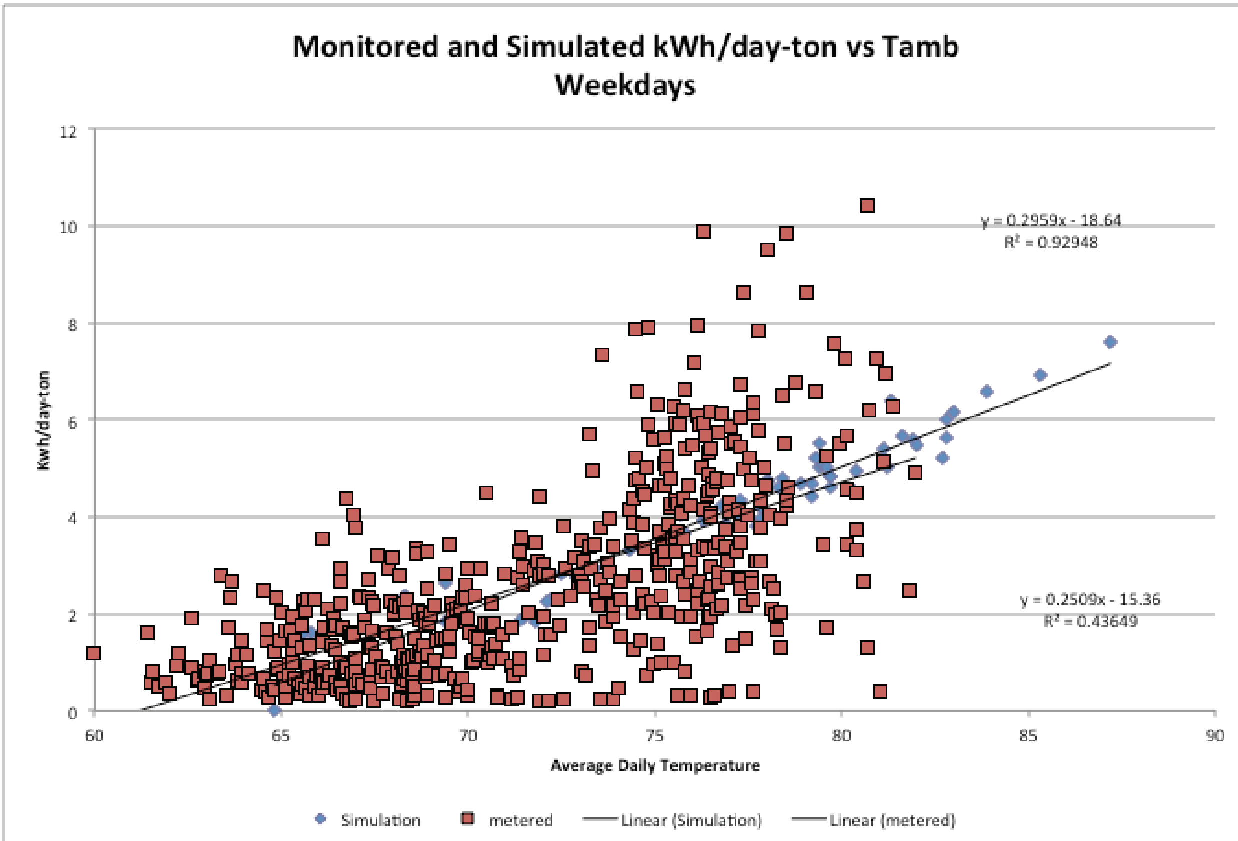

Figure 6. Weekday Simulation Model Calibration Plot

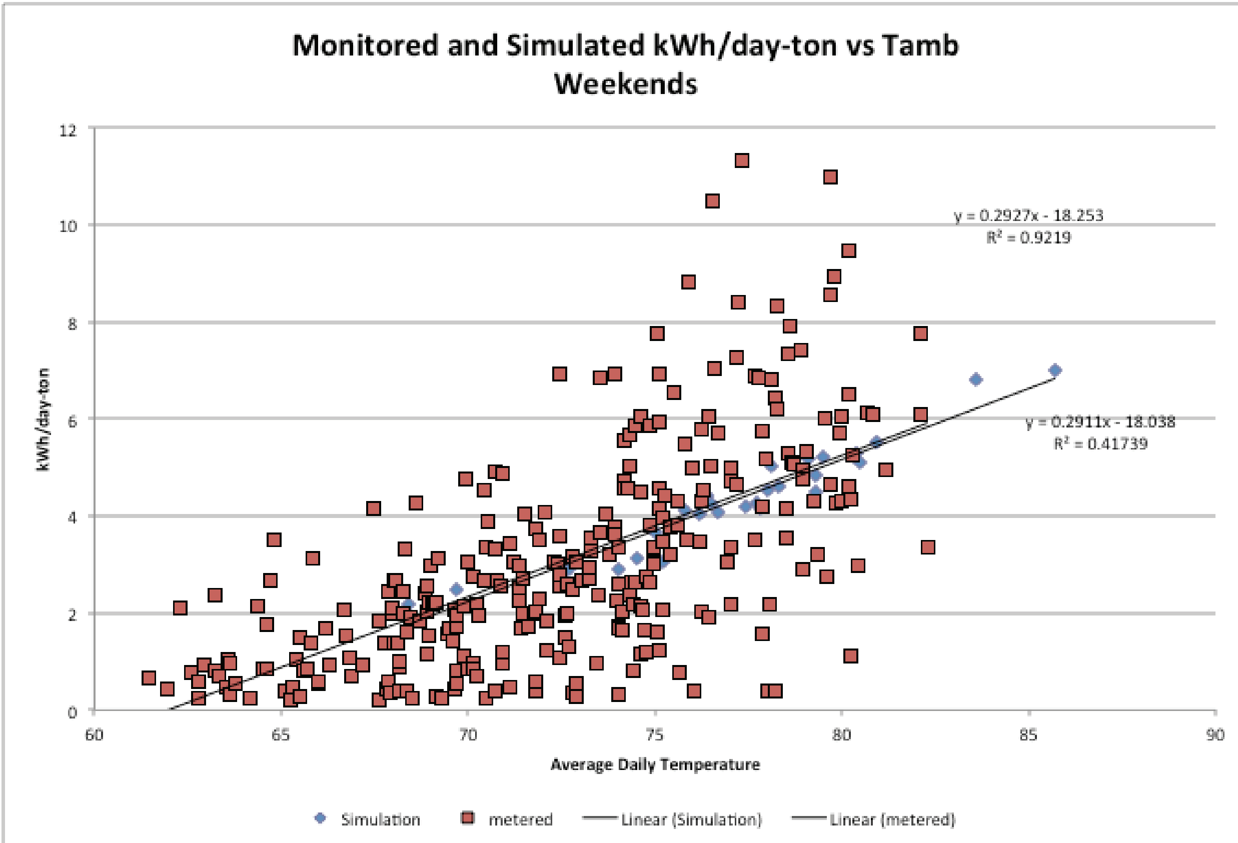

Figure 7. Weekend/Holiday Simulation Model Calibration Plot

Note, the modeled response and the average load curve from the monitored data were very closely matched at the conclusion of the calibration activity. However, the monitored data show a wide range of scatter relative to the simulated data, indicating the influence of occupant behavior on cooling energy consumption.

The calibrated prototype model was used to simulate the savings from high efficiency central air conditioner and air source heat pumps. The engineering analysis provided two sets of estimates. Separate estimates were generated for both normal replacement (replace on failure) and early replacement scenarios. Under the normal replacement scenario, air conditioning systems were simulated with a baseline SEER 13 air conditioner and with a series of high efficiency air conditioners ranging from SEER 14 to SEER 21. Heat pump systems were simulated with a baseline SEER 13 heat pump and with a series of high efficiency heat pumps ranging from SEER 14 to SEER 18. Under the early replacement scenario, the baseline unit efficiency was set at SEER 10, which is typical of units manufactured 20 years ago.

The analysis required two sets of estimates. The early replacement baseline was used to compare the engineering analysis to the billing analysis. This comparison yielded an engineering adjustment factor. The adjustment factor was then applied to the engineering estimates developed under the normal replacement scenario. The adjusted, normal replacement engineering estimates were used to develop the final results.

The basic efficiency assumptions for each of the air conditioner and heat pump measures are shown in Table 5. These data were taken from an extensive study of residential air conditioners and heat pumps conducted for the 2011 California DEER update study.[6] Besides these basic efficiency parameters, an extensive set of performance curves were developed representing mean performance of production units in each SEER category. The performance curves addressed unit full load efficiency and capacity over a range of outdoor and indoor temperature and humidity conditions, and the effects of part-load operation on unit efficiency. The simulation models include the effect of duct leakage into return air systems on HVAC system performance, which in turn affects the temperature and humidity of the entering air conditions.

Table 5. Baseline and Measure Performance Assumptions

Unit Type	Efficiency	Fan Type	EER	Sensible Heat Ratio	Air flow (CFM/ton)	Heating COP
Central Air Conditioner	SEER 10	Std 1-speed	9.3	0.74	396	
	SEER 13	Std 1-speed	11.1	0.75	376	
	SEER 14	EC motor	13.1	0.75	382	
	SEER 15	EC motor	12.7	0.70	320	
	SEER 16	EC motor	11.6	0.81	409	
	SEER 17	EC motor	12.3	0.80	422	
	SEER 18	EC motor	13.2	0.77	386	
	SEER 19	EC motor	13.82	0.78	381	
	SEER 20	EC motor	14.43	0.76	362	
	SEER 21	EC motor	15.03	0.76	348	
Air Source Heat Pump	SEER 10	Std 1-speed	9.0	0.69	371	2.98
	SEER 13	Std 1-speed	11.1	0.73	337	3.28
	SEER 14	EC motor	12.2	0.73	352	3.52
	SEER 15	EC motor	12.7	0.81	436	3.74
	SEER 16	EC motor	12.1	0.78	400	3.48
	SEER 17	EC motor	12.5	0.81	430	3.26
	SEER 18	EC motor	13.0	0.78	404	3.66

Engineering Results

The set of simulations described above were conducted for Asheville, North Carolina; Charlotte, North Carolina; and Greenville, South Carolina. The simulated savings were normalized per ton of cooling capacity. A summary of the simulation results is shown in Appendix C: Simulation Results. Savings results are shown for each SEER class and air conditioner or heat pump type. Engineering estimates were provided using a normal replacement (SEER 13) baseline and an early replacement (SEER 10) baseline. The estimates for early replacement were prepared for consistency with the billing analysis, which observes the change in consumption as existing equipment is replaced with the efficient equipment.

[6] DEER 2011 Update Study described at www.deeresources.com. See 2011 Update Documentation – Support documents (Updated May 16, 2012). Note, performance data for residential HVAC systems were revised relative to the values used in the previous Residential Smart $aver HVAC study.

Note, the energy and peak demand savings derived from the simulations are not proportional to the difference in SEER. The SEER, which is based on a standardized laboratory test, is not a reliable predictor of annual energy consumption under the more realistic operating conditions included in the building energy simulation models. Peak demand savings across the SEER levels are due to different strategies used by manufacturers to achieve a particular SEER rating and the influence of those strategies on energy efficiency under peak conditions. For example, units using multiple compressors can have high SEER ratings, while having relatively poor efficiency under peak conditions. Heat pumps save energy for both heating and cooling, thus the overall annual energy savings are greater for heat pumps than air conditioners. Also, heat pumps have different performance characteristics than air conditioners, causing differences in the demand savings within each SEER class. Energy savings as a function of unit SEER are based on the performance of units under operating conditions representative of units in the Carolina System, especially when considering the influence of warm moist air infiltration into the return air systems on system performance.

The savings per ton were applied to each participant in the program tracking system according to the installed cooling capacity (tons), location and the SEER of the rebated unit to create a customer specific estimate of savings. The customer specific estimates using the early replacement baseline (i.e., SEER 10) were then used to inform the billing analysis, as described in the next section.

Billing Analysis

This section of the report presents the results of a billing analysis conducted over the participants in the Carolina System Residential Smart $aver HVAC program. Billing data was obtained for all participants in the program between July 2011 and February 2012 that had accounts with Duke Energy (after processing, there were a total of 5,246 accounts from the Carolina System).[7] A panel model was used to determine program impacts, where the dependent variable was monthly electricity consumption from July 2010 and September 2012. Since engineering estimates were available for all these participants, a Statistically Adjusted Engineering (SAE) model was used for the analysis. The SAE model uses the customer-specific engineering savings estimate as the program variable, and the resulting estimated coefficient indicates the percentage of the engineering estimate realized on average by participants (i.e., the realization rate). The results of the billing analysis are presented in Table 6.

Table 6 : Estimated Carolina Residential Smart $aver Impacts: Billing Analysis

Program Component	Realization Rate	t-value
Air conditioners	94.7%	9.86
Heat Pumps	104.4%	19.34

This table shows that the Residential Smart $aver program produced statistically significant savings for participants in the Carolina System. The realization rate indicates that the savings from this billing analysis is not significantly different than the savings based upon the engineering analysis of air conditioners, and higher (but not significantly different) for heat pumps.

The remainder of this section discusses the procedure used in the billing analysis.

For this analysis, data are available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of data, known as "panel" data, it becomes possible to control, simultaneously, for differences across households as well as differences across periods in time through the use of a "fixed-effects" panel model specification. The fixed-effect refers to the model specification aspect that differences across homes that do not vary over the estimation period (such as square footage, heating system, etc.) can be explained, in large part, by customer-specific intercept terms that capture the net change in consumption due to the program, controlling for other factors that do change with time (e.g., the weather).

Because the consumption data in the panel model includes months before and after the installation of measures through the program, the period of program participation (or the participation window) may be defined specifically for each customer. This feature of the panel model allows for the pre-installation months of consumption to effectively act as controls for

[7] The actual sample size in the model included 4,208 accounts from North Carolina and 1,038 from South Carolina, for a total sample size of 5,246 households. Households with geothermal were excluded from this analysis because no engineering saving estimates were available. There were a total of 60 households with geothermal system. There were a total of 5 households with extremely low meter reading (<10 kWh) in every month.

post-participation months. In addition, this model specification, unlike annual pre/post-participation models such as annual change models, does not require a full year of post-participation data. Effectively, the participant becomes their own control group, thus eliminating the need for a non-participant group.

The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household.

Algebraically, the fixed-effect panel data model is described as follows:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it},$$

where:

- y_{it} = energy consumption for home *i* during month *t*
- α_I = constant term for site *i*
- β = vector of coefficients
- x = vector of variables that represent factors causing changes in energy consumption for home *i* during month *t* (i.e., weather and participation)
- ε = error term for home *i* during month *t*.

With this specification, the only information necessary for estimation is those factors that vary month to month for each customer, and that will affect energy use, which effectively are weather conditions and program participation. Other non-measurable factors can be captured through the use of monthly indicator variables (e.g., to capture the effect of potentially seasonal energy loads).

The effect of the Residential Smart $aver program is captured by including a variable which is equal to zero for the months prior to participation, and the engineering estimate (on a monthly basis) for all months after the household participated in the program. The coefficient on this variable is the realization rate, and indicates the relationship between the engineering estimate and the billing data estimate (if the estimate is greater than one, the billing data indicates a higher savings than the engineering estimate. If the coefficient is less than one, then the billing data indicates a smaller savings than the engineering models). The estimated model is presented in Table 7.

Table 7. Estimated Savings Model – dependent variable is (monthly kWh usage), July 2010 and September 2012 (savings are negative).

Independent Variable	Coefficient (percentage / 100)	t-value
Carolina – AC Eng. Est.	-0.946922	-9.86
Carolina – HP Eng. Est.	-1.044038	-19.34
Sample Size	observations (5,246 homes)	
R-Squared	74%	

The complete estimate model, showing the weather and time factors, is presented in Appendix A: Estimated Statistical Model. The billing analysis represents a pre/post comparison of energy consumption, using the existing air conditioner or heat pump as the "pre" equipment.

Gross Energy Impact Findings

The realization rate from the billing analysis (based upon the early replacement engineering estimates) was applied to the ratio of the savings associated with the early replacement to normal replacement engineering estimates, to give an estimate of the normal replacement energy savings. Since the billing analysis did not address demand savings, the engineering estimates of peak demand were not adjusted. The final billing analysis adjusted gross energy and demand savings per ton are shown in Table 8.

Table 8. Gross Energy and Demand Savings Per Ton for Normal Replacement

Measure	Asheville		Charlotte		Greenville	
	kWh/ton	kWh/ton	kWh/ton	kW/ton	kW/ton	kW/ton
AC_seer14	41.5	0.040	48.3	0.068	46.2	0.056
AC_seer15	53.3	0.024	82.2	0.079	73.6	0.057
AC_seer16	65.6	0.038	124.8	0.118	105.9	0.071
AC_seer17	103.2	0.074	173.0	0.141	149.3	0.107
AC_seer18	111.0	0.102	193.6	0.175	164.9	0.145
AC_seer19	138.6	0.124	232.1	0.201	200.2	0.170
AC_seer20	107.5	0.126	200.3	0.196	171.2	0.160
AC_seer21	122.1	0.205	256.7	0.255	205.5	0.274
Hp_seer14	84.2	0.048	98.7	0.056	86.5	0.055
Hp_seer15	197.5	0.134	227.8	0.115	206.1	0.133
Hp_seer16	270.2	0.100	282.8	0.145	274.4	0.128
Hp_seer17	198.9	0.116	261.2	0.160	235.9	0.151
Hp_seer18	329.2	0.126	359.1	0.163	342.4	0.153

Program participation by HVAC system type, size, and SEER were applied to the savings per ton estimates from Table 8 above to compute the program savings, as shown in Table 9.

Table 9. Summary of Program Savings by Measure

Measure	Participation Count	Gross Ex Post kWh Savings	Gross Ex Post kW Savings	Gross Ex Post kWh Savings per unit	Gross Ex Post kW Savings per unit
Air conditioner	2,075	561,485	540	270.6	0.260
Heat Pump	3,588	2,283,910	1,201	636.5	0.335

The kW savings estimated for the program are summer peak demand savings at the customer meter. Estimates of utility coincident peak savings were not included in the study. Coincidence factors are applied to the customer peak savings in the DSMore cost effectiveness[8] tool to estimate coincident peak savings.

The previous evaluation of the Residential Smart $aver HVAC Program in the Carolina System relied on building characteristics data from secondary resources such as the Residential Energy Consumption survey (RECS) and Duke Energy appliance saturation survey data from the Midwest; and metered data on HVAC system fans only. Although these data were the best available information at the time, the TecMarket team recommended expansion of the data collection activities to include metering of the full HVAC system.

The addition of a short-term HVAC system metering sample to the study improved the realization rate of the engineering estimates relative to the billing analysis. Primary building characteristics data were collected during meter installation. The primary building characteristics data were used to define model inputs, while the HVAC end-use data were used to calibrate model response. The calibration activity revealed significant variability in HVAC system use by occupants, which was captured on average in the simulation models.

Changes in engineering estimates of HVAC system savings between this evaluation and the previous evaluation were due to a combination of factors. The buildings in the calibration sample were more efficient on average than buildings used in the previous study, resulting in lower overall cooling energy consumption per square foot of conditioned floor area. The HVAC system oversizing was more pronounced in the calibration sample, resulting in more cooling capacity (tons) per square foot of conditioned floor area; and therefore lower energy consumption and savings per ton of installed cooling capacity. Revisions conducted in 2011 to the DEER curve fits used to define HVAC system performance resulted in changes in the modeled performance of several air conditioner and heat pump systems, which affected unit energy savings.

[8] DSMoreTM is a registered trademark of Integral Analytics and a proprietary software.

Net to Gross Analysis

Freeridership

TecMarket Works fielded a short survey with HVAC vendor allies to estimate freeridership. The instrument was established to use a primary "gateway" question to assess freeridership and adjusted it based on the responses to a follow-up question about the influence of the Smart $aver rebate.

The gateway question asked vendors what their customer's behavior would have been if the Smart $aver rebate had not been available:

Gateway Question (A): ***Of the Energy Efficient equipment that was rebated through the program, what percentage of those customers do you think would have still gone with an energy efficient model if the Duke Energy rebate were not available?***

The results of this question allow us to establish a gateway freeridership value for participants that reflects the degree that participants would have gone with some level of energy efficient equipment, although that level may be higher or lower than the equipment rebated via the program. To adjust this gateway value we wanted to know if the program had some level of influence on the choices that were made by the customers. The follow-up question asked vendors to estimate the influence of the Smart $aver rebate on their customer's choices:

Follow-up Question (B): ***What percentage of these customers do you think were in some way influenced by the rebate Duke Energy offered?***

The mean and median responses to the gateway (column A) and follow-up (column B) questions can be seen in Table 10.

Table 10. Vendor Responses Used to Estimate Freeridership

	(A) Gateway question (N=81)	(B) Follow-up question (N=80)
Mean percent	60.2%	60.2%
Median percent	60.0%	57.5%
Minimum	0%	0%
Maximum	100%	100%

The formula for estimating freeridership based on responses to these questions is shown below, where "A" and "B" represent responses to the two survey questions, and "Factor" represents a coefficient that accounts for a level of uncertainty around the establishment of a NTG ratio.

Freeridership = A * (1 – (B * Factor))

Freeridership is calculated separately for every vendor respondent who answered both questions (N=80), and the average of these individual scores provides the overall freeridership estimate for the program. The value of "Factor" would be set to 1.0 if it is assumed that vendors are not overestimating the effect of the program at all, and to a fractional value less than 1.0 depending on how much vendors are overstating the effect of the program. In this case, we do not know the true value of the Factor, so overall freeridership rates were calculated based on three different levels of Factor influence (50%, 75% and 100%) and then averaged to estimate freeridership for the residential Smart $aver HVAC program. Using this approach the net to gross factors accounting for freeridership is estimated at 32.1%, as seen in Table 11.

For the freerider analysis we have excluded the factor scores of 0% and 25%. A Factor value of zero (0%) would indicate the program has no effect and the entire effect estimated by vendors is an overestimation. This scenario was not included when estimating freeridership, since it is assumed that the program does have some effect and the value of the Factor, though unknown, should be greater than zero.) A factor of 25% was also not used. A 25% factor indicates that the vendors are substantially biased and the vast majority of the information they provide cannot be trusted although more of their information can be trusted than a 0% score. While we assume that some bias is present in the opinions of trade allies, we also suspect that the freerider estimates provided by these experts are more reliable than unreliable and therefore a factor of 25% is probably not reflective of the reliability of their opinions. We therefore use only the factors of 50%, 75%, and 100% in order to obtain an estimate of program freeridership. We use an averaging approach because we do not know the degree of reliability of the trade ally opinions, but we accept the condition that they are at least half reliable but probably not 100% reliable. Because the averaging approach is a balanced approach, with the mid-point in the reliability estimate at 75% reliable, the average score is also the same score as the 75% factor.

Table 11. Freeridership Estimates Based on Four Scenarios

Factor Value	Calculated Freeridership (N=80)
50%	41.3%
75%	32.1%
100%	22.9%
Average of 4 scenarios above	32.1%

This averaging approach for assessing the reliability of the opinions of the responding trade allies yields an estimated freerider scenario value of 32.1% at the program level.

Spillover

Because the Residential Smart $aver HVAC program involved large single-unit residential installations, individual participant spillover is assumed to be at or near zero. In most cases purchasing a new Smart $aver-rebated heat pump or central air conditioning unit is not assumed to lead to the purchase of additional heat pumps or central air conditioning units, since a home generally only requires one such unit.

Therefore the net to gross ratio is calculated as follows:

$$\begin{aligned} NTGR &= (1\text{-freeridership})*(1+\text{spillover}) \\ &= (1 - 0.321) * (1 + 0) \\ &= 0.679 \end{aligned}$$

Applying this discount to the gross savings from Table 9 yields the net savings seen in Table 12.

Table 12. Summary of Net Program Savings by Measure

Measure	Participation Count	Net Ex Post kWh Savings	Net Ex Post kW Savings	Net Ex Post kWh Savings per unit	Net Ex Post kW Savings per unit
Air conditioner	2,075	355,420	367	184	0.177
Heat Pump	3,588	1,445,715	815	432	0.227

Appendix A: Estimated Statistical Model

This appendix show the complete model estimated for the billing analysis. The model includes indicators for each month (the YYYYMM variable), temperature, and the participation variables.

Number of Observations Read	119284
Number of Observations Used	119284

Dependent Variable: billed_kwh

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5328	88572038490	16623881.098	60.03	<.0001
Error	113955	31556621817	276921.78331		
Corrected Total	119283	120128660307			

R-Square	Coeff Var	Root MSE	billed_kwh Mean
0.737310	34.90382	526.2336	1507.667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
acct_id	5245	71971687323	13721961	49.55	<.0001
yearmonth	25	13922238901	556889556	2011.00	<.0001
avg_temp*yearmonth	26	2455541272	94443895	341.05	<.0001
avg_humi*yearmonth	26	66409999	2554231	9.22	<.0001
PER	1	49804335	49804335	179.85	<.0001
K12	1	115	115	0.00	0.9838
LowInc	0	0	.	.	.
HEHC	1	1372329	1372329	4.96	0.0260
CFL	1	536142	536142	1.94	0.1641
part*eng_kWhm*system	2	104448074	52224037	188.59	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
yearmonth	25	1231910799	49276432	177.94	<.0001
avg_temp*yearmonth	26	2197982422	84537785	305.28	<.0001
avg_humi*yearmonth	26	64330281	2474242	8.93	<.0001
PER	1	45665932	45665932	164.91	<.0001
K12	1	1	1	0.00	0.9986
LowInc	0	0	.	.	.
HEHC	1	1200744	1200744	4.34	0.0373
CFL	1	831142	831142	3.00	0.0832
part*eng_kWhm*system	2	104448074	52224037	188.59	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
yearmonth	201008	-3310.07	1392.115	-2.38	0.0174
yearmonth	201009	-1396.59	804.6947	-1.74	0.0826
yearmonth	201010	1532.394	727.0271	2.11	0.0351
yearmonth	201011	6150.125	706.1836	8.71	<.0001
yearmonth	201012	8387.511	684.3789	12.26	<.0001

yearmonth	201101	8764.633	699.6097	12.53	<.0001
yearmonth	201102	7396.586	695.7183	10.63	<.0001
yearmonth	201103	6167.112	685.7324	8.99	<.0001
yearmonth	201104	6980.473	694.1058	10.06	<.0001
yearmonth	201105	2102.746	710.5296	2.96	0.0031
yearmonth	201106	-358.777	738.8097	-0.49	0.6272
yearmonth	201107	136.4402	760.3371	0.18	0.8576
yearmonth	201108	-317.27	786.3983	-0.4	0.6866
yearmonth	201109	-2648.83	743.7373	-3.56	0.0004
yearmonth	201110	3100.02	690.2297	4.49	<.0001
yearmonth	201111	6568.197	694.6389	9.46	<.0001
yearmonth	201112	8582.303	707.6768	12.13	<.0001
yearmonth	201201	8776.658	699.2766	12.55	<.0001
yearmonth	201202	8761.895	698.0546	12.55	<.0001
yearmonth	201203	7522.578	681.4656	11.04	<.0001
yearmonth	201204	4744.384	714.7355	6.64	<.0001
yearmonth	201205	3518.252	686.8504	5.12	<.0001
yearmonth	201206	2451.966	768.8646	3.19	0.0014
yearmonth	201207	1010.077	715.1162	1.41	0.1578
yearmonth	201208	449.3813	781.1805	0.58	0.5651
avg_temp*yearmonth	201008	115.3036	12.77003	9.03	<.0001
avg_temp*yearmonth	201009	91.86356	5.578523	16.47	<.0001
avg_temp*yearmonth	201010	50.75414	3.102613	16.36	<.0001
avg_temp*yearmonth	201011	-22.8468	3.108379	-7.35	<.0001
avg_temp*yearmonth	201012	-70.6796	1.850082	-38.2	<.0001
avg_temp*yearmonth	201101	-94.52	4.738153	-19.95	<.0001
avg_temp*yearmonth	201102	-45.9723	2.577658	-17.83	<.0001
avg_temp*yearmonth	201103	-30.3811	2.66716	-11.39	<.0001
avg_temp*yearmonth	201104	-27.5162	2.250343	-12.23	<.0001
avg_temp*yearmonth	201105	39.9456	3.888185	10.27	<.0001
avg_temp*yearmonth	201106	76.3084	2.803597	27.22	<.0001
avg_temp*yearmonth	201107	71.47788	3.889542	18.38	<.0001
avg_temp*yearmonth	201108	71.00651	4.404832	16.12	<.0001
avg_temp*yearmonth	201109	97.56893	3.122934	31.24	<.0001
avg_temp*yearmonth	201110	28.96807	2.384852	12.15	<.0001
avg_temp*yearmonth	201111	-21.7065	2.973034	-7.3	<.0001
avg_temp*yearmonth	201112	-47.9917	3.816609	-12.57	<.0001
avg_temp*yearmonth	201201	-66.2322	4.517243	-14.66	<.0001
avg_temp*yearmonth	201202	-64.9989	4.604803	-14.12	<.0001
avg_temp*yearmonth	201203	-27.3575	1.469691	-18.61	<.0001
avg_temp*yearmonth	201204	1.909719	3.842822	0.5	0.6192

avg_temp*yearmonth	201205	24.6745	2.435963	10.13	<.0001
avg_temp*yearmonth	201206	36.19436	4.134534	8.75	<.0001
avg_temp*yearmonth	201207	58.07509	2.855813	20.34	<.0001
avg_temp*yearmonth	201208	64.85429	3.897988	16.64	<.0001
avg_temp*yearmonth	201209	66.77095	7.466552	8.94	<.0001
avg_humi*yearmonth	201008	0.240299	4.602752	0.05	0.9584
avg_humi*yearmonth	201009	1.179383	2.066596	0.57	0.5682
avg_humi*yearmonth	201010	1.446387	2.243157	0.64	0.5191
avg_humi*yearmonth	201011	0.752876	1.998479	0.38	0.7064
avg_humi*yearmonth	201012	4.613606	2.045863	2.26	0.0241
avg_humi*yearmonth	201101	10.21215	2.013702	5.07	<.0001
avg_humi*yearmonth	201102	-0.62046	1.989975	-0.31	0.7552
avg_humi*yearmonth	201103	8.180687	1.798315	4.55	<.0001
avg_humi*yearmonth	201104	-6.37639	2.689651	-2.37	0.0178
avg_humi*yearmonth	201105	3.485499	1.789513	1.95	0.0514
avg_humi*yearmonth	201106	4.027509	2.250521	1.79	0.0735
avg_humi*yearmonth	201107	0.726048	2.04634	0.35	0.7227
avg_humi*yearmonth	201108	6.923881	1.960248	3.53	0.0004
avg_humi*yearmonth	201109	12.07322	2.08619	5.79	<.0001
avg_humi*yearmonth	201110	-0.11882	1.878006	-0.06	0.9496
avg_humi*yearmonth	201111	-5.23856	1.945498	-2.69	0.0071
avg_humi*yearmonth	201112	-12.0629	1.861512	-6.48	<.0001
avg_humi*yearmonth	201201	-2.28322	1.898922	-1.2	0.2292
avg_humi*yearmonth	201202	-6.60924	2.048447	-3.23	0.0013
avg_humi*yearmonth	201203	-14.0148	2.135693	-6.56	<.0001
avg_humi*yearmonth	201204	1.639983	2.238389	0.73	0.4638
avg_humi*yearmonth	201205	-1.5199	1.906775	-0.8	0.4254
avg_humi*yearmonth	201206	3.383568	2.378396	1.42	0.1548
avg_humi*yearmonth	201207	0.688971	1.811082	0.38	0.7036
avg_humi*yearmonth	201208	0.633322	2.243801	0.28	0.7777
avg_humi*yearmonth	201209	4.912986	2.96106	1.66	0.0971
PER		-214.271	16.68579	-12.84	<.0001
K12		0.056142	32.55003	0	0.9986
LowInc		0	.	.	.
HEHC		-58.3231	28.00877	-2.08	0.0373
CFL		10.23431	5.907442	1.73	0.0832
part*eng_kWhm*system	AC	-0.94692	0.096011	-9.86	<.0001
part*eng_kWhm*system	HP	-1.04404	0.053989	-19.34	<.0001

Appendix B: Counts of Participant / Non-participants

This appendix presents the counts of participants and non-participants in each month. The first row is always the last month before the first participant, such that the first participant showed up in July 2011 with the first row started in June 2011. The last row is the last month of billing data included in the billing analysis, and it may not be the last month of participation cut-off for this analysis. For example the cut-off month is February 2012, whereas the billing data goes through September 2012, with the last couple of months having a non-participant count of zero. Note that this table of participants includes homes installing air conditioners, heat pumps and geothermal heat pumps (unlike the SAE modeling excluding the homes with geothermal system).

state	yearmonth	Participant_count	Non_participant_count
Carolinas	201106	0	4934
	201107	344	4653
	201108	1211	3937
	201109	1944	3189
	201110	2680	2515
	201111	3459	1800
	201112	4144	1117
	201201	4799	478
	201202	5209	30
	201203	5253	0
	201204	5203	0
	201205	5202	0
	201206	5128	0
	201207	5197	0
	201208	5184	0
	201209	2307	0

Appendix C: Simulation Results

Table D-1. Unadjusted Normalized Measure Savings from Calibrated Simulations

Asheville	Early Replacement		Normal Replacement	
	kWh/ton	kW/ton	kWh/ton	kW/ton
AC_seer14	147.1	0.212	43.8	0.040
AC_seer15	159.5	0.196	56.3	0.024
AC_seer16	172.5	0.209	69.2	0.038
AC_seer17	212.2	0.245	109.0	0.074
AC_seer18	220.5	0.273	117.2	0.102
AC_seer19	249.6	0.295	146.3	0.124
AC_seer20	216.8	0.298	113.5	0.126
AC_seer21	232.2	0.377	128.9	0.205
Hp_seer14	329.8	0.164	80.6	0.048
Hp_seer15	438.4	0.250	189.2	0.134
Hp_seer16	508.0	0.216	258.8	0.100
Hp_seer17	439.7	0.232	190.5	0.116
Hp_seer18	564.5	0.242	315.3	0.126

Greenville	Early Replacement		Normal Replacement	
	kWh/ton	kW/ton	kWh/ton	kW/ton
AC_seer14	229.8	0.244	48.8	0.056
AC_seer15	258.8	0.245	77.7	0.057
AC_seer16	292.9	0.260	111.9	0.071
AC_seer17	338.7	0.296	157.6	0.107
AC_seer18	355.2	0.334	174.2	0.145
AC_seer19	392.5	0.359	211.4	0.170
AC_seer20	361.8	0.348	180.8	0.160
AC_seer21	398.0	0.462	217.0	0.274
Hp_seer14	372.1	0.218	82.9	0.055
Hp_seer15	486.7	0.296	197.4	0.133
Hp_seer16	552.1	0.291	262.8	0.128
Hp_seer17	515.2	0.315	226.0	0.151
Hp_seer18	617.2	0.316	327.9	0.153

Charlotte	Early Replacement		Normal Replacement	
	kWh/ton	kW/ton	kWh/ton	kW/ton
AC_seer14	277.7	0.228	51.0	0.068
AC_seer15	313.6	0.239	86.8	0.079

Charlotte	Early Replacement		Normal Replacement	
	kWh/ton	kW/ton	kWh/ton	kW/ton
AC_seer16	358.5	0.278	131.8	0.118
AC_seer17	409.5	0.301	182.7	0.141
AC_seer18	431.2	0.335	204.5	0.175
AC_seer19	471.8	0.361	245.1	0.201
AC_seer20	438.2	0.356	211.5	0.196
AC_seer21	497.8	0.414	271.1	0.255
Hp_seer14	415.0	0.217	94.5	0.056
Hp_seer15	538.7	0.275	218.2	0.115
Hp_seer16	591.4	0.305	270.9	0.145
Hp_seer17	570.7	0.321	250.2	0.160
Hp_seer18	664.5	0.324	343.9	0.163

Appendix D: DSMore Table

Per Measure Impacts Summary for Residential Smart $aver HVAC

Technology ⇩ / Impacts ⇨	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (customer peak/unit)	EM&V gross kW (coincident peak/unit)	Unit of measure	Combined spillover less freeridership adjustment	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
Air Conditioner		Carolinas	270.6	0.260	N/A	unit	32.10%	184	0.177	N/A	no	15
Heat Pump		Carolinas	636.5	0.335	N/A	unit	32.10%	432	0.227	N/A	no	15
Program wide		**Carolinas**	**502.4**	**0.308**	**N/A**	**unit**	**32.10%**	**341**	**0.209**	**N/A**	**no**	**15**

Notes: 1. Technology names should match the DSMore naming convention.
2. Energy impacts are average per installed unit for each DSMore technology and unit description (measure/ton/sq.ft., etc.)
3. Any analysis using a control group (such as billing analysis with a control group) does not need a freeridership adjustment (it is already in the analysis via the control group adjustment)
4. EM&V load shape: "no" if using standard DSMore load shape for technology units, "yes" if an evaluation-provided load shape should be used for DSMore.

Notes: Coincidence factors to be applied in DSMore using the residential HVAC load shape in the DSMore library.

Final Report

Process Evaluation of the Power Manager Program in the Carolinas System:

An Analysis of Participant Surveys after Power Manager Events

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

March 21, 2013

Submitted by

Nick Hall and Dave Ladd

TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

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Executive Summary

Significant Findings from Participant Surveys

- Only 55% of participants surveyed are aware that Power Manager has been activated since they joined the program. The most frequently cited reasons for being aware of Power Manager activation events were "home temperature rises" followed by "air conditioner shuts down".
- 60% of participants were at home during the Power Manager activation event or non-event high temperature day which triggered the Event or Non-Event survey.
- Among participants who were home during a Power Manager activation event, only 28% were aware that the activation had occurred. Although there was no Power Manager activation for the Non-Event surveys, 16% of these participants believed an event had occurred. This difference is statistically significant, but half of both groups said they "don't know" if there was an activation or not.
- Among participants who were at home and were able to give comfort ratings for "before" and "during" the event or non-event high temperature day, 43% of those in the Event group reported a decline in comfort ratings, compared to only 15% of those in the Non-Event group.
- The amount of the decline in comfort ratings was also larger during activation events: On a 10-point scale, the Events participants' mean comfort fell by 1.4 overall during the activation event, versus an average decline of 0.1 in the Non-Event group. Among only those participants who reported a decline in comfort, the average decline was 3.4 for the Event group and 2.0 for Non-Event participants.
- Thirty-four participants (15% of 220 surveyed) were not the original occupant who joined the program and had a Power Manager device installed. These participants were less likely to be aware of device activation since joining the program by moving into a home with Power Manager (35% aware vs. 59% of original occupants), but more likely to report a decline in comfort during the recent activation event (73% vs. 38% of original occupants at home during the event).
- When asked to describe the cause of their decrease in comfort on the day of the activation event or non-event high temperature day, 88% of Event participants blamed "rising temperatures", while only 9% blamed the Power Manager activation. Among Non-Event participants (for whom there was no device activation), 100% blamed rising temperatures and none blamed Power Manager.
- The age of the participants' air conditioner unit and the outdoor high temperature have some effect on declines in comfort, but not as much effect as the presence of a Power Manager activation event.
- During the activation event or non-event high temperature day, 8% of Event participants adjusted their thermostat settings, compared to 22% of Non-Event participants. Overall, 39% of participants turned on fans, which was the most common action taken.
- Satisfaction with this program is high: Mean satisfaction ratings on a 10-point scale (were 10 is "most satisfied") were 8.7 among Event participants and 8.8 among Non-Event

participants. Using the same scale, participants were also willing to recommend the program with mean scores of 8.4 for Events and 8.7 for Non-Events. Satisfaction with Duke Energy overall was similarly high, with mean scores of 8.8 for both groups. Participants surveyed who were not the original occupant who joined the program were somewhat less likely to recommend the program (mean score 7.9), but also gave high satisfaction scores for the program (8.4) and for Duke Energy (8.7).

Introduction and Purpose of Study

The purpose of this process study was to evaluate participant behavior, awareness of, and satisfaction with Duke Energy's Power Manager® Program as it was administered in the Carolina System.

Summary of the Evaluation

The evaluation was conducted by TecMarket Works. The survey instruments were developed and administered by TecMarket Works.

Researchable Issues

1. Determine what percentage of program participants are aware of the occurrence of individual program events.

2. Determine whether customer comfort or discomfort during a Power Manager event is affecting participant behavior.

3. Determine overall participant satisfaction with the Power Manager program.

Description of Program

Power Manager (PM) is a voluntary residential program, available to homeowners with a qualifying central air conditioning (AC). There are two types of events that may be implemented for PM. First, Economic Events can be implemented on days where energy demand and/or energy costs are expected to be high. For such an event, Duke Energy has permission from Power Manager participants to cycle their air conditioning off and on for a period of time. Second, Emergency Events can be implemented by Duke Energy's system operations center (SOC) when emergency conditions occur. For such an event, participants' air conditioning would be turned off for the duration of the Power Manager emergency event.

The target load reduction in the Carolinas System is 1.3kW per device. Events may be called on non-holiday weekdays during the months of June through September.

Program Participation

Power Manager Program	Year-end 2012 Participation
Customers	159,469
Devices	185,043

Methodology

TecMarket Works conducted after-event phone surveys (event surveys) to collect participant information for this evaluation. The survey was maintained in a "ready-to-launch" status until notified of a control event affecting switches used by Duke Energy. The surveys were launched as soon as possible following the end of the control event (at 5pm Eastern) and continued over a 27 hour period with all call attempts made during regular surveying hours (10:00 a.m. to 8:00 p.m. Eastern Daylight Time, Monday through Saturday). For example, if a control event occurred on a Monday, calling hours for that particular event were:

- Monday 5pm-8pm Eastern
- Tuesday 10am-8pm Eastern

Event surveys followed events occurring on June 29, July 9 and July 17, 2012. TecMarket Works surveyed a total of 147 participants in the Carolina System. The survey can be found in Appendix A: Event Survey Instrument.

Before we asked the participants about the event, we inquired if they knew that there was a control event within the last 7 days so that we could understand if they are able to identify when a control event had occurred. The surveyor then notified the customer that they had just had a control event which had begun at <*start hour of control*> and ended at <*end hour of control*>. This allowed the participants to immediately recall the time period of the event and be able to respond to questions regarding the impact of that event on their use of their air conditioner and allow recollection of other actions taken, as well as the impact of the event on their comfort. Once informed of the event that had just occurred, the survey also assessed satisfaction with the program at the point of an event.

TecMarket Works also called Power Manager participants on hot days without control events to conduct the same survey (with slight wording alterations, as shown in red text Appendix B: Non-Event Survey Instrument). This survey was conducted on two different non-event days of at least 86°F. The heat index was also considered in determining a non-event day. On and following the high temperature dates of August 31 and September 7, TecMarket Works surveyed at total of 73 Power Manager participants.

The schedule of Power Manager event days and non-event high temperature days used for this survey in North and South Carolina is shown in Table 1, along with the high temperatures and heat indexes for those dates.[1]

Table 1. Schedule of Events and Non-Event High Temperature Days in the Carolinas System

Event ID	State	Type	Event Date	Event Hours	Date of Survey	High temp	Heat Index
NC-event1	NC	Event	29-Jun-12	2:30 to 5pm	29-Jun-12	105	107

[1] Temperature and heat index readings were taken from Weather.com for Charlotte (North Carolina) and Greenville (South Carolina).

NC-event1	NC	Event	29-Jun-12	2:30 to 5pm	30-Jun-12		
SC-event1	SC	Event	29-Jun-12	2:30 to 5pm	29-Jun-12	103	105
SC-event1	SC	Event	29-Jun-12	2:30 to 5pm	30-Jun-12		
NC-event2	NC	Event	9-Jul-12	1:30 to 5pm	9-Jul-12	96	103
NC-event2	NC	Event	9-Jul-12	1:30 to 5pm	10-Jul-12		
SC-event2	SC	Event	9-Jul-12	1:30 to 5pm	9-Jul-12	94	99
SC-event2	SC	Event	9-Jul-12	1:30 to 5pm	10-Jul-12		
NC-event3	NC	Event	17-Jul-12	2:30 to 5pm	17-Jul-12	94	96
NC-event3	NC	Event	17-Jul-12	2:30 to 5pm	18-Jul-12		
SC-event3	SC	Event	17-Jul-12	2:30 to 5pm	17-Jul-12	92	96
SC-event3	SC	Event	17-Jul-12	2:30 to 5pm	18-Jul-12		
NC-nonevent1	NC	Non	31-Aug-12	NA	31-Aug-12	91	94
NC-nonevent1	NC	Non	31-Aug-12	NA	1-Sep-12		
SC-nonevent1	SC	Non	31-Aug-12	NA	31-Aug-12	90	93
SC-nonevent1	SC	Non	31-Aug-12	NA	1-Sep-12		
NC-nonevent2	NC	Non	7-Sep-12	NA	7-Sep-12	87	90
NC-nonevent2	NC	Non	7-Sep-12	NA	8-Sep-12		
SC-nonevent2	SC	Non	7-Sep-12	NA	7-Sep-12	86	90
SC-nonevent2	SC	Non	7-Sep-12	NA	8-Sep-12		

Number of completes and sample disposition for each data collection effort

Participant Event Surveys

From the sample list of customers, 834 participants were called between June 29, 2012 and July 18, 2012, and a total of 147 usable telephone surveys were completed yielding a response rate of 17.6% (147 out of 834).

Participant Non-Event Surveys

From the sample list of customers, 520 participants were called between August 31, 2012 and September 8, 2012, and a total of 73 usable telephone surveys were completed yielding a response rate of 14.0% (73 out of 520).

Expected and achieved precision

Participant Event Surveys

The survey sample methodology had an expected precision of 90% +/- 6.5% and an achieved precision of 90% +/- 6.8%.

Participant Non-Event Surveys

The survey sample methodology had an expected precision of 90% +/- 6.5% and an achieved precision of 90% +/- 9.6%.

Number of completes and sample disposition for each data collection effort

Participant Event Surveys

The event survey was conducted using a random sample from 40,894 Power Manager participants in the Carolinas. There were 147 Carolina customers willing to participate in the survey.

Participant Non-Event Surveys

The non-event surveys were conducted on and following the high temperature dates of August 31 and September 7, 2012. TecMarket Works surveyed a total of 73 Power Manager participants.

Threats to validity, sources of bias and how those were addressed

There is a potential for social desirability bias[2] but the customer has no vested interest in their reported program participation, so, this bias is expected to be minimal.

Snapback and Persistence

The theoretical additional energy and capacity used by customers that may occur from implementing an energy efficiency product is often called "snapback." There is little to no literature or snapback analysis within the evaluation industry that has been able to identify a snapback condition.

In this process evaluation, survey participants were asked if they had adjusted the thermostat on their air conditioners during an event or non-event cycle. Six Event participants and five Non-Event participants reported setting a lower thermostat temperature during the cycle. (See *Thermostat Adjustments* on page 25.)

[2] Social desirability bias occurs when a respondent gives a false answer due to perceived social pressure to "do the right thing."

Participant Surveys

TecMarket Works surveyed current Power Manager participants in order to better gauge their awareness of Power Manager events and their perception of discomfort caused by Power Manager curtailment events.

TecMarket Works conducted the event surveys regarding each event during a 27-hour window beginning at 5 p.m. EDT on the day that a curtailment event occurred and ending at 8 p.m. EDT the day after the curtailment event. Calling hours were 10 a.m.- 8 p.m. EDT following events occurring on June 29, July 9 and July 17. TecMarket Works surveyed a total of 147 participants in the Carolinas (67 from North Carolina and 80 from South Carolina). The Event survey protocol is located in Appendix A: Event Survey Instrument.

In order to control for customer perceptions and experiences not caused by Power Manager curtailment events, TecMarket Works also surveyed participants referencing days on which the heat index was high enough to trigger a curtailment event, but on which no curtailment event actually occurred. On and following the high temperature dates of August 31 and September 7, TecMarket Works surveyed a total of 73 participants in the Carolinas (29 from North Carolina and 44 from South Carolina). The high temperature Non-Event survey is located in Appendix B: Non-Event Survey Instrument.

Home Occupancy During Power Manager Activation

TecMarket Works asked Event respondents whether they were home during the actual event timeframe (typically 2:30-6:00pm EDT) and asked Non-Event survey respondents if they were home at 3pm EDT on the date of the high temperature. The results in Figure 1 and Figure 2 show that roughly 60% of both event and non-event survey respondents were home during these times.

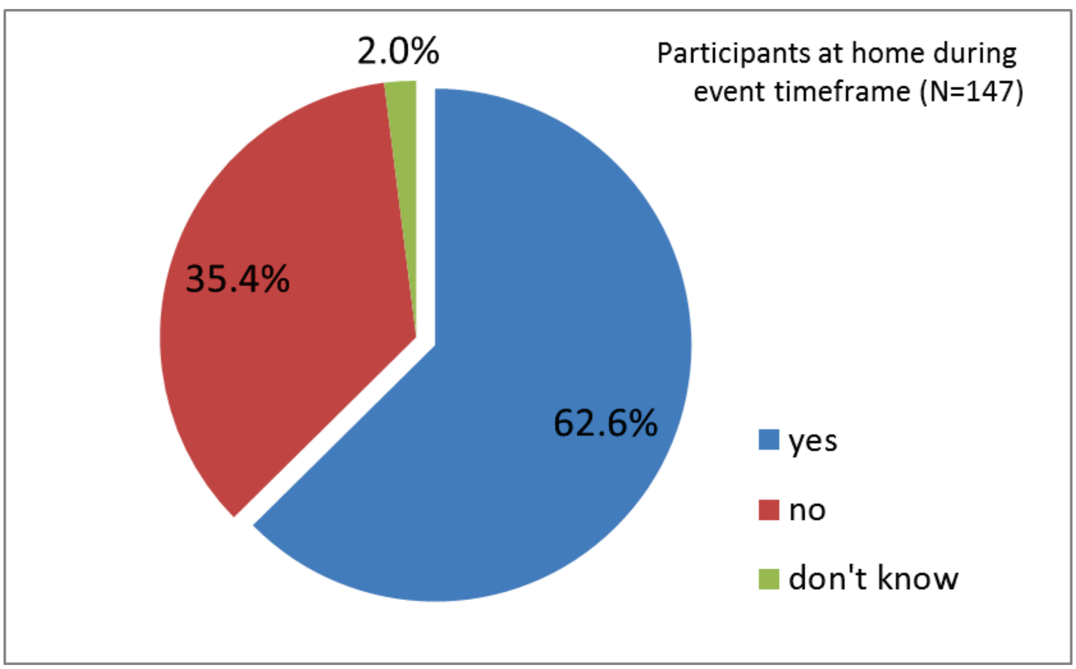

Figure 1. Event Participants at Home During Event Timeframe (N=79)

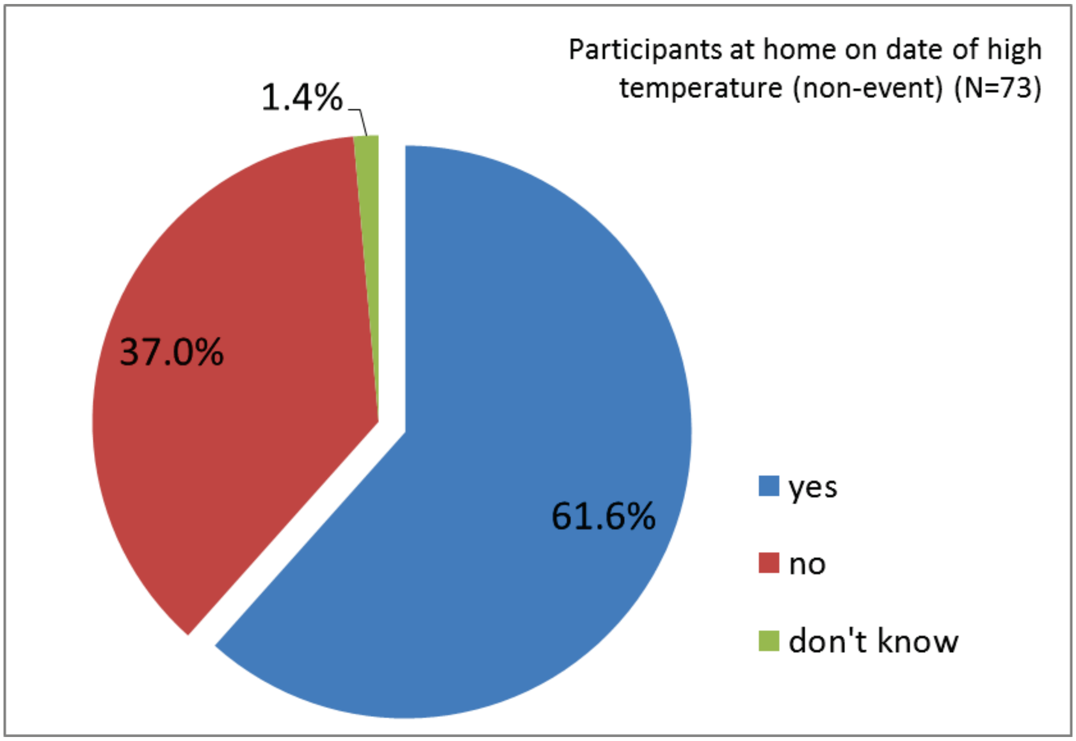

Figure 2. Non-Event Participants at Home on Date of High Temperature (N=75)

General Awareness of Device Activations

In order to gauge awareness of the Power Manager device activation, TecMarket Works first asked Event and Non-Event participants if they were aware of a device activation occurring since they had joined the program. The results in Figure 3 show that a little over half of Event and Non-Event participants were aware that an activation had occurred at some point since their enrollment, while more than a third were unaware of whether an activation had occurred or not. Only a handful of participants were sure that Power Manager had not been activated (8.2% of Event participants or 12 out of 147, and 11.0% of Non-Event participants or 8 out of 73). These differences between Event and Non-Event participants are not statistically significant.

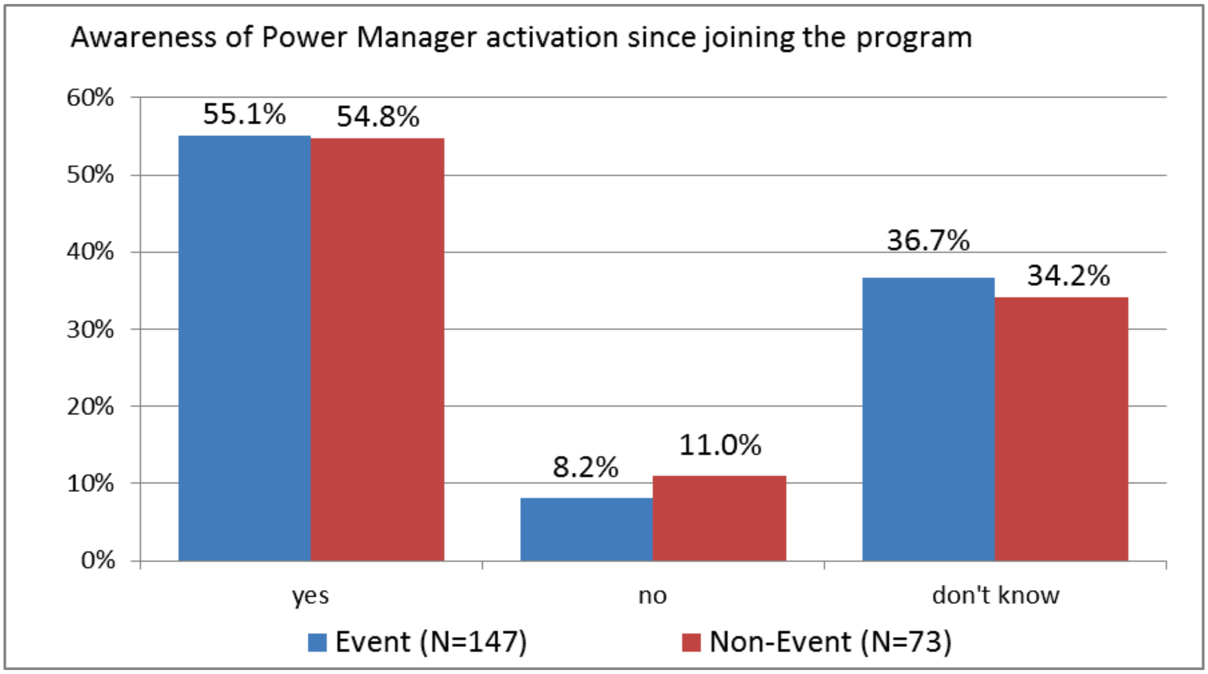

Figure 3. Awareness of Power Manager Activation Since Enrolling in the Program

TecMarket Works followed up the initial awareness question by asking participants an open-ended question as to how they knew that the Power Manager device had been activated. Nearly half of participants stated that they did not know how to tell if the Power Manager device had been activated, as seen in Table 2. For both Event and Non-Event participants, the most commonly mentioned indicator of Power Manager activation was "home temperature rises", followed by "air conditioning shuts down".

Table 2. Reasons for Awareness of Activation

	Percentage of times mentioned by…		
	Event Participants (N=147)	Non-Event Participants (N=73)	Difference
Home temperature rises	32.0%	26.0%	6.0%
AC shuts down	16.3%	15.1%	1.2%
The light on the meter is on	6.8%	4.1%	2.7%
Bill credits	5.4%	5.5%	-0.1%
The light on the AC unit flashes	8.2%	1.4%	6.8%
Lower bills	2.7%	2.7%	0.0%
Indoor thermometer does not match thermostat setting	0.7%	2.7%	-2.0%
Another person told me it had been activated	1.4%	1.4%	0.0%
Non-bill contact from Duke Energy (mailer, phone, employee)	2.0%	0.0%	2.0%
Fan goes into cycling mode	0.7%	0.0%	0.7%
Unique response (see below)	0.0%	1.4%	-1.4%
Don't know	41.5%	49.3%	-7.8%

Note: Multiple responses were allowed per participant

One Non-Event participant offered a unique response to this question:

- *"Hands on meter are moving -- also need to have little clip on unit taken off."*

Event participants' reasons for awareness of Power Manager activations are broken out separately in Figure 4 for those who were aware that Power Manager had been activated since they joined the program, who were not aware, and who "don't know" if they were aware. Event participants who were aware of Power Manager being activated were significantly less likely to not be able to name a reason why they were aware of the activation (aware but "don't know" reason 25.9% or 21 out of 81, versus not aware and "don't know" 58.3% or 7 out of 12 and don't know if activated and "don't know" reason 61.1% or 33 out of 54; aware respondents significantly different from other groups at $p<.05$ using student's t-test).

Event participants who were aware that Power Manager has been activated since they joined the program were significantly more likely to mention "home temperature rises" (44.4% or 36 out of 81) as a reason why they know the device has been activated compared to the other groups (16.7% or 2 out of 12 for "not aware" and 16.7% or 9 out of 54 for "don't know if aware"; differences are significant at $p<.05$ using student's t-test). For all three groups, the most frequently mentioned reasons for awareness of device activation were "home temperature rises" and "air conditioner shuts down".

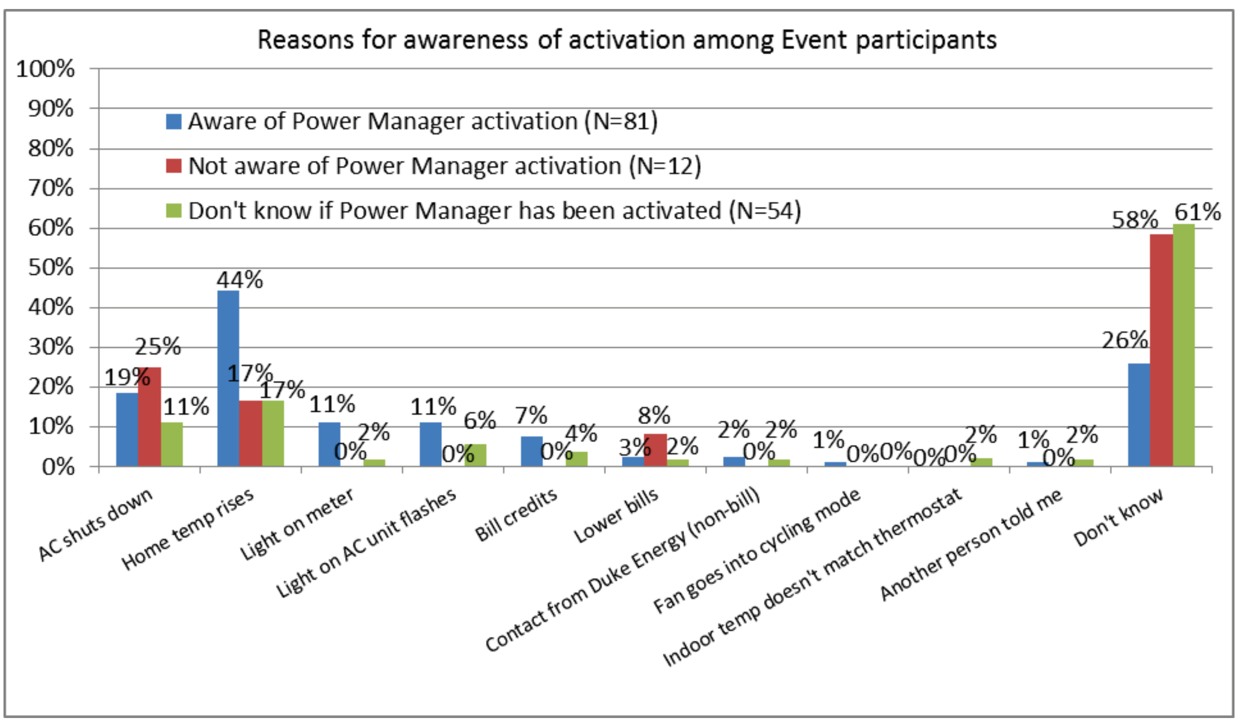

Figure 4. Reasons for Awareness of Power Manager Activation Among Event Participants
Note: Multiple responses were allowed per participant.

Non-Event participants' reasons for awareness of Power Manager activation are broken out separately in Figure 5 for those who were aware that Power Manager had been activated since they joined the program, who were not aware, and who "don't know" if they were aware. Figure 5 show a similar pattern to that of Event participants. Most of the Non-Event participants who believe that Power Manager has not been activated since they joined the program (75.0% or 6 out of 8) and most who state that they "don't know" how to tell if Power Manager is activated (72.0% or 18 out of 25) could not name a reason for their awareness of the device activating ("don't know"). This is significantly higher than the percentage of Non-Event participants aware of device activation who "don't know" how to tell if the device is activated (30.0% or 12 out of 40; this difference is significant at p<.05 using student's t-test).

Non-Event participants who were aware that Power Manager has been activated since they joined the program were significantly more likely to mention "home temperature rises " (35.0% or 14 out of 40) and "air conditioner shuts down" (25.0% or 10 out of 40) than the other two groups (differences are significant, at least p<.10 using student's t-test).

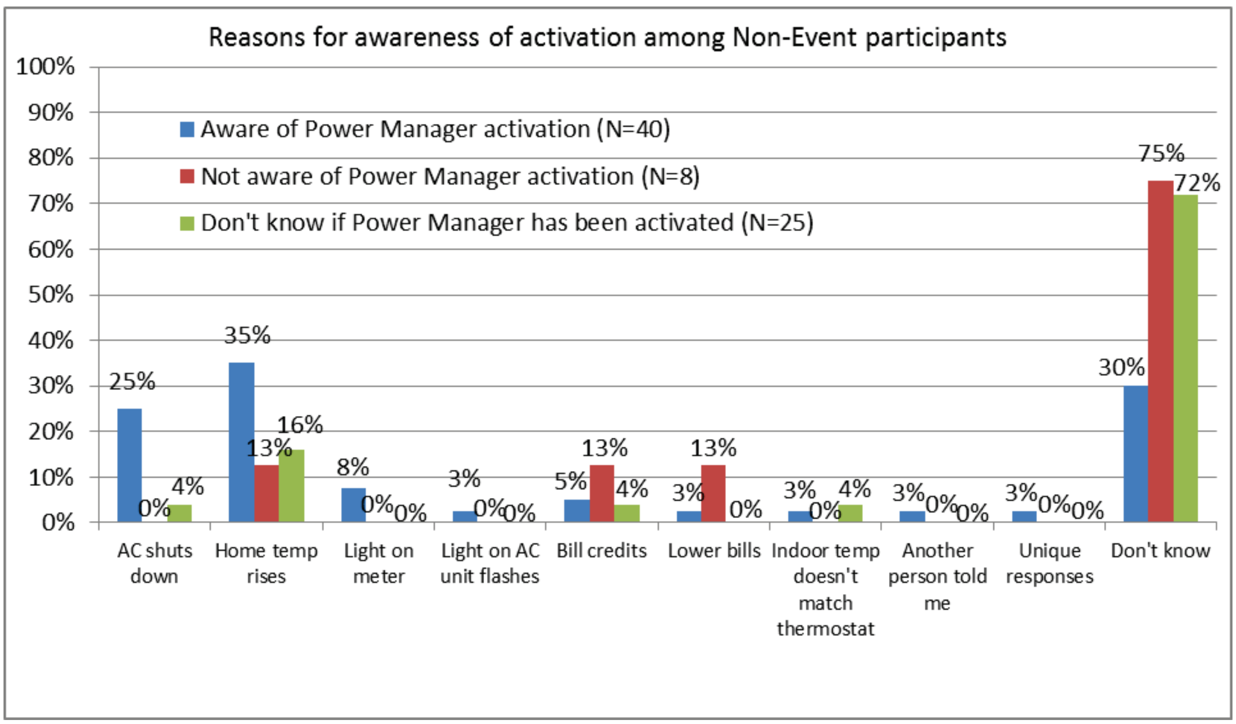

Figure 5. Reasons for Awareness of Power Manager Activation Among Non-Event Participants
Note: Multiple responses were allowed per participant

Awareness of Activation and Monthly Billing

Table 3 shows differences in awareness of Power Manager activation according to whether participants receive their monthly energy bills by email or regular mail. Participants who get their bills by email are more likely to mention "air conditioning shuts down" as the reason for their awareness (26.7% or 8 out of 30, versus 13.2% or 24 out of 182 for participants who receive their bills by mail; this difference is statistically significant at p<.05 using student's t-test). Participants who get bills by regular mail were more likely to mention "home temperature rises" as the reason why they know Power Manager has been activated (33.5% or 61 out of 182, versus 10.0% or 3 out of 30 participants who receive bills by email; this difference is also statistically significant at $p<.05$ using student's t-test).

Table 3. Awareness of Activation: Mail Versus email

	Receive monthly bills by …	
	mail (N=182)	**email (N=30)**
Aware of Power Manager activation since joining the program	56.6%	46.7%
How can you tell when Power Manager is activated?		
Home temperature rises	33.5%	10.0%
AC shuts down	13.2%	26.7%
Bill credits	5.5%	3.3%
Lower bills	3.3%	0.0%
Don't know	44.0%	50.0%

Note: Event and Non-Event participant results are combined in this table. Eight participants were excluded from this table because they receive their bills through both mail and email, their bills are sent to a third party, or they didn't know how they receive their bills.

Table 4 compares awareness of Power Manager activation among participants who review their Duke Energy bills regularly (more than half the time) versus those who do not (less than half the time, never and "don't know"). Participants who review their bills more than half the time are significantly more likely to be aware that Power Manager has been activated since they joined the program (57.5% or 100 out of 174, versus 45.7% or 21 out of 46 among those who check their bills less than half of the time; this difference is statistically significant at $p<.10$ using student's t-test). Participants who check their bills more often were also more likely to mention bill credits as the source of their awareness, although only a small number mentioned bill credits (6.9% or 12 out of 174, versus none of the participants who review their bills less than half the time; this difference is statistically significant at $p<.05$ using student's t-test). Participants who regularly check their bills are also more likely to mention "home temperature rises" as a reason for their awareness (32.8% or 57 out of 174, compared to 19.6% or 9 out of 46 who do not regularly read their bills), and are less likely to not be able to give any reasons ("don't know" 40.2% or 70 out of 174) compared to those who don't regularly check their bills (58.7% or 27 out of 46; both differences significant at $p<.05$ using student's t-test).

Table 4. Awareness of Activation: Reviewing Monthly Bills

	Review the details of Duke Energy bill…	
	Every month / more than half the time (N=174)	**Less than half the time / never / don't know (N=46)**
Aware of Power Manager activation since joining the program	57.5%	45.7%
How can you tell when Power Manager is activated?		
Home temperature rises	32.8%	19.6%
AC shuts down	14.9%	19.6%

Bill credits	6.9%	0.0%
Lower bills	2.9%	2.2%
Don't know	40.2%	58.7%

Note: Event and Non-Event participant results are combined in this table.

Awareness of Power Manager Device Activation in the Past Seven Days

TecMarket Works then asked both Event and Non-Event participants who were home during the event (or high temperature non-event) whether they were aware of their Power Manager device being activated in the past seven days. However, in the case of the Non-Event participants, such activation had not occurred[3]. These results are shown in Figure 6 and Figure 7.

As seen in Figure 6, just 28.3% (26 out of 92) of Event participants were aware of a Power Manager activation, and 22.8% (21 out of 92) believed there had been no activation at all, while the plurality of 48.9% (45 out of 92) did not know whether an activation had occurred or not.

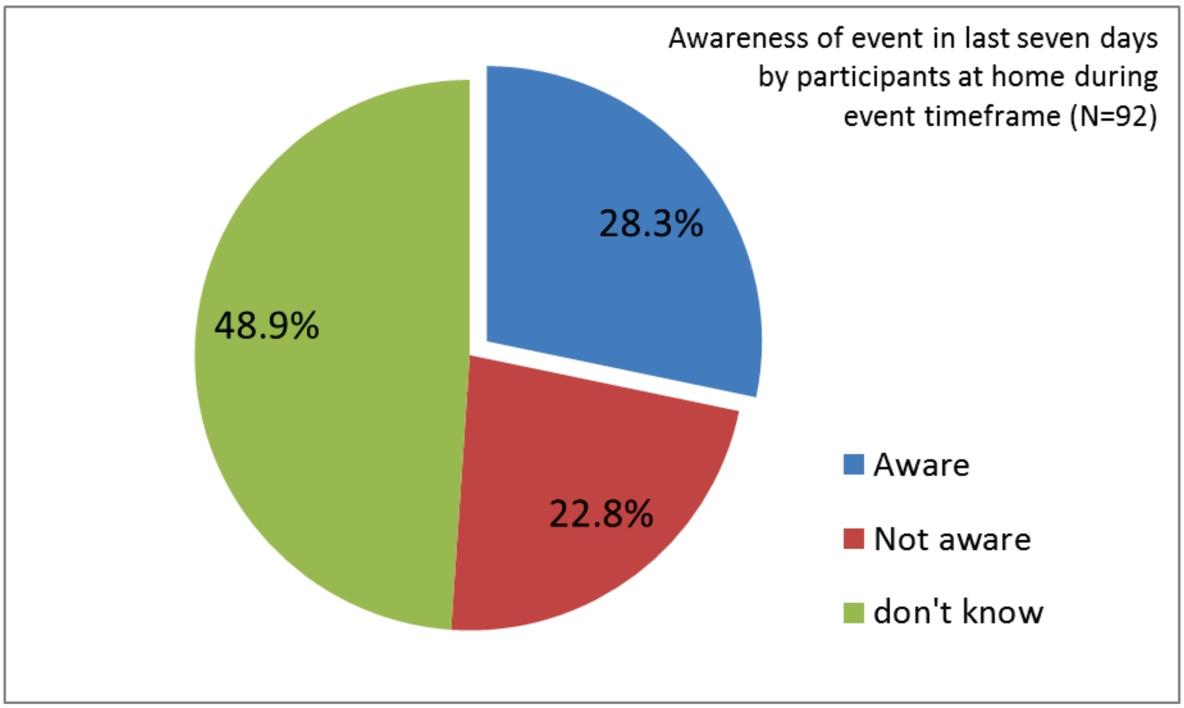

Figure 6. Awareness of Activation in Past Seven Days by Event Participants at Home (N=92)

Figure 7 indicates that compared to Event participants, a significantly smaller percentage (15.6% or 7 out of 45) of Non-Event participants believed there had been a Power Manager activation in the past seven days (statistically significant at $p<.05$ using student's t-test). A larger number of Non-Event participants (26.7% or 12 out of 45) correctly stated that there had been no Power

[3] Non-Event surveys were always fielded at least 10 days after an actual Power Manager activation, so there were no cases where a non-event high temperature day coincided with a Power Manager event.

Manager event in the past seven days, while the majority of Non-Event participants (57.8% or 26 out of 45) said they could not tell if there had been a Power Manager activation or not.

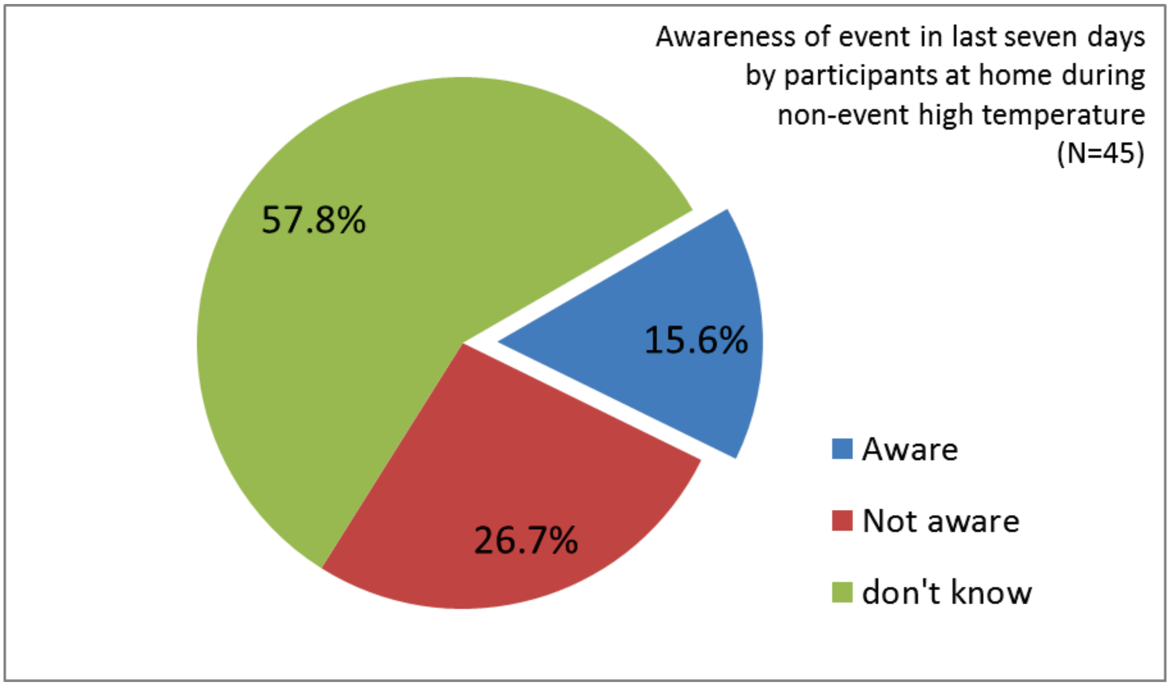

Figure 7. Awareness of Event in Last Seven Days by Non-Event Participants at Home (N=45)

TecMarket Works also asked participants who were not at home during the event timeframe (or high temperature non-event day) whether they were aware of a Power Manager device activation. As shown in Figure 8, only 5.9% (3 out of 51) of Event participants not at home during an event thought that a Power Manager activation had occurred. Figure 9 shows that a slightly higher 11.1% (3 out of 27) of Non-Event participants who were not at home thought that a Power Manager activation had occurred.

Event participants who were home during a Power Manager event were significantly more likely to believe there was an activation (28.3% or 26 out of 92) than Event participants who were not at home (5.9% or 3 out of 51; this difference is significant at $p<.01$ using student's t-test). There were no significant differences in awareness of activation between Non-Event participants who were at home and those who were not.

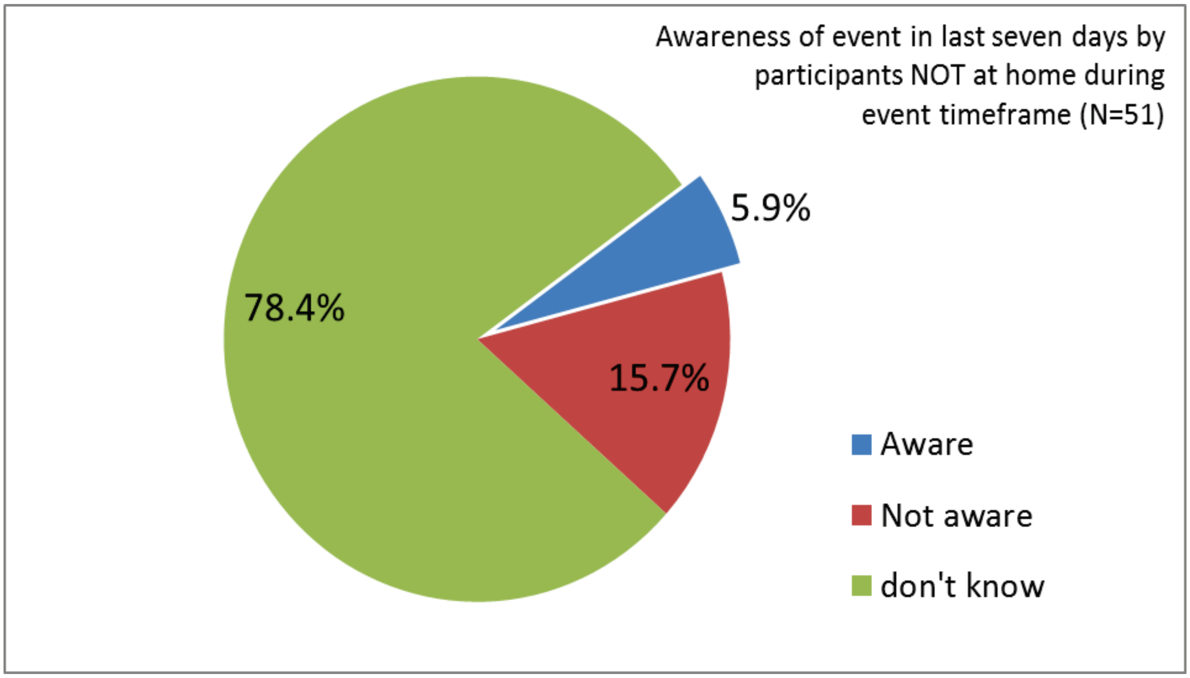

Figure 8. Awareness of Activation in Past Seven Days by Event Participants NOT at Home (N=51)

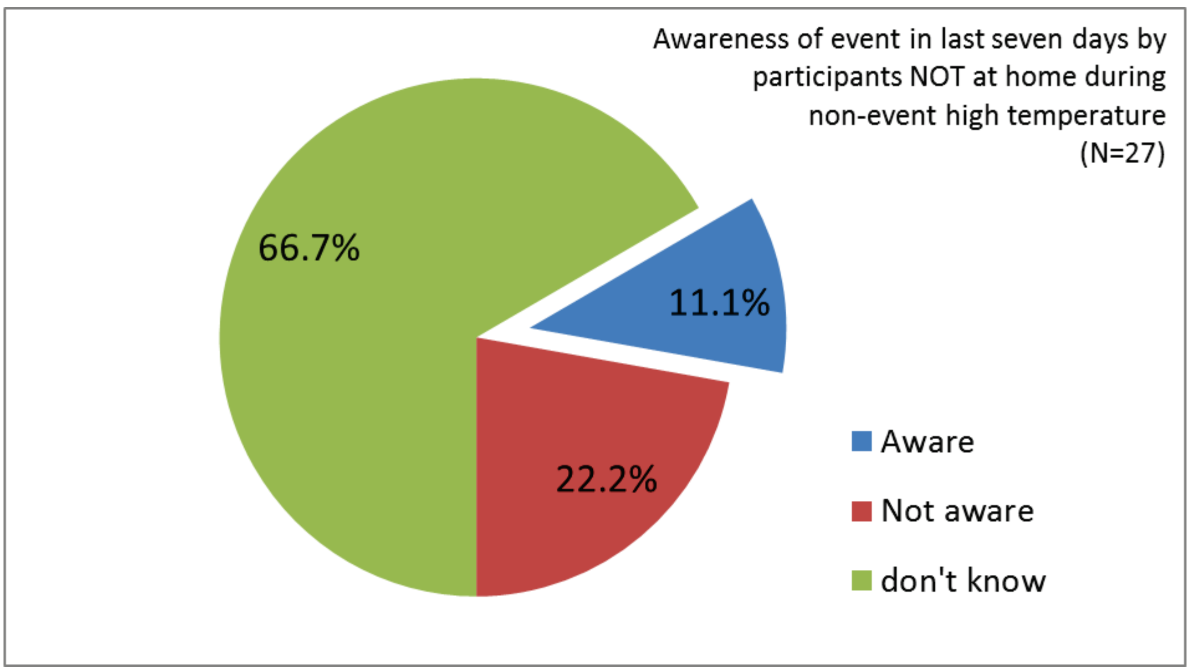

Figure 9. Awareness of Event in Last Seven Days by Non-Event Participants NOT at Home (N=27)

Changes in Comfort and Comfort Drivers

The next part of the survey for both Event and Non-Event participants dealt with any perceived change in comfort being ascribed to a Power Manager activation and whether there were other drivers of that comfort change beyond the activation.

TecMarket Works asked two comfort related questions to the 92 Event participants and 45 Non-Event participants who indicated that they or a family member were home during the event or high temperature. The first question asked for the participant to rate their level of comfort before the activation or time of high temperature on a 1-to-10 scale with one being very uncomfortable and ten being very comfortable. TecMarket Works then asked participants to rate their comfort level during the event or time of high temperature using the same scale.

Figure 10 below shows that although the majority of both Event and Non-Event survey respondents indicated no change in their comfort level during the Power Manager activation or time of high temperature, those who were surveyed after an actual Power Manager event were significantly more likely to notice a decrease in comfort (43.0% or 34 out of 79 Event participants' comfort ratings declined, compared to just 14.6% or 6 out of 41 Non-Event participants; this difference is significant at p<.01 using student's t-test).

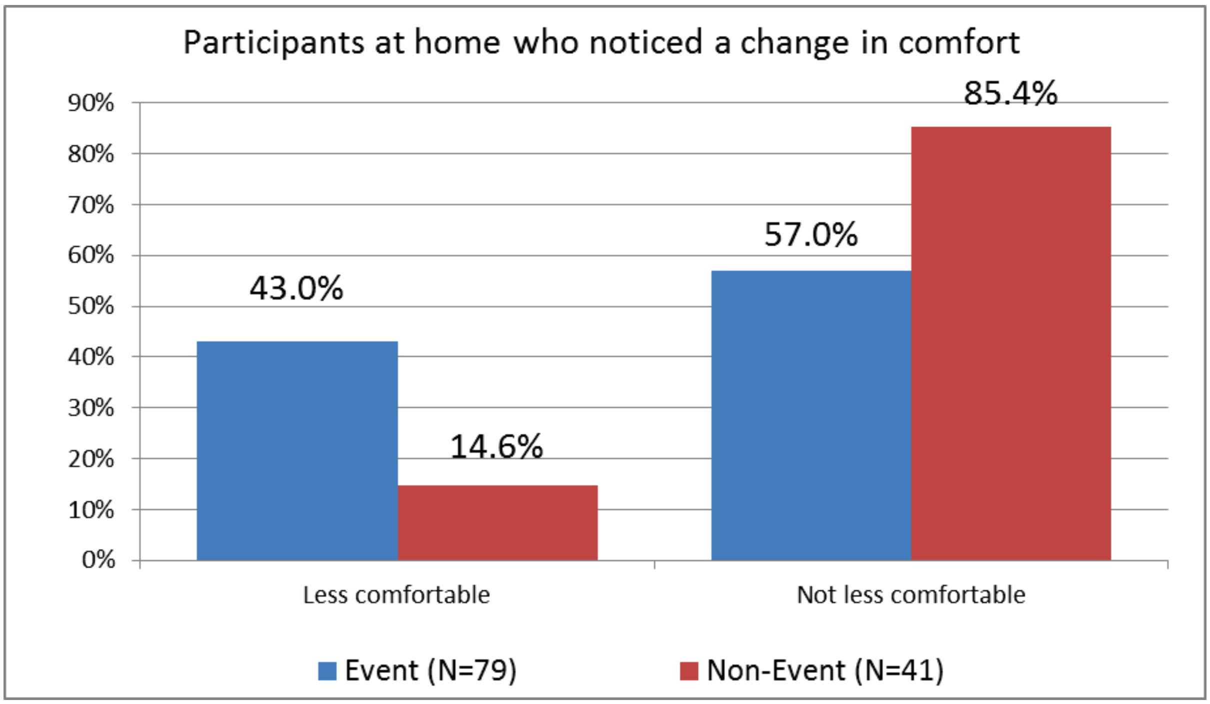

Figure 10. Comfort Change Perception by Participants at Home
Note: Only respondents who answered both comfort rating questions are included in this table.

There is also a significant difference between North and South Carolina in Power Manager participants noticing a decline in comfort during events, shown in Figure 11. A little over half (52.5% or 21 out of 40) of North Carolina Event participants reported a decline in comfort, compared to just a third (33.3% or 13 out of 39) of Event participants in South Carolina (this difference is significant at p<.05 using student's t-test). There is no significant difference between states for Non-Event participants (13.3% reported less comfort in North Carolina, compared to 15.4% in South Carolina).

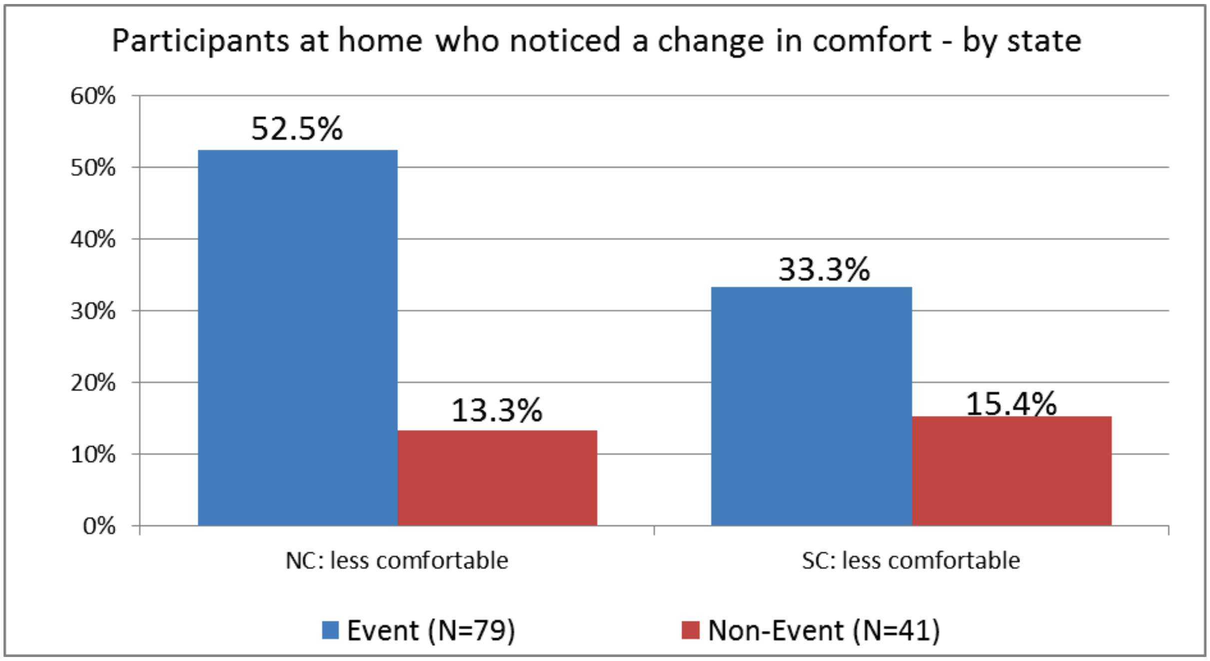

Figure 11. Comfort Change Perception by Participants at Home by State
Note: Only respondents who answered both comfort rating questions are included in this table.

Table 5 shows the mean ratings for before and during the event or high temperature as well as the high, low and mean differences for Event and Non-Event participants. While there is no significant decline in comfort ratings from before (8.61) to during (8.49) among Non-Event participants (for whom there was no Power Manager event), there is a significant decline in comfort for Event participants (whose air conditioning was cycled off by Power Manager on a high temperature day). Event participants' comfort ratings fell from 8.51 before the event (not significantly different from Non-Event participants' pre-event comfort) down to 7.09 after, which represents a statistically significant decline for Event participants, and is significantly lower than the comfort level reported by Non-Event participants during a high temperature non-event day (both differences are significant at $p<.01$ using ANOVA).

Table 5. Comfort Rating Differences for Events and Non-Events by Customers at Home

	Event (N=79)	Non-Event (N=41)
Mean comfort rating before event or high temperature day	8.51	8.61
Mean comfort rating during event or high temperature day	7.09	8.49
Mean difference of ratings	-1.42	-0.12
Highest difference (among those who became less comfortable)	7	3
Lowest difference (among those who became less comfortable)	1	1

Note: Only respondents who answered both comfort rating questions are included in this table.

Table 6 shows the range of comfort decline among those respondents who reported a decline in comfort. The range of reported comfort decline was much higher for Event participants: Event participants' comfort ratings declined by as much as 7 points on a 10-point scale (with an average decline of 3.41 points), while Non-Event participants' who reported lower comfort ratings never went down by more than 3 points (with an average decline of 2.0 points). The 34 Event participants who reported a decline in comfort reported an average comfort level of only 5.18 during the Power Manager activation event (significantly lower than their comfort rating before the event at $p<.01$ using ANOVA). For the six Non-Event participants, the 2.0 point decline in comfort ratings from "before" to "during" was also significant (at $p<.01$ using ANOVA); differences between Event and Non-Event participants are not significant for "before" or "after" ratings.

Table 6. Comfort Rating Differences for Events and Non-Events Among Those Who Reported Their Comfort Level Declined During Event or High Temperature Day

	Event (N=34)	Non-Event (N=6)
Mean of pre-event comfort rating	8.59	8.00
Mean of rating during event or high temperature	5.18	6.00
Mean difference of ratings	-3.41	-2.00
Comfort rating declined by 1 point	11.8%	16.7%
Comfort rating declined by 2 points	29.4%	66.7%
Comfort rating declined by 3 points	20.6%	16.7%
Comfort rating declined by 4 points	5.9%	0.0%
Comfort rating declined by 5 points	17.6%	0.0%
Comfort rating declined by 6 points	5.9%	0.0%
Comfort rating declined by 7 points	8.8%	0.0%

Note: Only respondents whose comfort ratings declined during the event/high temperature day are included in this table.

Figure 12 shows the percentage of participants who reported a decline in comfort by the outdoor high temperature on the day of the event or non-event. In the Carolinas during the 2012 cooling season, Power Manager activation events only occurred on days when the temperature was 92 degrees or warmer (by design, activation events occur on days when electricity demand for cooling is at its highest, which tend to be the hottest days of the season). On all of the high temperature non-event days, the outdoor high was 91 degrees or less.

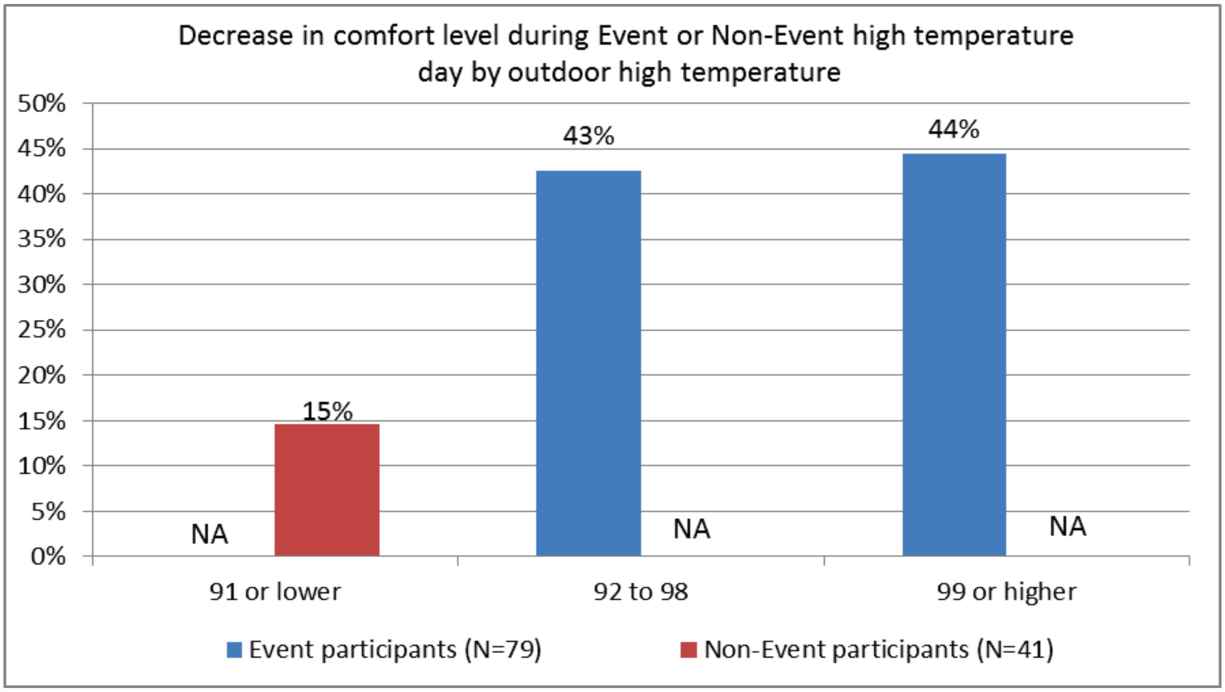

Figure 12. Decrease in Comfort by Outdoor High Temperature (total N=120)
Note: There were no non-event high temperature days in the Carolinas where the outdoor temperature was 92 degrees or higher, and no Power Manager activation event days where the temperature was 91 degrees or lower.

The complete distribution of high temperatures for event and non-event days in the Carolinas can be found in Table 1. Schedule of Events and Non-Event High Temperature Days in the Carolinas System on page 7. For further discussion, see Comfort Ratings by High Temperature on page 37.

Power Manager Activation When the Device Was Installed by Previous Occupants
According to data provided by Duke Energy, 34 participants surveyed in the Carolinas were not the original occupants when the Power Manager device was installed at their property (16.3% or 24 out of 147 Event participants and 13.7% or 10 out of 73 Non-Event participants). As shown in Table 7, participants who are not the original occupant to join the Power Manager program are less aware of device activation (35.3% or 12 out of 34, versus 58.6% or 109 out of 186 for original occupants; statistically significant at $p<.05$ using student's t-test). They are also less likely than original occupants to cite bill credits as the reason for their awareness of activation (0% or none of 34, compared to 6.5% or 12 out of 186 for original occupants; this difference is significant at $p<.10$ using student's t-test).

Table 7. Awareness of Activation: Power Manager Installed by Previous Occupant

	Not the original occupant who signed up for Power Manager (N=34)	Original occupant who signed up for Power Manager (N=186)
Aware of Power Manager activation since joining the program	35.3%	58.6%
How can you tell when Power Manager is activated?		
Home temperature rises	23.5%	31.2%
AC shuts down	20.6%	15.1%
Bill credits	0.0%	6.5%
Lower bills	0.0%	3.2%
Don't know	52.9%	42.5%

Note: Event and Non-Event participant results are combined in this table.

Eighteen of the 34 participants in this survey who were signed up for Power Manager by previous occupants were at home during the event or non-event high temperature day surveyed. These participants were not more likely to be aware that Power Manager was activated on recent event dates, but they are more likely to report a decline in comfort, as seen in Table 8. About a third of all Event participants correctly noted that the device was activated shortly before this survey was taken (no significant differences between groups). However, a much larger percentage of participants who inherited a Power Manager device from a previous occupant reported a decline in comfort during the activation event (72.7% or 8 out of 11, compared to just 38.2% or 26 out of 68 for those who joined the program themselves; this difference is significant at $p<.05$ using student's t-test).

Table 8. Power Manager Installed by Previous Occupant: Awareness of Activation in Past Seven Days

	Not the original occupant who signed up for Power Manager	Original occupant who signed up for Power Manager
Base: Event participants at home during event	**N=12**	**N=80**
Aware of activation in past 7 days (Power Manager was activated)	33.3%	27.5%

Base: Event participants at home during event who answered both comfort questions	**N=11**	**N=68**
Decline in comfort during event	72.7%	38.2%
Base: Non-Event participants at home during high temperature day	**N=6**	**N=39**
Aware of activation in past 7 days (Power Manager was not activated)	33.3%	12.8%
Base: Non-Event participants at home during high temperature day who answered both comfort questions	**N=4**	**N=37**
Decline in comfort during non-event high temperature day	25.0%	13.5%

Participant Perceptions Relative to Comfort Change

TecMarket Works asked participants who noted a change in comfort during the event or non-event timeline an open-ended question as to what they believe caused the change in comfort. The responses are shown below in Figure 13.

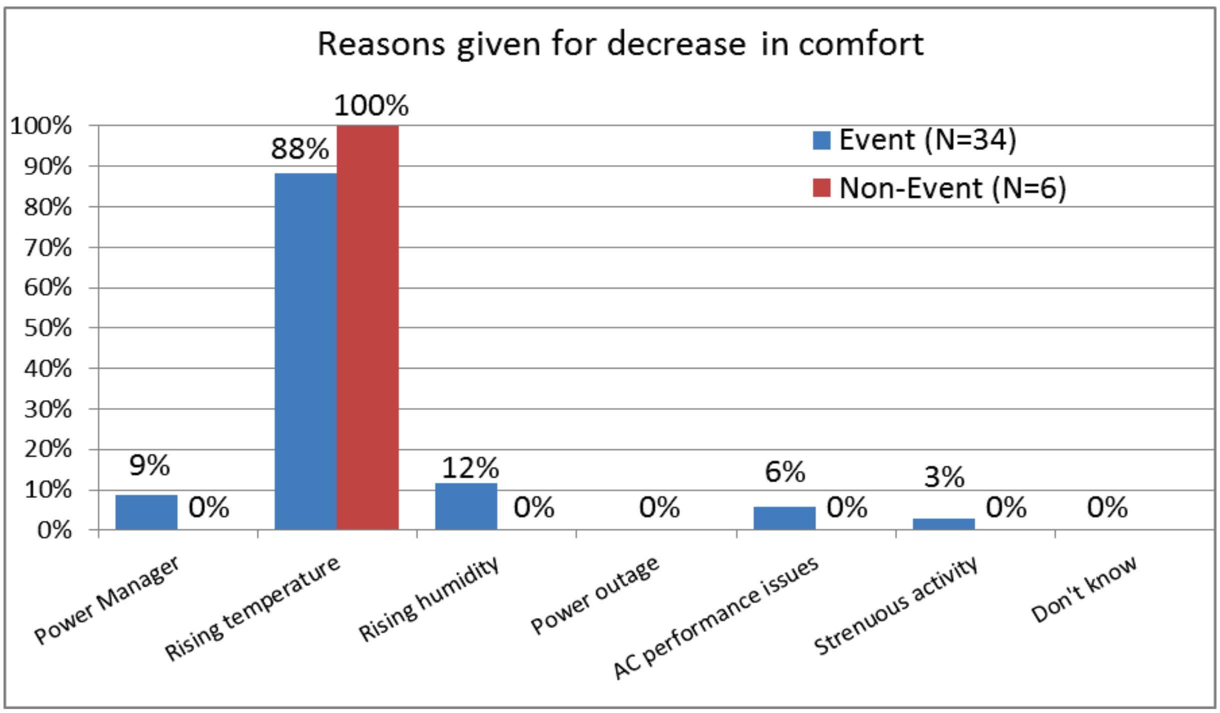

Figure 13. Reasons for Comfort Change

Note: Only respondents whose comfort ratings declined during the event/high temperature day are included in this table.

Figure 13 shows that the vast majority of Event and Non-Event participants who reported a decrease in their comfort level during an event or high temperature day attribute their change in comfort to the rising temperature (88.2% or 30 out of 34 Event participants, and 100% or 6 out of 6 Non-Event participants).

Very few Event participants (8.8% or 3 out of 34) and none of the Non-Event participants cited Power Manager as contributing to their decline in comfort. Similar number of Event participants attributed their change in comfort to performance issues with their air conditioning unit (5.9% or 2 out of 34) or rising humidity (11.8% or 4 out of 34), though neither of these was mentioned by Non-Event participants.

Power outage was not mentioned as a factor contributing to comfort change by any respondents.

This data – along with the data from Figure 6 showing that only 28.3% of Event participants were aware of a Power Manager device activation occurring in the past seven days – suggests there is uncertainty among many participants as to how Power Manager affects their air conditioner and home comfort level. That is, many participants may be unaware that the Power Manager device is causing the changes they feel in comfort.

Decreases in Comfort and Age of Air Conditioning Units

Three Event participants in the Carolinas blamed Power Manager for their decrease in comfort: Two have air conditioning units that are 6 years old or less, and one has a unit between 13 and 20 years old. Two Event participants blamed performance issues with their air conditioner units: one has a unit between 7 and 12 years old, and the other did not know the age of their air conditioner. Of the six Non-Event participants who noticed a decline in comfort, three have air conditioners 6 years old or newer, two have units 7 to 12 years old, and one did not know the age of their air conditioning unit.

Behaviors During Event Activation

TecMarket Works asked several questions regarding behavior associated with a Power Manager device activation.

Thermostat Adjustments

Participants who indicated that they or a family member had been home during the time of the event or high temperature non-event day were asked if they had adjusted their thermostat during that time.

Seven Event participants (7.6% of 92 at home during the event) stated that they adjusted their thermostats: six turned their thermostats down by 1 to 5 degrees, and one made short-term adjustments that ultimately left the thermostat settings where they were before the event. The average change for these seven Event respondents was down 2.1 degrees.

Ten Non-Event participants (22.2% of 45 at home during the high temperature day) stated that they had adjusted their thermostats: five turned their thermostats down by 1 to 5 degrees, four turned their thermostats up by 1 or 2 degrees, and one did not know what changes were made to their thermostat settings. The average change for the nine Non-Event respondents who gave specific thermostat settings was down 0.8 degrees.

Use of Fans and Other Ways to Keep Cool

Participants who indicated that they or a family member had been home during the time of the event or high temperature period were then asked if they had turned on any fans during that time period. This was the most common response to high temperatures reported by respondents; the results are shown in Table 9.

Table 9. Did You or Your Family Turn on a Fan During Event or High Temperature?

	Event (N=92)	Non-Event (N=45)
Yes	39.1%	37.8%
No	56.5%	60.0%
Don't Know	4.3%	2.2%

Participants were also asked an open-ended question as to whether they did anything else to keep cool during the timeframe of the Power Manager device activation or high temperature. A majority of both Event (68.5% or 63 out of 92) and Non-Event participants (80.0% or 36 out of 45) stated that they did nothing else (or nothing at all) in response to the device activation or high temperature. The remaining responses (all mentioned by fewer than 10%) are included in Table 10.

Table 10. Other Activities Participants Took to Cool Down

	Event (N=92)	Non-Event (N=45)
Continued normal activities / nothing different	68.5%	80.0%
Closed blinds / shades	8.7%	6.7%
Drank water / cool drinks	6.5%	2.2%
Wore less clothing	2.2%	2.2%
Moved to a cooler part of the house	2.2%	2.2%
Stayed indoors	4.3%	0.0%
Cooled off with water (shower, sprinkler, hose, pool)	2.2%	0.0%
Keep doors shut / use other doors to keep heat out	2.2%	0.0%
Reduce activity level	2.2%	0.0%
Turn on room / window AC	2.2%	0.0%
Unique responses (listed below)	4.3%	0.0%
Don't know / refused	6.5%	4.4%

Only two respondents in the Carolinas (2.2% of 92 Event participants; 0.0% of 45 Non-Event participants) indicated that they had used room or window air conditioners to keep cool or to compensate for the Power Manager device activation.

Four Event participants (4.3% of 92 at home during an event) took unique actions, listed below.

- "*Opened back door*."

- "*Lights off in most rooms.*"
- "*Keep AC at the EPA recommended setting; use exhaust fans; grill out to avoid cooking in house; use Energy Star products; use programmable thermostat.*"
- "*Changed AC filter because we knew the system would be working hard.*"

Age of Air Conditioner and Change in Comfort Levels During Event

TecMarket Works asked participants for the age of their air conditioner. The distributions are shown below in Figure 14.

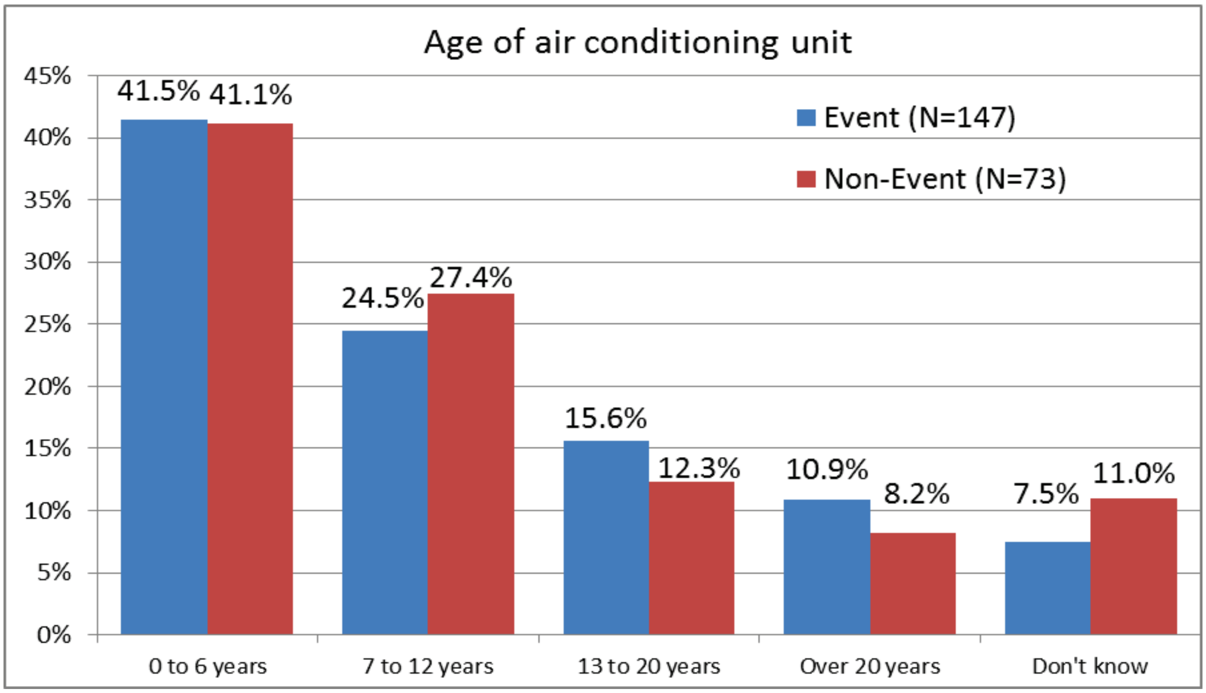

Figure 14. Air Conditioner Age

Figure 15 shows mean comfort ratings by age of air conditioner. Although participants with AC units more than 20 years old have slightly lower mean comfort ratings than participants with newer AC units, there is no statistically significant relationship between age of air conditioner and comfort levels before or during an event or high-temperature day.[4]

[4] The lack of significance is partly due to sample size: there were only 9 participants surveyed in the Carolinas who were at home during the event or high temperature day, who provided comfort ratings, and had AC units over 20 years old.

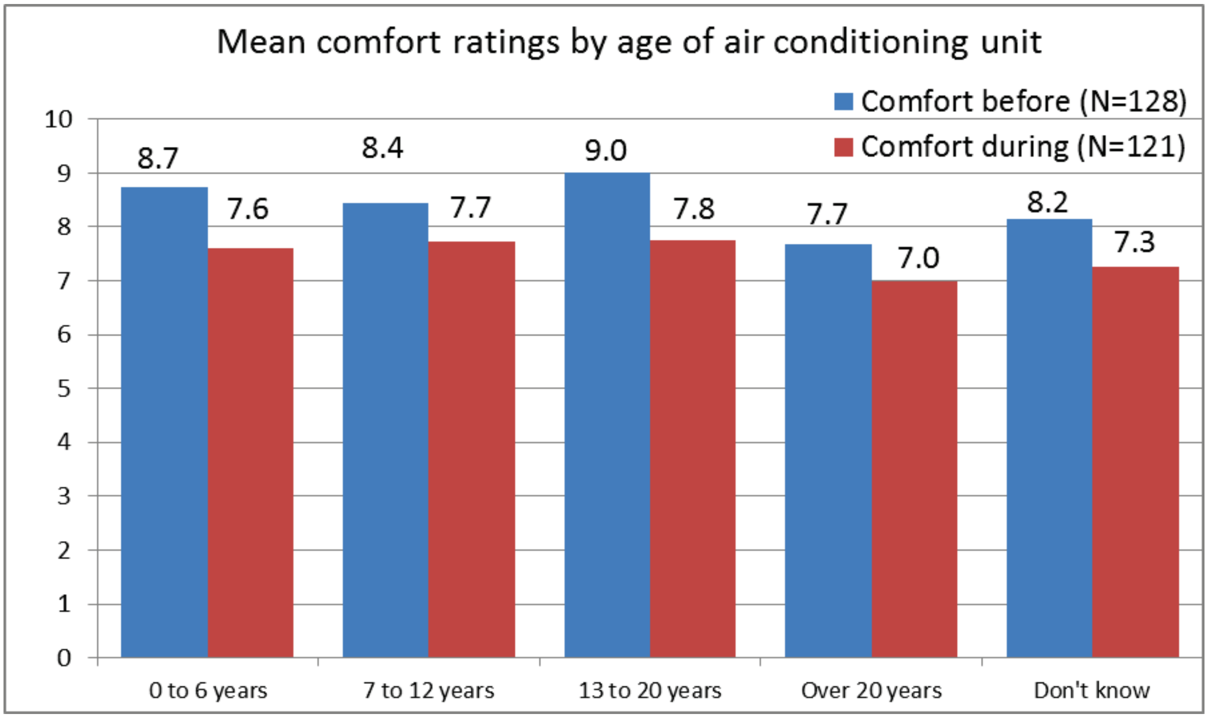

Figure 15. Mean Comfort Ratings by Air Conditioner Age
Note: Only respondents who were at home during an event or high temperature day gave comfort ratings.

The distribution of air conditioner ages is similar between Event and Non-Event participants, with about two-third of air conditioners in both groups being less than 12 years old (as seen in Figure 14). Cross-tabulating air conditioner age with comfort, and using age of air conditioner to predict a decrease in comfort (using a simple linear regression), yields the following line chart (Figure 16).

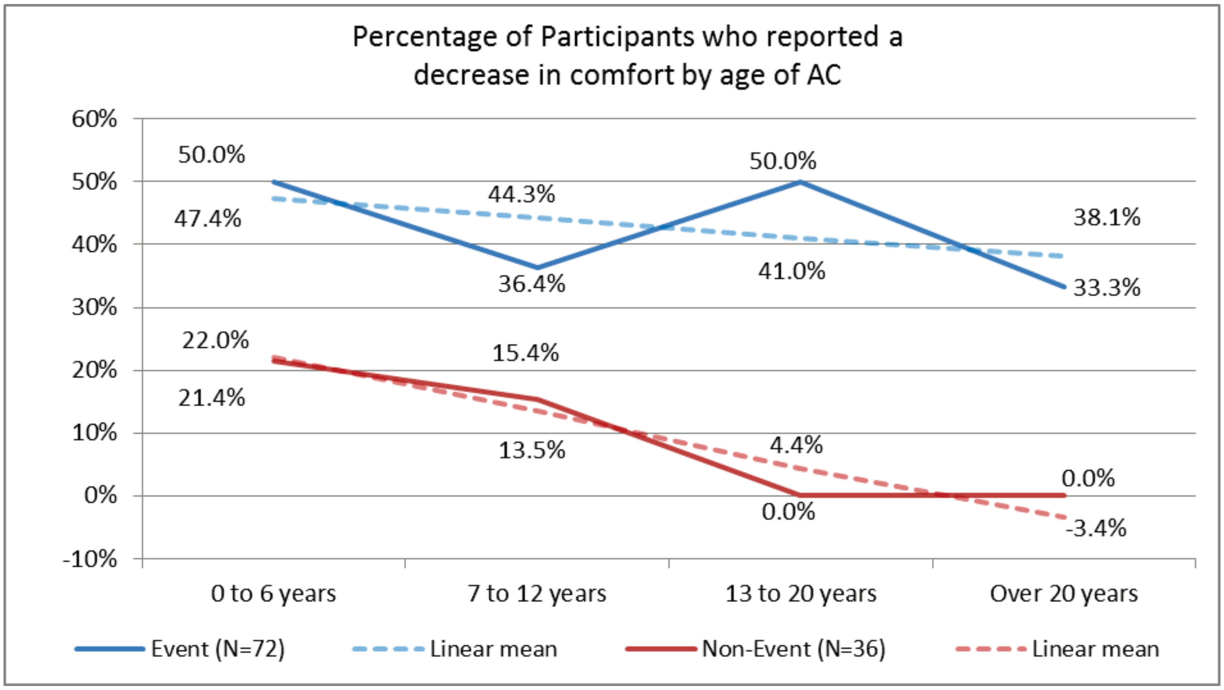

Figure 16. Comfort Decline vs. Air Conditioner Age

In Figure 16 the linear means (regression lines[5]) for the two survey subgroups show that age of air conditioner has no significant effect on discomfort during Power Manager activation events (the dotted blue line is close to a slope of zero), while age of air conditioner does not play a significant role in discomfort on hot days for the Non-Event group either (though the dotted red line has a slightly steeper slope). The effect of air conditioner age on comfort levels is not statistically significant for Event or Non-Event participants: age of AC unit explains only 5.5% of variance (R-squared) in change in comfort, and for Event participants age of AC unit explains 0.4% of variance (R-squared) in change in comfort. Neither of these regression lines is significantly different from a slope of zero (meaning no effect) at p<.10 or better.

However, recall from Figure 10 that activation of Power Manager on event days causes discomfort for significantly more Event participants overall (this is also indicated in Figure 16 because the dotted blue line is always higher than the dotted red line). Though the regression lines are not significant predictors at p<.10 or better, the negative slopes of these lines is somewhat counterintuitive (the models predict that there is slightly more discomfort for respondents with newer AC units than older ones). One interpretation of these results is that Power Manager neutralizes the advantage of newer air conditioners when it is activated – or in other words, older air conditioner units are less affected by Power Manager activation (because they are less effective in the first place) – though this would not explain decreases in comfort on non-event high temperature days (when Power Manager devices are not activated). It should also be noted that comfort ratings are fundamentally subjective measures (respondents with the same AC units may give different scores on the same temperature days; while respondents with

[5] Two regressions were run separately and plotted together, one for Event participants and one for Non-Event participants (dotted lines). Both regression models predict the percent of participants noticing a decline in comfort using only the age of air conditioner. Actual percentages noticing a decline in comfort by age of AC unit are also plotted for Event and Non-Event participants (solid lines).

different AC units on different temperature days may give identical ratings. These models do not account for any individual characteristics of respondents, which remain "unexplained variance.")

Figure 17 shows a similar analysis using the same model but predicting the amount of decline in comfort ratings (rather than whether or not there was a decline in comfort ratings[6]). The result for Non-Event participants in consistent with other findings: there is much less decline in comfort ratings on high temperature non-event days than during Power Manager activation events (the blue lines are always higher than the red lines).

These models again predict that the older the AC unit is, the *smaller* their decline in comfort will be on Event days (participants with AC units less than 6 years old reported their comfort declined by 1.77 points, versus just 1.00 points for those with AC units more than 20 years old). However, this seems consistent with the proposition that older air conditioner units are less affected by Power Manager activation (because they are less effective in the first place). If older AC units don't keep people as comfortable in the first place, then they have "less comfort to lose" during Power Manager events. Neither of the regressions in Figure 17 are statistically significant at p<.10 or better; the regression for Event participants explains 0.5% of variance, while the regression for Non-Event participants explains 3.3% of the variance in comfort ratings point decline.

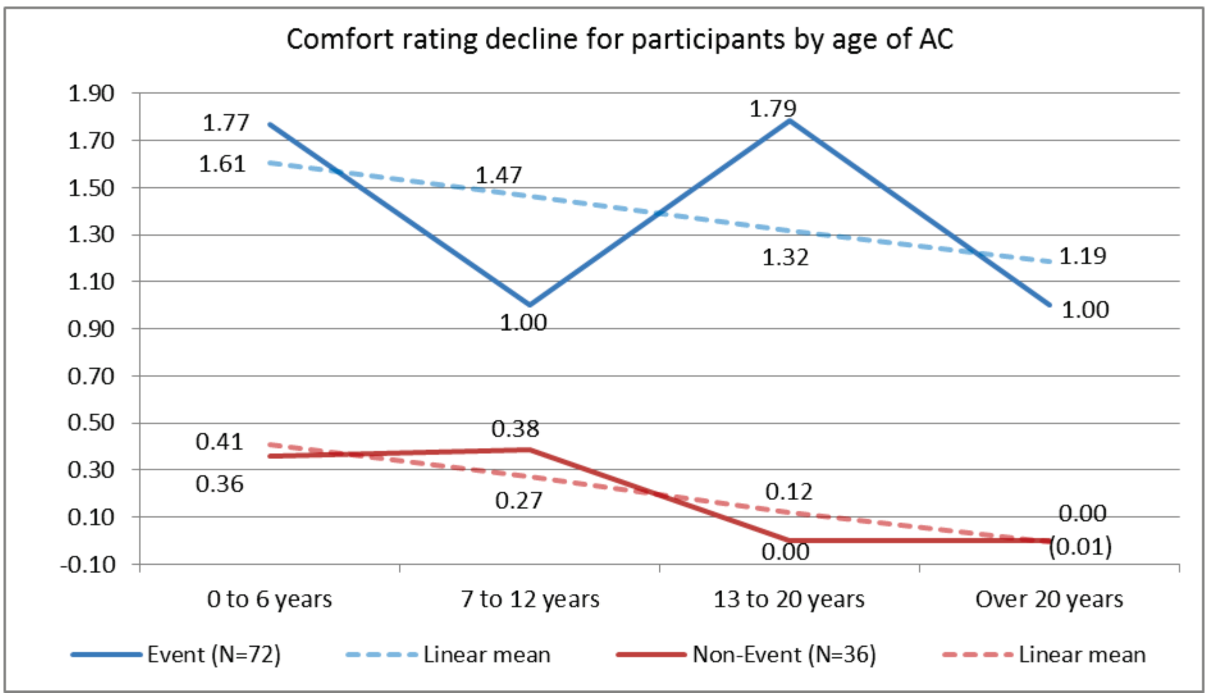

Figure 17. Comfort Ratings Point Decline vs. Air Conditioner Age

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[6] Two regressions were run separately and plotted together, one for Event participants and one for Non-Event participants (dotted lines). Both regression models predict the change in comfort ratings on a 10-point scale using only the age of air conditioner. Actual mean decline in comfort rating points (on a 10-point scale) by age of AC unit are also plotted for Event and Non-Event participants (solid lines).

Age of Air-Conditioner and Change in Comfort Levels During Event: Controlling for Outdoor High Temperatures

TecMarket Works also used regression analysis to predict changes in comfort level taking both age of air conditioner and the high temperature on the event day (or non-event high temperature day) into account[7]. This analysis allows us to separate the effects of the outdoor temperature and the age of the air conditioner unit; the results are shown in Figure 18.

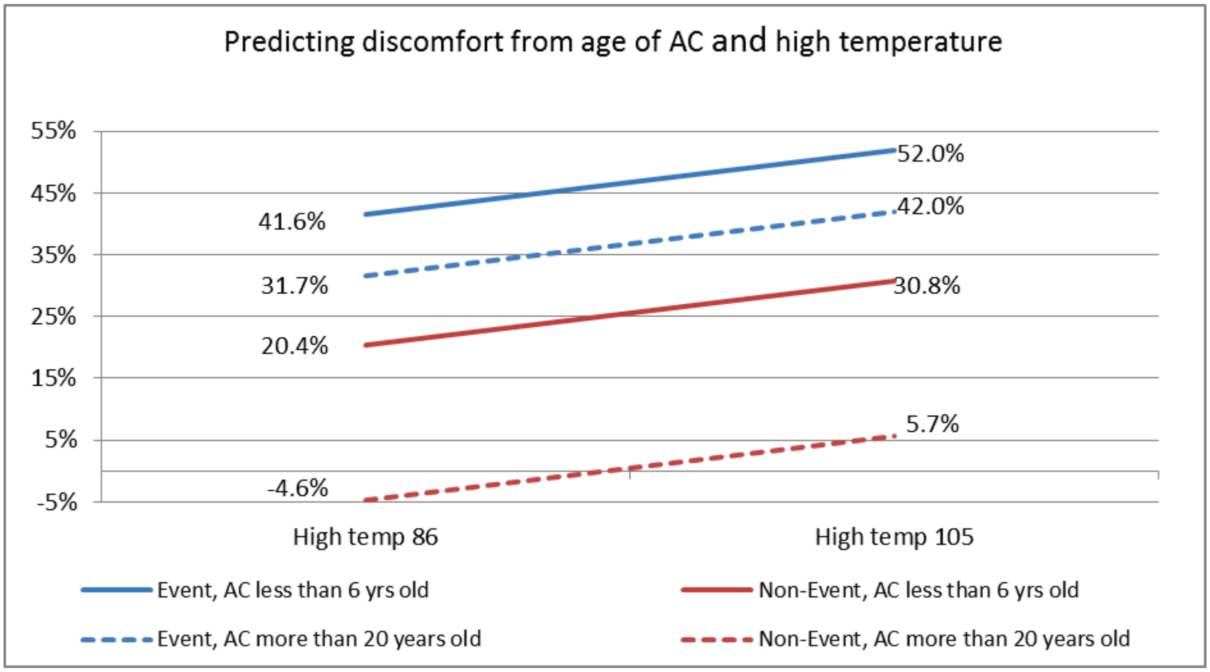


Figure 18. Comfort Change vs. Air Conditioner Age and High Temperature

Figure 18 indicates that the age of the air conditioner unit is related to increasing discomfort for Non-Event participants, but has less effect on comfort changes for Event participants – even when controlling for differences in outdoor temperature. Among households with an air conditioner 6 years old or less (solid lines), Event participants were about twice as likely to report a decline in comfort (predicted 41.6% of Events and 20.4% of Non-Events at 86 degrees, and 52.0% of Events and 30.8% of Non-Events at 105 degrees). For those with AC units more than 20 years old, the differences are even greater (predicted 31.7% for Events and negative[8] 4.6% for Non-Events at 86 degrees, 42.0% for Events and 5.7% for Non-Events at 105 degrees).

The fact that the two blue lines are relatively close together, while the two red lines are farther apart, is another indication that the age of the AC unit has less effect on comfort ratings for

[7] One regression was run, predicting the percent of participants noticing a decline in comfort using the following predictors: outdoor high temperature, age of AC unit, Event vs. Non-Event, and an interaction term for Event-by-age-of-air-conditioner. The interaction term allows the effect of age of air conditioner to vary for Event and Non-Event participants. The chart only plots the predicted regression lines (not the actual distributions).

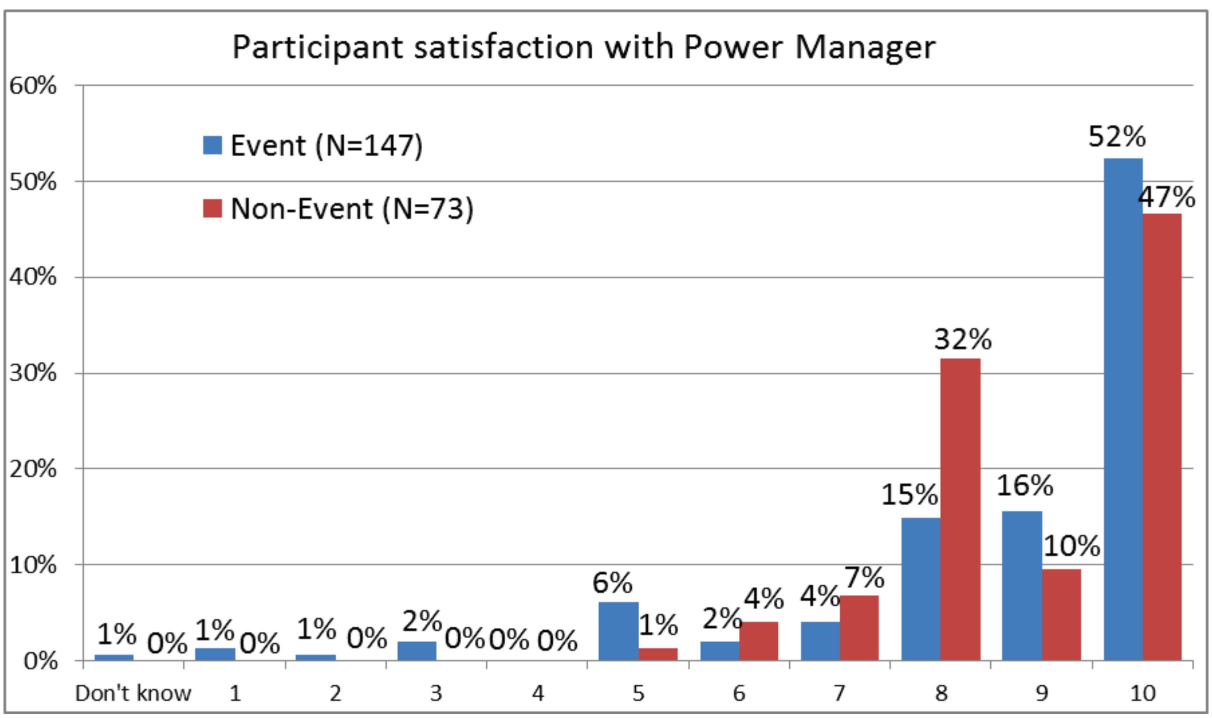
[8] There were no Non-Event participant surveys conducted for days where the temperature was over 91 degrees, and all Event surveys were conducted on days where the temperature was 92 degrees or higher. Since this is a linear regression, the model can predict negative percentages for values at the extreme of the distribution. (Though logically, the number of participants who say their comfort level declined cannot be less than 0%).

participants during a Power Manager activation event. Furthermore, the differences between predicted levels of discomfort at 86 degrees and 105 degrees (about 10%) are less than the differences predicted newer vs. older AC units (about 10% to 25%) or Event vs. Non-Event (about 20% to 35%). This indicates that the effect of outdoor temperature is less of a factor in participant comfort compared to the age of their AC unit, and especially compared to whether or not Power Manager was activated. The standardized coefficients[9] from the regression model also indicate that temperature is less important than age of AC or the occurrence of Power Manager events: temperature had the least effect (beta=0.059) of any predictors in the model, while the presence of a Power Manager event had the most (beta=0.189), and age of air conditioner had the second-largest effect (beta=0.172).

The regression model in Figure 18 explains 10.6% of the variance (R-squared) in comfort decline, and overall is significant at $p<.05$ using ANOVA (though none of the individual predictors by themselves are significant at $p<.10$ or better).

Respondent Satisfaction and Willingness to Recommend the Program

Participants' satisfaction with the Power Manager program is high with an overall mean of 8.75 on a 10-point scale with "1" being not at all satisfied and "10" being very satisfied, and about half (50.5% or 111 out of 220) of participants rating their satisfaction with Power Manager a "10 out of 10". Event respondents' mean satisfaction with Power Manager is 8.71 while the mean for Non-Event respondents is 8.84 (difference between these groups are not statistically significant). The distribution of ratings is shown in Figure 19 below.



[9] The standardized coefficient (also known as beta) is rescaled so that variance equals 1.0. This allows the effect of variables scaled in different units (such as years and degrees) to be compared with each other.

Figure 19. Distribution of Power Manager Satisfaction Ratings

Participants in the event survey were also asked to rate the likelihood that they would recommend Power Manager to a friend or colleague on a 10-point scale where "1" means "very unlikely" and "10" means "very likely". Just over half (51.4% or 113 out of 220) of participants surveyed rated their likelihood of recommending the program at "10 out of 10", and the mean rating for likelihood of recommending the program was 8.50 overall. By subgroups, the mean recommendation rating was 8.38 among Event participants and 8.73 among Non-Event participants (differences between these groups are not statistically significant). Responses to this question are shown in Figure 20.

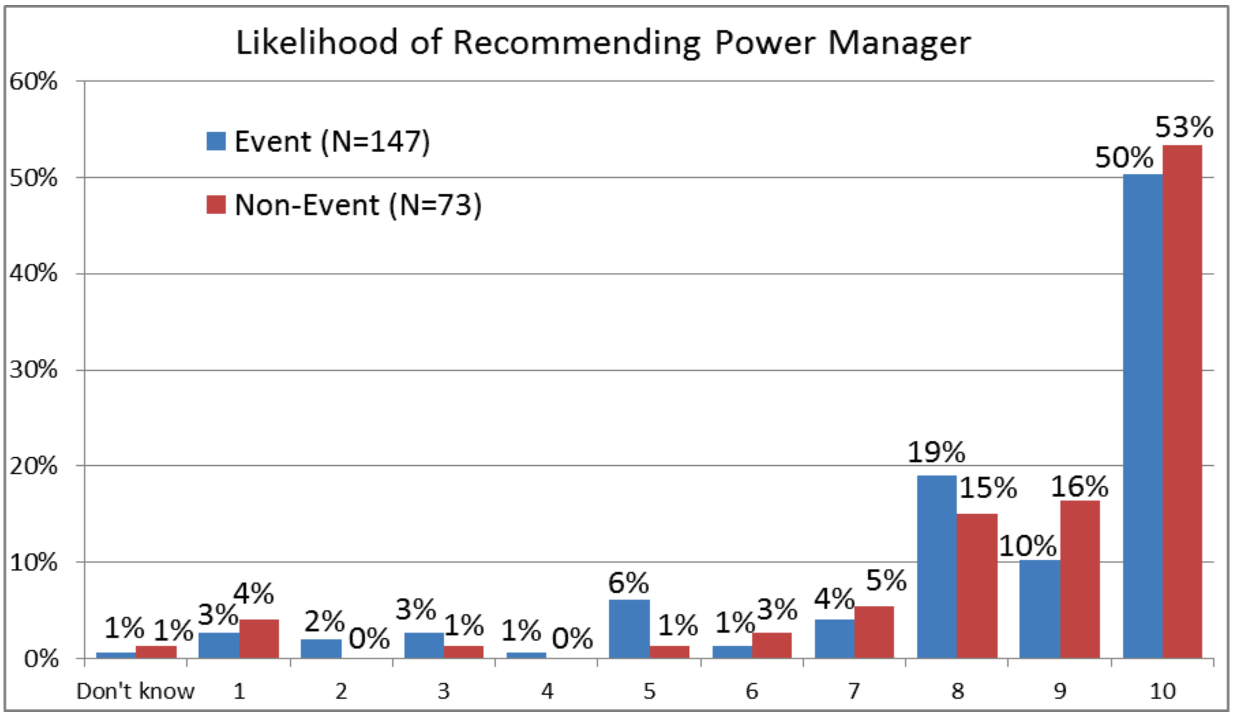


Figure 20. Distribution of Likelihood Ratings for Recommending Power Manager

Participants' overall satisfaction with Duke Energy is also high with an overall mean of 8.77 on a 10-point scale with "1" being not at all satisfied and "10" being very satisfied, and almost half (45.9% or 101 out of 220) of participants rating their satisfaction with Duke Energy a "10 out of 10". Event respondents' mean satisfaction with Duke Energy is 8.75 while the mean for Non-Event respondents is 8.79 (difference between these groups are not statistically significant). The distribution of ratings is shown in Figure 21 below.

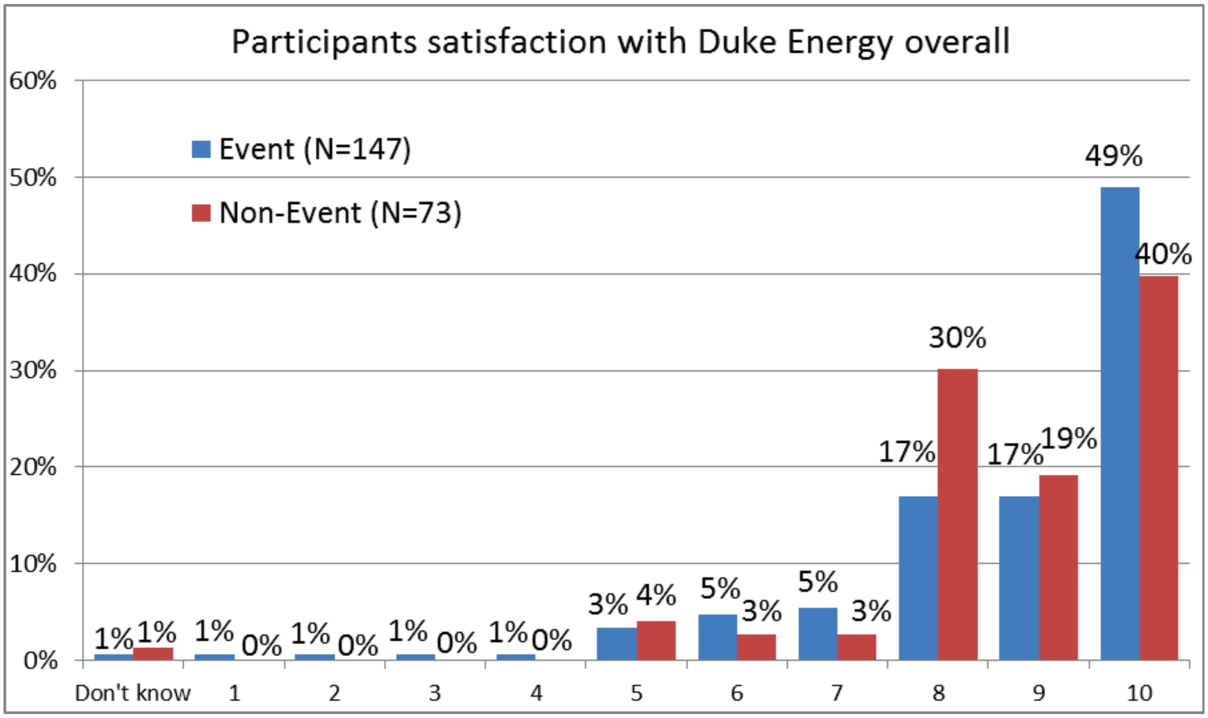


Figure 21. Distribution of Duke Energy Overall Satisfaction Ratings

Satisfaction with Power Manager When the Device Was Installed by Previous Occupants

Thirty-four participants surveyed (15.5% of 220) were not the occupant of their home when Power Manager was installed. The overall mean satisfaction ratings of participants who "inherited" the device from a previous owner are slightly lower than for those who joined the program themselves, though the only statistically significant difference is for likelihood of recommending the program at p<.10 using ANOVA. Table 11 shows the mean ratings for these three questions.

Table 11. Power Manager Installed by Previous Occupant: Awareness of Activation in Past Seven Days

Mean ratings on 10-point scale (10 is highest, 1 is lowest)	**Not the original occupant who signed up for Power Manager (N=34)**	**Original occupant who signed up for Power Manager (N=186)**
Satisfaction with Power Manager	8.38	8.82
Likelihood of recommending Power Manager to a friend or colleague	7.85	8.62
Satisfaction with Duke Energy	8.68	8.78

Note: Event and Non-Event participants are combined in this table.

Figure 22 shows the complete distribution for participant satisfaction with Power Manager. Though the overall means are not significantly different, 14.7% (5 out of 34) of participants who inherited a previous installation rated the program a "5" or lower on a ten point scale, compared to just 5.9% (11 out of 186) of those who joined the program themselves (this difference is significant at p<.05 using student's t-test).

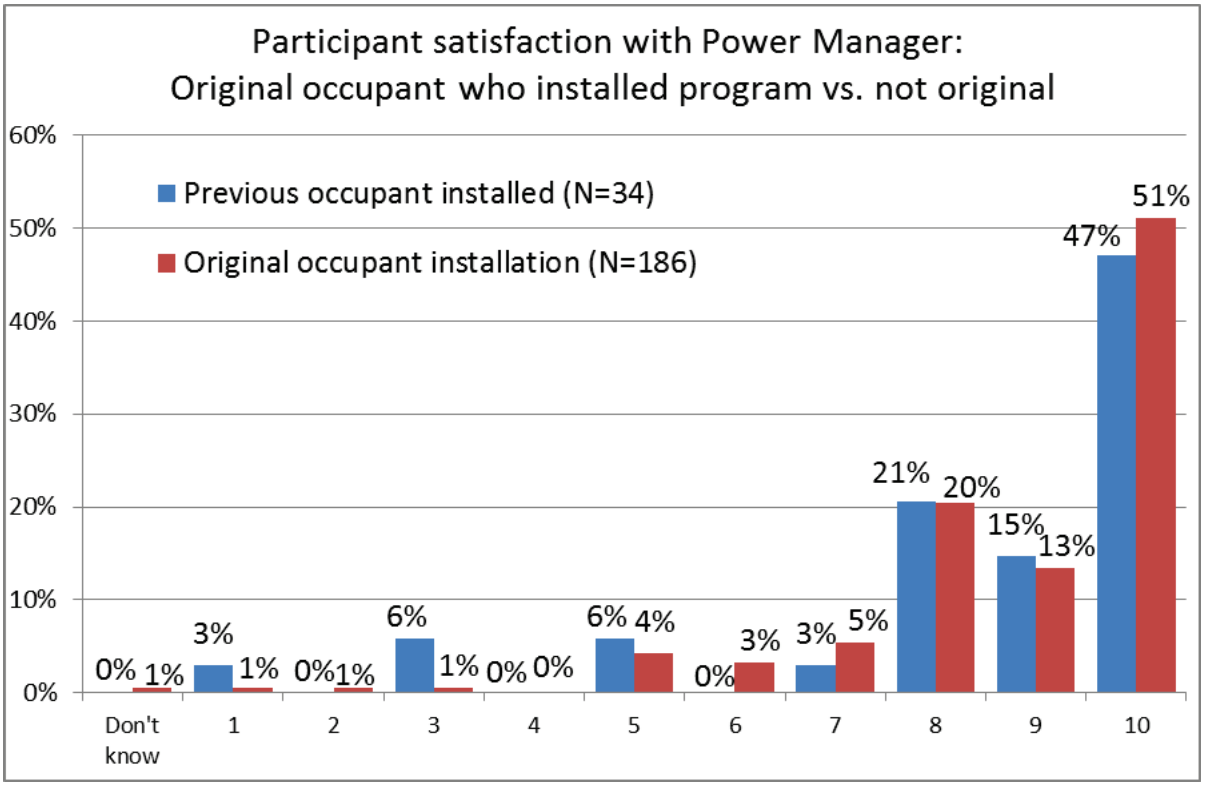


Figure 22. Satisfaction with Power Manager Program by Installing Occupant
Note: Event and Non-Event participants are combined in this chart.

Likelihood of recommending the program was the ratings question with the largest difference between groups. Among those who were not the occupant who originally installed Power Manager, 23.5% (8 out of 34) said their likelihood of recommending the program was a "5" or less on a 10-point scale, versus only 9.7% (18 out of 186) of participants who were the original installers giving a recommendation rating of "5" or less; this difference is significant at p<.05 using student's t-test.

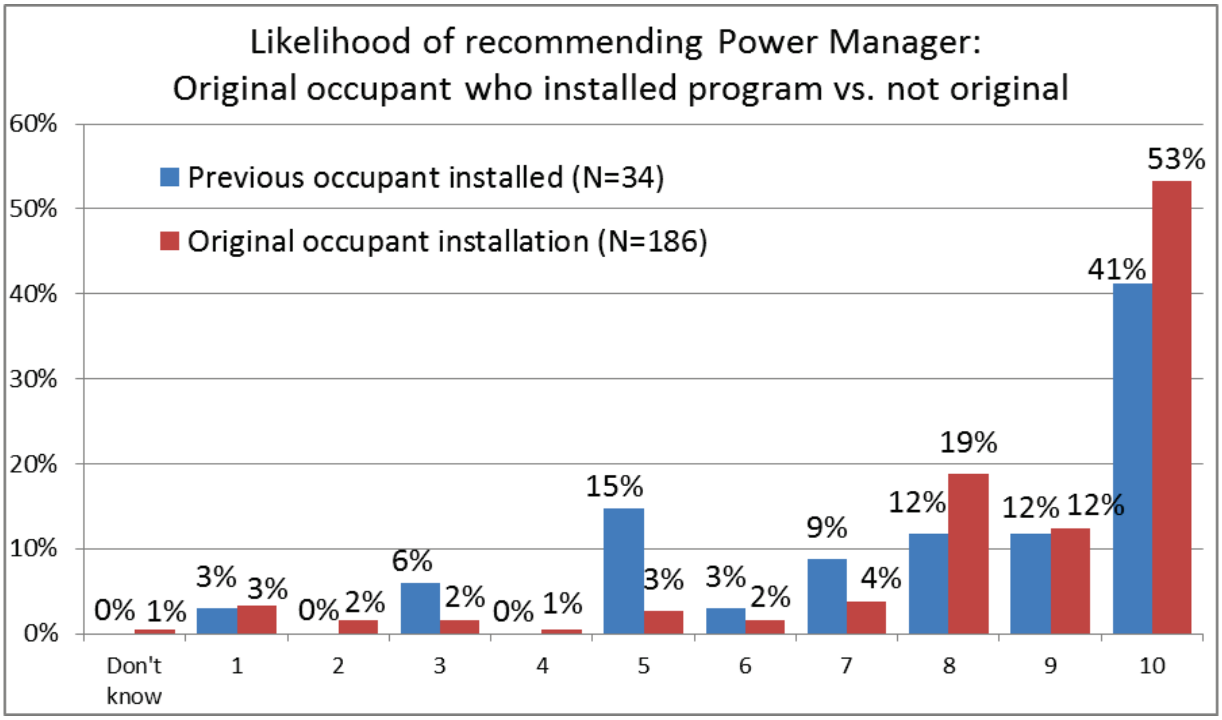


Figure 23. Likelihood of Recommending Power Manager Program by Installing Occupant
Note: Event and Non-Event participants are combined in this chart.

Exploring Factors that Affect Comfort Ratings

High Temperature Correlations with Comfort Levels

There is no significant overall correlation (Pearson Correlation = -0.035) between a surveyed participant's comfort level before the event or high temperature day and the temperature[10] on the day in question, regardless of whether there was an event or not . This indicates that people are comfortable in their homes with their temperature settings before an event or high temperature day. However, there is a significant correlation (Pearson Correlation = -0.255 and statistically significant at the $p<.01$ level) between a surveyed participant's comfort level and the temperature during the event or high temperature period. This indicates that the hotter it is outside on event days (or high temperature non-event days), the less comfortable respondents are in their homes.

Finally, looking at reported change in comfort levels compared to the high temperature for the day in question reveals a smaller significant correlation (Pearson Correlation = 0.154 and statistically significant at $p<.05$ level). This indicates that the outdoor temperature has a significant effect on whether a Power Manager participant in the Carolinas will become less comfortable during an event or high temperature day.

[10] Heat Index is very highly correlated with High Temperature (Pearson Correlation = 0.942 which is significant at $p<.01$), and correlates with measures of respondent comfort at the same levels that High Temperature does. Therefore only High Temperature correlations are reported in this section.

Comfort Ratings by High Temperature

Figure 24 and Figure 25 show mean comfort ratings before and during Power Manager events and non-event high temperature days by the outdoor high temperature on that day (the schedule of events and non-events and corresponding high temperatures and heat index readings can be found in Table 1). As seen previously (such as in Figure 10), non-event high temperature days have little effect on participants' comfort levels (small differences between red and blue bars at every temperature level), while Power Manager activation events do cause a significant decrease in comfort ratings.

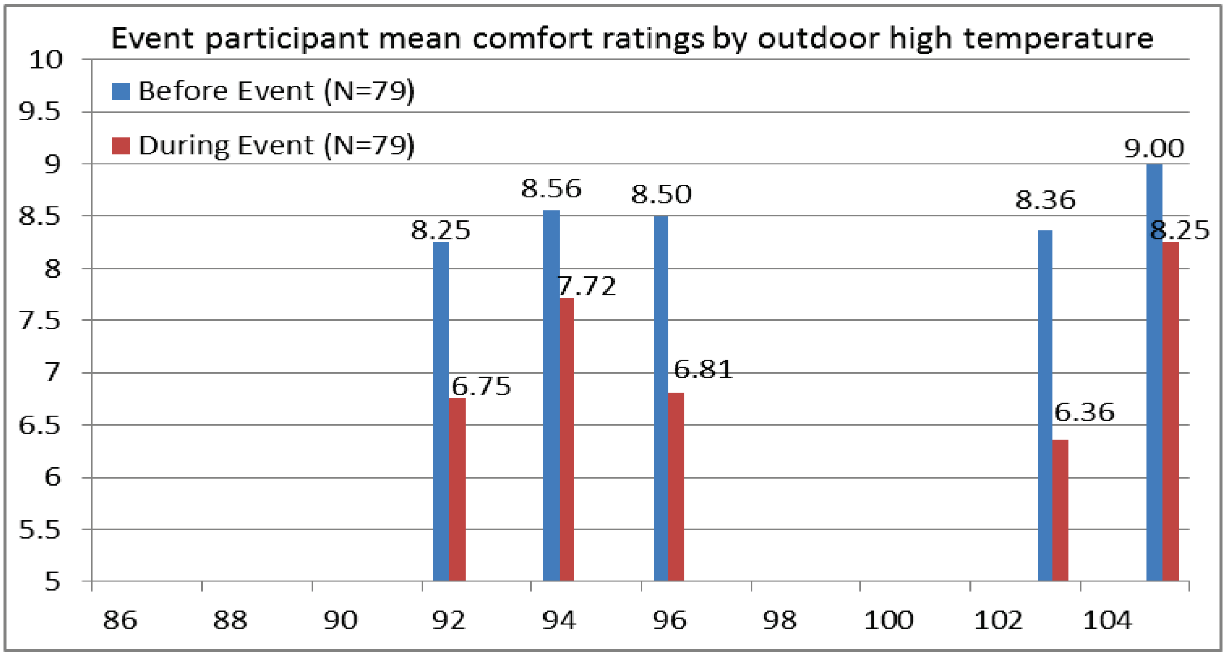


Figure 24. Comfort Ratings Before and During Events by Outdoor High Temperature (N=79)

Note: Only respondents who were at home during the event and who provided both comfort ratings are included in this chart.

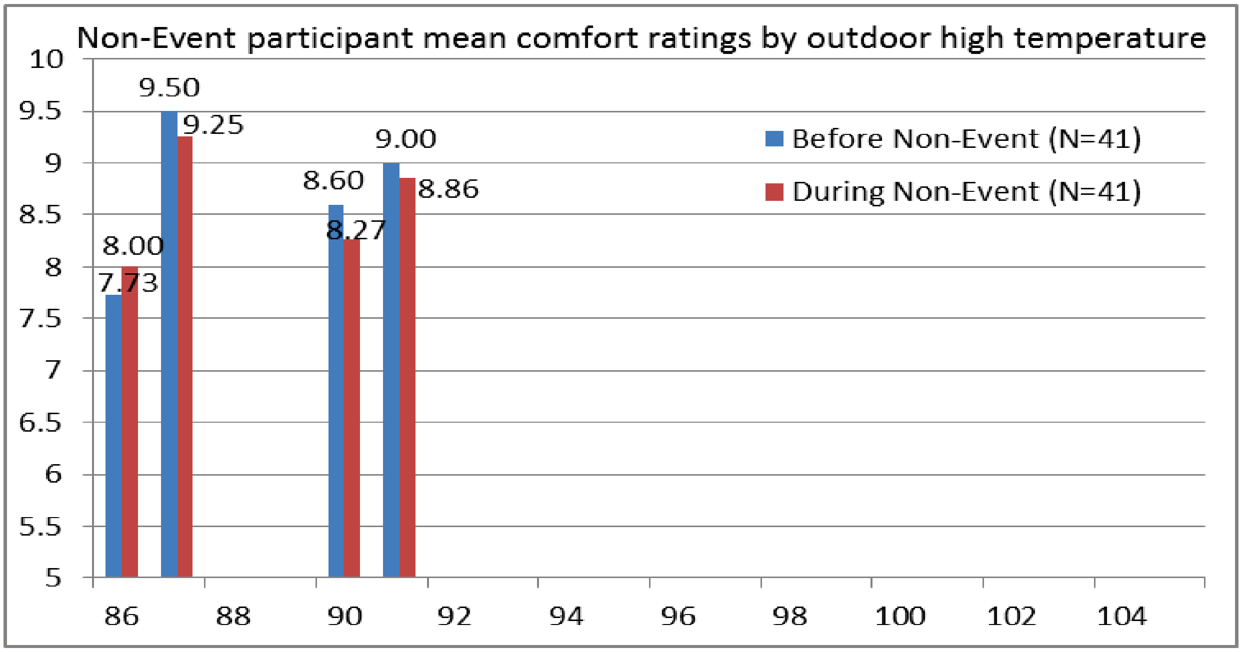


Figure 25. Comfort Ratings Before and During Non-Events by Outdoor High Temperature (N=41)

Note: Only respondents who were at home during the event and who provided both comfort ratings are included in this chart.

Figure 26 and Figure 27 show the same mean comfort ratings by three outdoor high temperature ranges. Power Manager Events decrease comfort for every temperature category, and the decrease appears to be greater when the temperature is highest (comfort rating was 6.78 during events on days when the temperature was 99 or higher, compared to 7.18 on days when the temperature was 92 to 98 degrees; though this difference is not statistically significant). For Event participants, the difference between "before" and "during" comfort levels was statistically significant at the $p<.01$ level using ANOVA (for both temperature ranges shown).

Mean "before" ratings for Event and Non-Event participants as categorized in these two charts range from 8.50 to 8.61, and there are no statistically significant differences by temperature level or Event vs. Non Event.

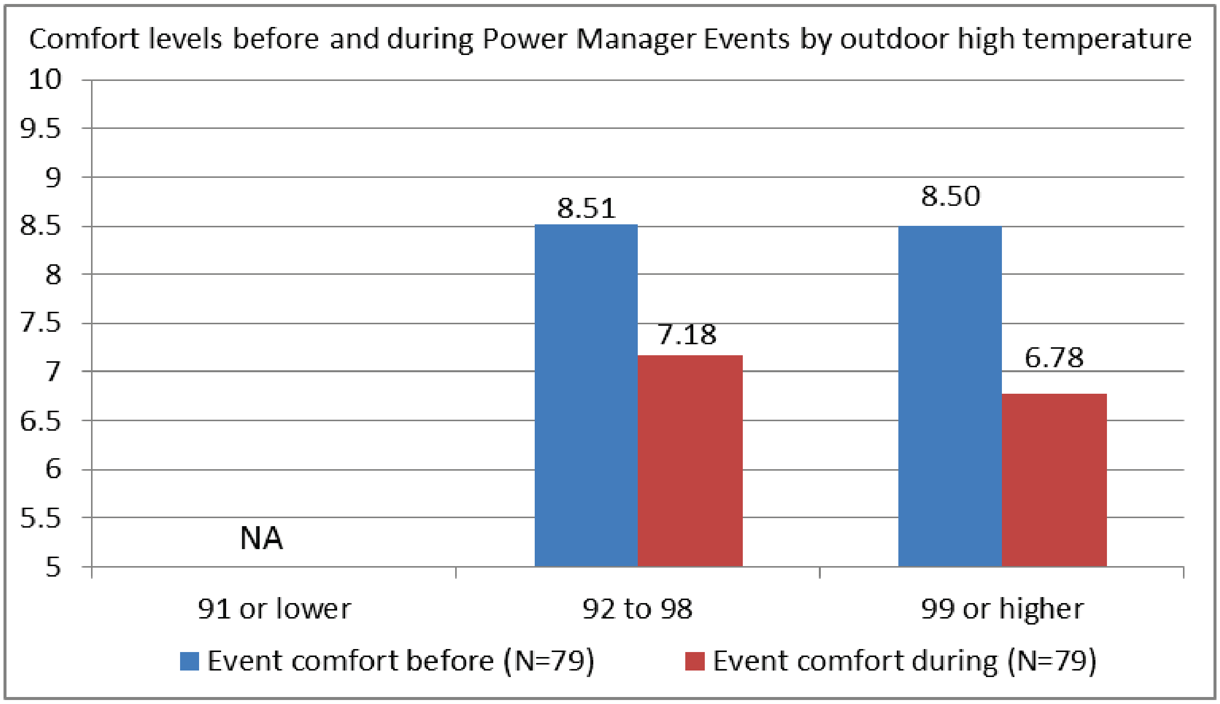


Figure 26. Comfort Ratings Before and During Events by Outdoor High Temperature (N=79)

Note: There were no Event days in the Carolinas where the outdoor temperature was 91 degrees or less. Only respondents who were at home during the event and who provided both comfort ratings are included in this chart.

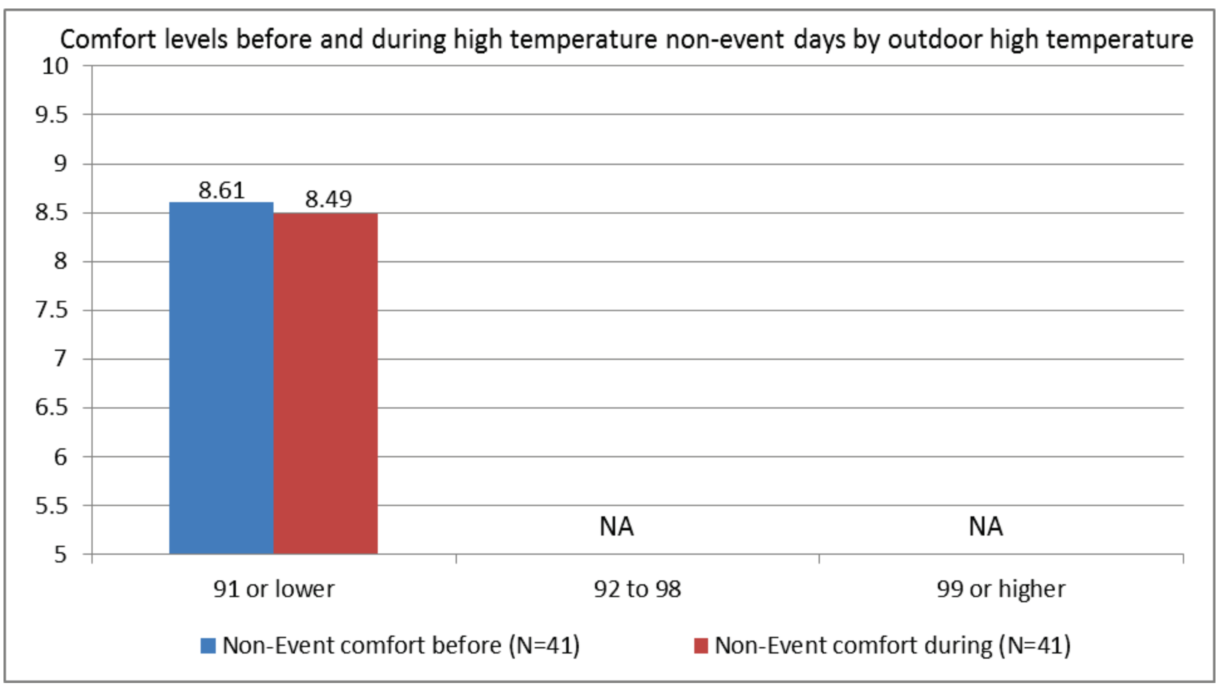


Figure 27. Comfort Ratings Before and During Non-Events by Outdoor High Temperature (N=41)

Note: There were no non-event high temperature days in the Carolinas where the outdoor temperature was 92 degrees or higher. Only respondents who were at home on the non-event high temperature day and who provided both comfort ratings are included in this chart.

Figure 28 shows the percentage of participants who reported a decline in comfort ratings during an event or non-event high temperature day. The percentage of participants who reported a decline in comfort during Power Manager events is remarkably consistent across outdoor temperature levels (43% to 44%), and is significantly greater (p<.05 using student's t-test) than the percentage of Non-Event participants reporting a decline in comfort on non-event high temperature days (15%, only about one-third as likely as for Event participants).

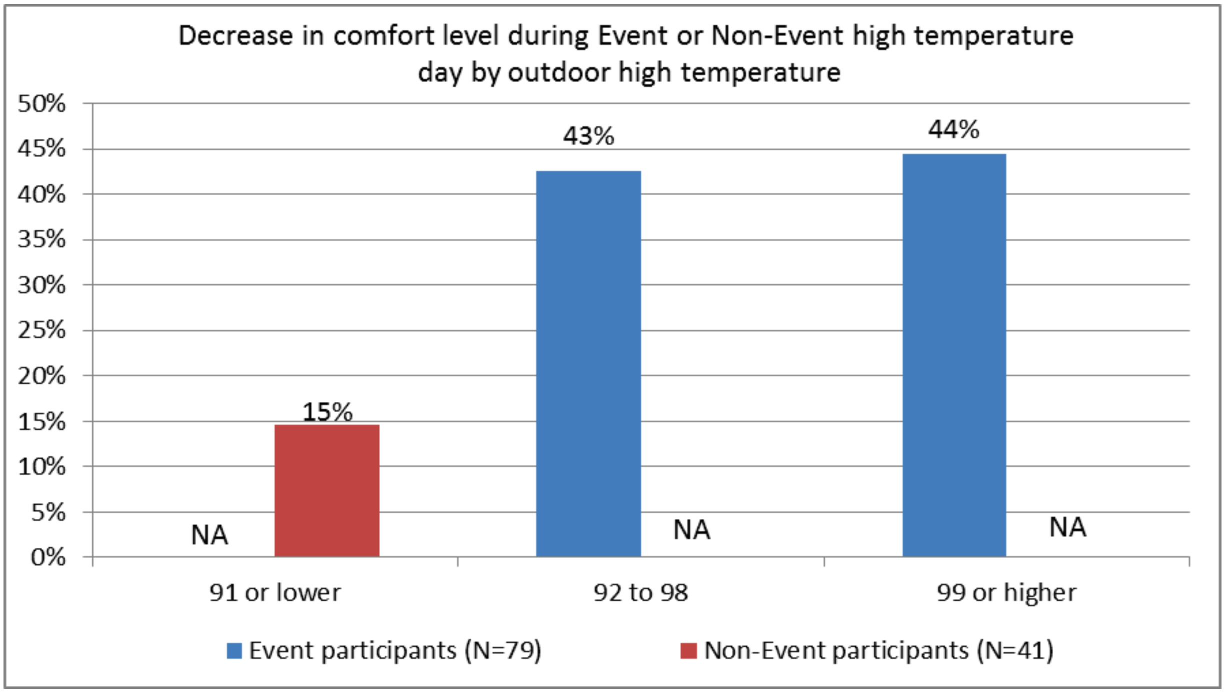


Figure 28. Decrease in Comfort by Outdoor High Temperature (total N=120)
Note: There were no non-event high temperature days in the Carolinas where the outdoor temperature was 92 degrees or higher, and no Power Manager activation event days where the temperature was 91 degrees or lower.

Comfort Ratings by Thermostat Settings

Event participants were more likely to notice a change in comfort during Power Manager events than Non-Event participants were to notice a change on a high temperature non-event day. However, the magnitude of the change for Event participants in the Carolinas was greatest for those who set their thermostats to 73 to 75 degrees, as seen in Figure 29.

Eleven Event participants had their thermostats set at 72 degrees or lower and their mean comfort ratings declined from an initial 7.82 before the event (significantly lower than groups with higher thermostat settings at p<.10 using ANOVA) to 7.09 during the event (not a statistically significant decline). While 24 participants had their thermostats set at 73 to 75 degrees and reported the largest decline in comfort; their mean comfort ratings fell from 8.88

before the event to 6.75 after the event (significant at p<.01 using student's t-test). For Event participants who had their thermostats set to between 76 and 78 degrees, or 79 degrees or higher, the decline in mean comfort ratings from "before" to "during" was significant at p<.05 or better (using student's t-test).

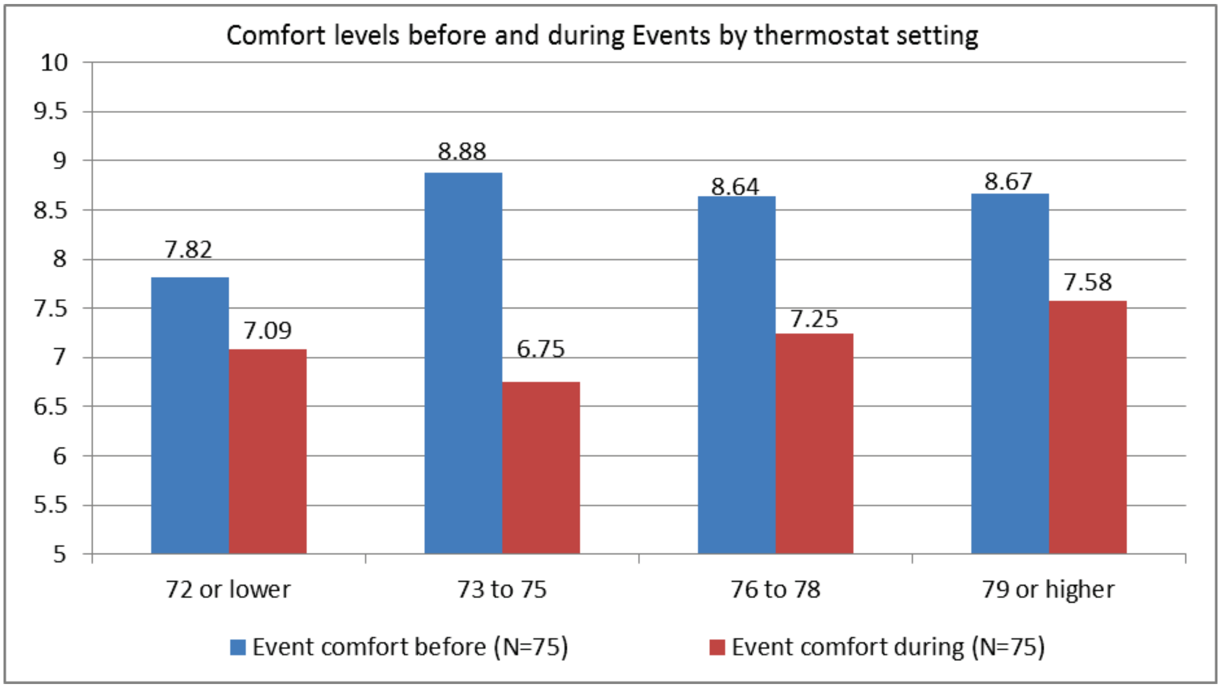


Figure 29. Changes in Comfort by Thermostat Settings – During Power Manager Events (N=75)

Changes in comfort ratings for Non-Event participants on high temperature days are shown in Figure 30. For these participants, there were no significant changes in comfort ratings from "before" to "during" at any thermostat level (although Non-Event participants who set their thermostats to 72 or lower were significantly more comfortable than those who set their thermostats to 73 to 75 degrees, at p<.05 using ANOVA).

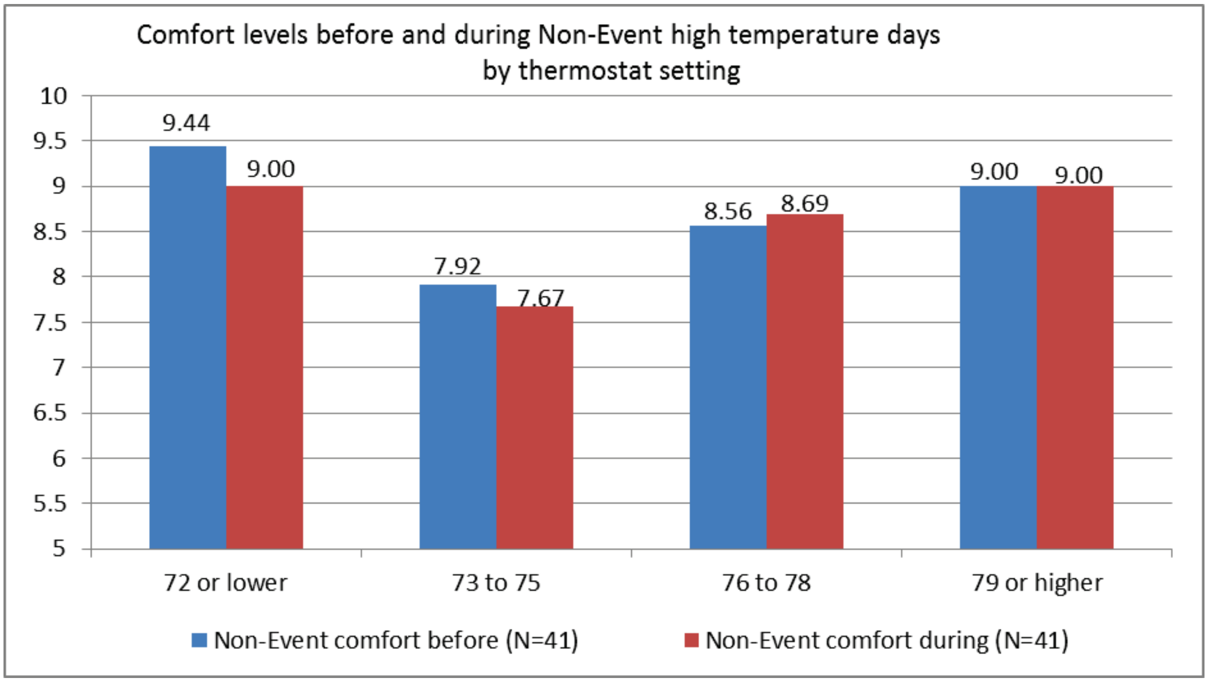


Figure 30. Changes in Comfort by Thermostat Settings – During High Temperature Non-Events (N=41)

Thermostat Settings by Age of Air Conditioner

There is no statistically significant relationship between the age of a participant's air conditioning unit and the temperature at which they had their thermometers set to during an event or non-event high temperature day. At least two-thirds of participants set their thermostats between 73 and 78 degrees regardless of the age of their air conditioning unit, as seen in Figure 31.

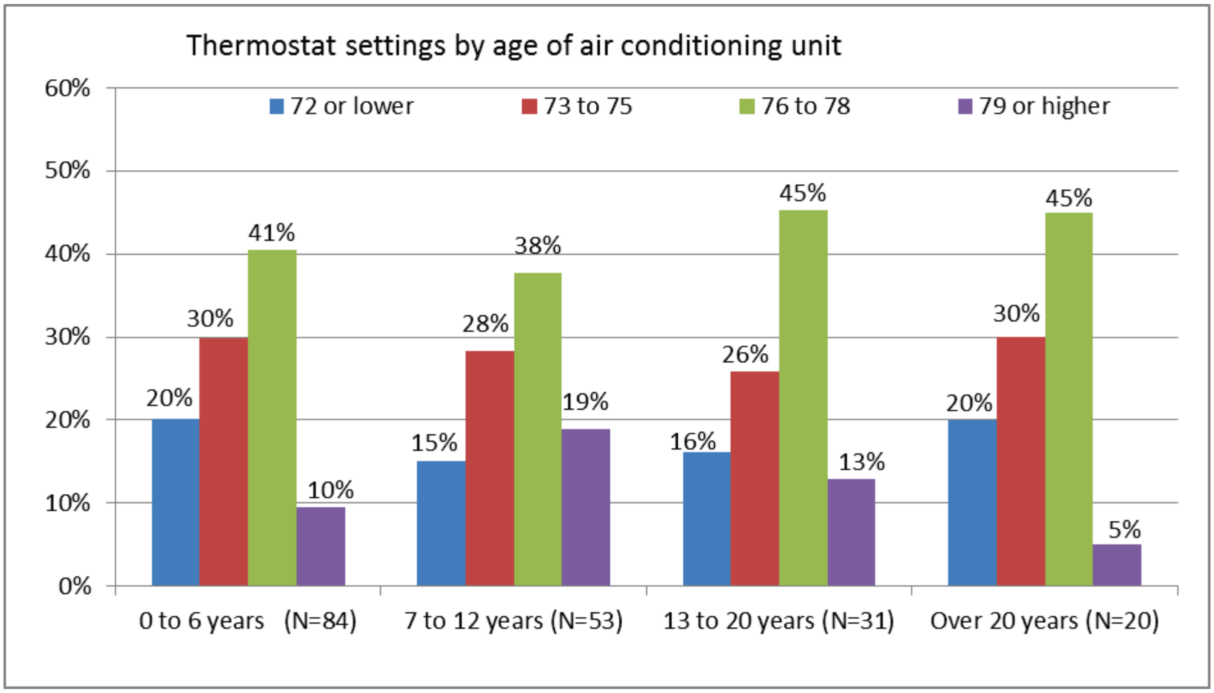


Figure 31. Thermostat Settings by Age of Air Conditioning Unit (Event and Non-Event Participants Combined)

Note: Only respondents who were able to specify thermostat settings and ages of air conditioning units are included in this chart (total N=188).

Appendix A: Event Survey Instrument

Use two attempts at different times of the day within 27 hours of event notification before dropping contact from the contact list. Call times are from 10:00 a.m. to 8:00 p.m. EDT or 9-7 CDT Monday through Saturday. No calls on Sunday. For example, if a control event occurs on a Monday, calling hours for that particular event would be:

Monday 5pm-8pm Eastern (4-7 Central)
Tuesday 10am-8pm Eastern (9-7 Central)

Note: Only read words in bold type, Italics are instructions.

State
( ) Indiana
( ) Ohio
( ) Kentucky
( ) North Carolina
( ) South Carolina

Info
Survey ID: __________________________
Event ID: __________________________
Surveyor Name: __________________________

Option
( ) 1.0 kW
( ) 1.5 kW

Introduction
On the first call attempt
Hello, my name is _____, and I'm calling on behalf of Duke Energy. According to our information, you presently participate in Duke Energy's Power Manager Program. This program allows Duke Energy to cycle your air conditioner when there is a critical need for electricity in the region. This is a short survey that will take about 5 minutes to complete, and the information you provide will be confidential and will help to improve the program.

On the second and final call attempt
Hello, this is _____ calling again on behalf of Duke Energy, with a survey about their Power Manager Program. This is my last attempt to reach you. Sorry for any inconvenience.

1. Are you aware of your participation in the Power Manager program?
( ) Yes
( ) No
( ) DK/NS

If no, **May I please speak to the person who would be most familiar with your household's participation in the Power Manager program?**
If not available, try to schedule a callback time within the 27 hour time-frame for the particular event. If transferred, begin survey from beginning (Introduction).

2. Has Duke Energy activated the Power Manager device since you joined the program?
*[If they ask what this means, respond with: "***Duke Energy has the ability to send a signal to activate the device to cycle your central air conditioner on and off during an event***." Then repeat the question.]*
( ) Yes
( ) No
( ) DK/NS

3. How do you know when the device has been activated?
[ ] A/C shuts down
[ ] Home temperature rises
[ ] The light on the meter is on
[ ] Light on AC unit flashes
[ ] Bill credits
[ ] Lower bill
[ ] Other: _________________
[ ] DK/NS

4. Has your device been activated within the last 7 days?
( ) Yes
( ) No
( ) DK/NS

(Ohio only)
5. If you were rating your overall satisfaction with the Power Manager Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?
( ) Very Satisfied
( ) Somewhat Satisfied
( ) Neither Satisfied nor Dissatisfied
( ) Somewhat Dissatisfied
( ) Very Dissatisfied
( ) Refused
( ) DK/NS

(Ohio only)
5a. Why do you give it that rating?

Your Power Manager device was recently activated on {*date*} starting at {*start time*} and ending at {*end time*}.

6. At what temperature was your thermostat set to during the time of the event?
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees
( ) 98-100 degrees
( ) greater than 100 degrees
( ) It's programmed into the thermostat
( ) Thermostat was turned off
( ) Air conditioner was turned off
( ) DK/NS

7. Were you or any members of your household home when Duke Energy activated your Power Manager device at that time?
( ) Yes
( ) No
( ) DK/NS

If no or don't know, skip to question 14.

8. During this recent activation, using a scale of 1 to 10 where 1 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort <u>before</u> the control event?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

9. Using the same scale of 1 to 10 where 1 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort <u>during</u> the control event?
( ) 1
( ) 2

( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

Ask question 10 if score from question 9 is lower than score from question 8:
(Select all that apply.)
10. What do you feel caused your decrease in comfort?
[ ] Power Manager
[ ] Rising Temperature
[ ] Rising Humidity
[ ] Power Outage
[ ] Other: _________________
[ ] DK/NS

11. When Duke Energy activated your Power Manager device *{today or yesterday}*, **did you or any other members of your household adjust the settings on your thermostat?**
( ) Yes
( ) No
( ) DK/NS

If yes to question 11,
NOTE: enter a numeral for a temperature, or DK if not sure.
11a. What temperature was it originally at, and what temperature did you set it to during the control event?
Original temperature setting (degrees F): _________________________
Adjusted temperature setting (degrees F): _________________________

12. When Duke Energy activated your Power Manager device, did you or any other members of your household turn on any fans to keep cool?
( ) Yes
( ) No
( ) DK/NS

13. What else did you or other members of your household do to keep cool?
[ ] Continued normal activities/ Didn't do anything different
[ ] Turned on room/window air conditioners
[ ] Closed blinds/shades
[ ] Moved to a cooler part of the house
[ ] Left the house and went somewhere cool
[ ] Wore less clothing

[ ] Drank more water/cool drinks
[ ] Turned on fans
[ ] Opened windows
[ ] Other: _________________
[ ] DK/NS

Now I'm going to ask you some questions about your air conditioning use.

14. How often do you use your central air conditioner? Would you say you use it ...
(Read first 5 answers aloud, stop when they answer.)
[ ] **Not at all**
[ ] Only on the hottest days
[ ] Frequently during the cooling season
[ ] Most days during the cooling season
[ ] Everyday during the cooling season
[ ] DK/NS

15. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm?
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees
( ) 98-100 degrees
( ) greater than 100 degrees
( ) DK/NS

16. At what <u>outside temperature</u> do you tend to turn on the air conditioner?
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees

( ) 98-100 degrees
( ) greater than 100 degrees
( ) It's programmed into the thermostat
( ) DK/NS

17. How old is your air conditioner?
( ) 0 to 6 years old
( ) 7 to 12 years old
( ) 13 to 20 years old
( ) over 20 years old
( ) DK/NS

18. Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with the Power Manager program?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10

If 7 or below ask,
18b. Why are you less than satisfied with Power Manager?
(Select all that apply)
[ ] They activated my Power Manager device more often than I would like
[ ] The bill credits/incentives were not large enough
[ ] I was uncomfortable when my Power Manager device was activated
[ ] Other: _________________
[ ] DK/NS

19. Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with Duke Energy?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10

If 7 or below,
19b. Why are you less than satisfied with Duke Energy?

20. Using a scale of 1 to 10, where 1 means "Extremely Unlikely" and 10 means "Extremely Likely", how likely is it that you would recommend this program to a friend or colleague?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10

If 7 or below,
20a. Why would you not recommend the program?

21. Did you experience any power outage issues on the day of the event?
( ) Yes
( ) No
( ) DK/NS

22. Do you get your Duke Energy bill in the mail or by email?
( ) Mail
( ) Email
( ) DK/NS
( ) Other: __________________

23. How do you pay your bill? Do you…
(Read first 3 answers aloud, stop when they answer.)
( ) **Mail a check**
( ) log into your Duke Energy account and pay online
( ) or do you have an auto-pay set up for your account?
( ) Other: __________________

24. On average, how often do you review the details of your Duke Energy bill?
(Read first 4 answers aloud, stop when they answer.)
( ) **Every month**
( ) More than half the time
( ) Less than half the time
( ) Never
( ) Other: __________________
( ) DK/NS

25. How many people live in this home?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more
( ) prefer not to answer

We have reached the end of the survey. Do you have any comments that you would like for me to pass on to Duke Energy?

Thank you for your time and feedback today!
Politely end call.

Appendix B: Non-Event Survey Instrument

Note: Text that is in red font indicates the changed wording from the Event survey to this Non-Event survey.

Use two attempts at different times of the day within 27 hours of weather exceeding 90°F and no Power Manager event being called. Call times are from 10:00 a.m. to 8:00 p.m. EDT or 9-7 CDT Monday through Saturday. No calls on Sunday. For example, if a high temperature/no event day occurs on a Monday, calling hours for that particular non-event would be:

> *Monday 5pm-8pm Eastern (4-7 Central)*
> *Tuesday 10am-8pm Eastern (9-7 Central)*

Note: Only read words in bold type. Italics are instructions.

State
( ) Indiana
( ) Ohio
( ) Kentucky
( ) North Carolina
( ) South Carolina

Info
Survey ID: ___________________________
Event ID: ___________________________
Surveyor Name: ___________________________

Option
( ) 1.0 kW
( ) 1.5 kW

Introduction
on the first call attempt
Hello, my name is _____, and I'm calling on behalf of Duke Energy. According to our information, you presently participate in Duke Energy's Power Manager Program. This program allows Duke Energy to cycle your air conditioner when there is a critical need for electricity in the region. This is a short survey that will take about 5 minutes to complete, and the information you provide will be confidential and will help to improve the program.

on the second and final call attempt
Hello, this is _____ calling again on behalf of Duke Energy, with a survey about their Power Manager Program. This is my last attempt to reach you. Sorry for any inconvenience.

1. Are you aware of your participation in the Power Manager program?
( ) Yes

( ) No
( ) DK/NS

If no, **May I please speak to the person who would be most familiar with your household's participation in the Power Manager program?**
If not available, try to schedule a callback time within the 27 hour time-frame for the particular event. If transferred, begin survey from beginning (Introduction).

2. Has Duke Energy activated the Power Manager device since you joined the program?
*[If they ask what this means, respond with: "***Duke Energy has the ability to send a signal to activate the device to cycle your central air conditioner on and off during an event***." Then repeat the question.]*
( ) Yes
( ) No
( ) DK/NS

3. How do you know when the device has been activated?
[ ] A/C shuts down
[ ] Home temperature rises
[ ] The light on the meter is on
[ ] Light on AC unit flashes
[ ] Bill credits
[ ] Lower bill
[ ] Other _________________________
[ ] DK/NS

4. Has your device been activated within the last 7 days?
( ) Yes
( ) No
( ) DK/NS

(Ohio only)
5. If you were rating your overall satisfaction with the Power Manager Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?
( ) Very Satisfied
( ) Somewhat Satisfied
( ) Neither Satisfied nor Dissatisfied
( ) Somewhat Dissatisfied
( ) Very Dissatisfied
( ) Refused
( ) DK/NS

(Ohio only)
5a. Why do you give it that rating?

6. At what temperature was your thermostat set to at 3pm on {*day of high temperature*}?
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees
( ) 98-100 degrees
( ) greater than 100 degrees
( ) It's programmed into the thermostat
( ) Thermostat was turned off
( ) Air conditioner was turned off
( ) DK/NS

7. Were you or any members of your household home at that time?
( ) Yes
( ) No
( ) DK/NS

If no or don't know, skip to question 14.

8. During this recent activation, using a scale of 1 to 10 where 1 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort on {*day before high temperature*}?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

9. Using the same scale of 1 to 10 where 1 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort on {*day of high temperature*}?
( ) 1
( ) 2
( ) 3

( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

Ask question 10 if score from question 9 is lower than score from question 8:
(Select all that apply.)
10. What do you feel caused your decrease in comfort?
[ ] Power Manager
[ ] Rising Temperature
[ ] Rising Humidity
[ ] Power Outage
[ ] Other _________________________
[ ] DK/NS

11. On *{day of high temperature}*, did you or any other members of your household adjust the settings on your thermostat?
( ) Yes
( ) No
( ) DK/NS

If yes to question 11,
NOTE: enter a numeral for a temperature, or DK if not sure.
11a. What temperature was it originally at, and what temperature did you set it to on *{day of high temperature}*?
Original temperature setting (degrees F): _________________________
Adjusted temperature setting (degrees F): _________________________

12. When Duke Energy activated your Power Manager device, did you or any other members of your household turn on any fans to keep cool?
( ) Yes
( ) No
( ) DK/NS

13. What else did you or other members of your household do to keep cool?
[ ] Continued normal activities/ Didn't do anything different
[ ] Turned on room/window air conditioners
[ ] Closed blinds/shades
[ ] Moved to a cooler part of the house
[ ] Left the house and went somewhere cool
[ ] Wore less clothing
[ ] Drank more water/cool drinks

[ ] Turned on fans
[ ] Opened windows
[ ] Other ___________________
[ ] DK/NS

Now I'm going to ask you some questions about your air conditioning use.

14. How often do you use your central air conditioner? Would you say you use it ...
(Read first 5 answers aloud.)
[ ] Not at all
[ ] Only on the hottest days
[ ] Frequently during the cooling season
[ ] Most days during the cooling season
[ ] Everyday during the cooling season
[ ] DK/NS

15. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm?
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees
( ) 98-100 degrees
( ) greater than 100 degrees
( ) DK/NS

16. At what outside temperature do you tend to turn on the air conditioner?
( ) less than 65 degrees
( ) 65-68 degrees
( ) 69-72 degrees
( ) 73-75 degrees
( ) 76-78 degrees
( ) 79-81 degrees
( ) 82-84 degrees
( ) 85-87 degrees
( ) 88-90 degrees
( ) 91-94 degrees
( ) 95-97 degrees
( ) 98-100 degrees

( ) greater than 100 degrees
( ) It's programmed into the thermostat
( ) DK/NS

17. How old is your air conditioner?
( ) 0 to 6 years old
( ) 7 to 12 years old
( ) 13 to 20 years old
( ) over 20 years old
( ) DK/NS

18. Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with the Power Manager program?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10

If 7 or below ask,
18b. Why are you less than satisfied with Power Manager?
(Select all that apply)
[ ] They activated my Power Manager device more often than I would like
[ ] The bill credits/incentives were not large enough
[ ] I was uncomfortable when my Power Manager device was activated
[ ] Other ___________________________
[ ] DK/NS

19. Using a scale of 1 to 10 where 1 indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with Duke Energy?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10

If 7 or below,
19b. Why are you less than satisfied with Duke Energy?

20. Using a scale of 1 to 10, where 1 means "Extremely Unlikely" and 10 means "Extremely Likely", how likely is it that you would recommend this program to a friend or colleague?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10

If 7 or below,
20a. Why would you not recommend the program?

21. Did you experience any power outage issues on ***{day of high temperature}?***
( ) Yes
( ) No
( ) DK/NS

22. Do you get your Duke Energy bill in the mail or by email?
( ) Mail
( ) Email
( ) DK/NS
( ) Other: __________________

23. How do you pay your bill? Do you…
(Read first 3 answers aloud, stop when they answer.)
( ) Mail a check
( ) log into your Duke Energy account and pay online
( ) or do you have an auto-pay set up for your account?
( ) Other: __________________

24. On average, how often do you review the details of your Duke Energy bill?
(Read first 4 answers aloud, stop when they answer.)
( ) Every month
( ) More than half the time
( ) Less than half the time
( ) Never
( ) Other: __________________
( ) DK/NS

25. How many people live in this home?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more
( ) prefer not to answer

We have reached the end of the survey. Do you have any comments that you would like for me to pass on to Duke Energy?

Thank you for your time and feedback today!
Politely end call.

Appendix C: Survey Participant Customer Descriptive Data

Survey participants were also asked how many people lived in their home. This distribution is shown below in Figure 32. Most Power Manager households surveyed have one or two people living in them: only 21.9% (32 out of 147) of Event households have three or more members, while 27.3% (20 out of 73) of Non-Event households have three or more members.

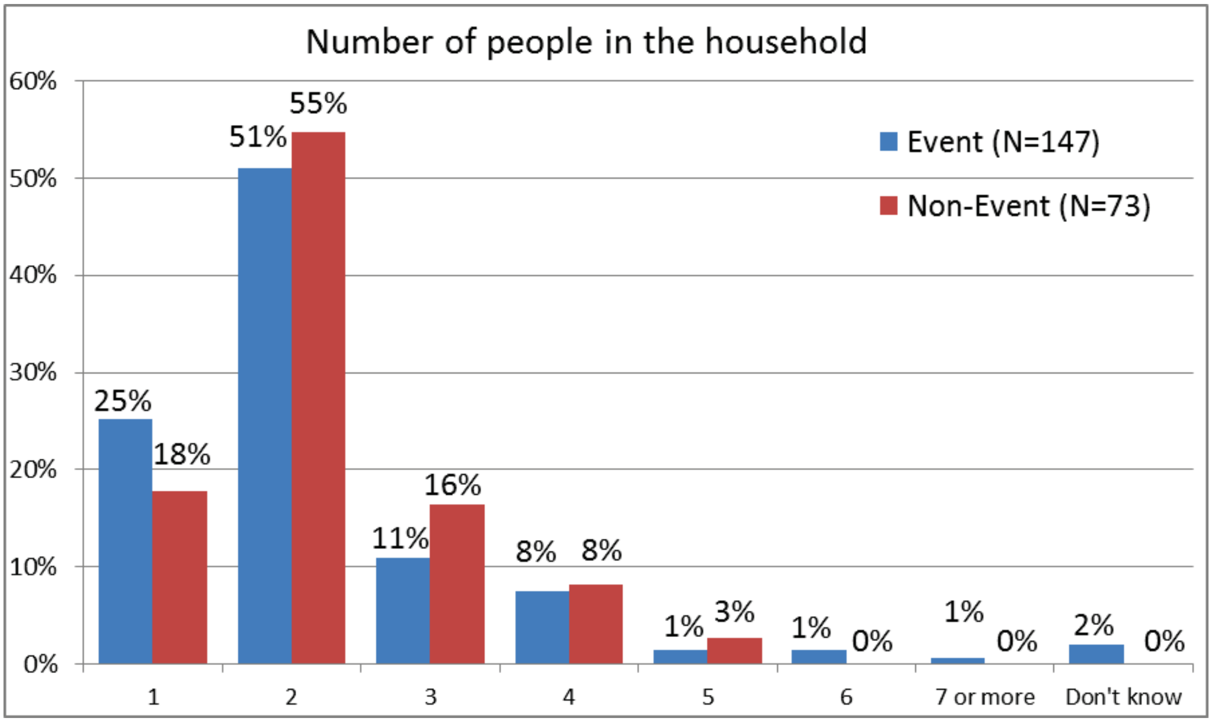


Figure 32. Population Distribution of Event and Non-Event Participants

Data provided by Duke Energy includes a variable for respondent age. This distribution for Event and Non-Event participants is shown in Figure 33. About half of participants surveyed were age 65 or older (51.7% or 76 out of 147 Event participants, and 49.3% or 36 out of 73 Non-Event participants).

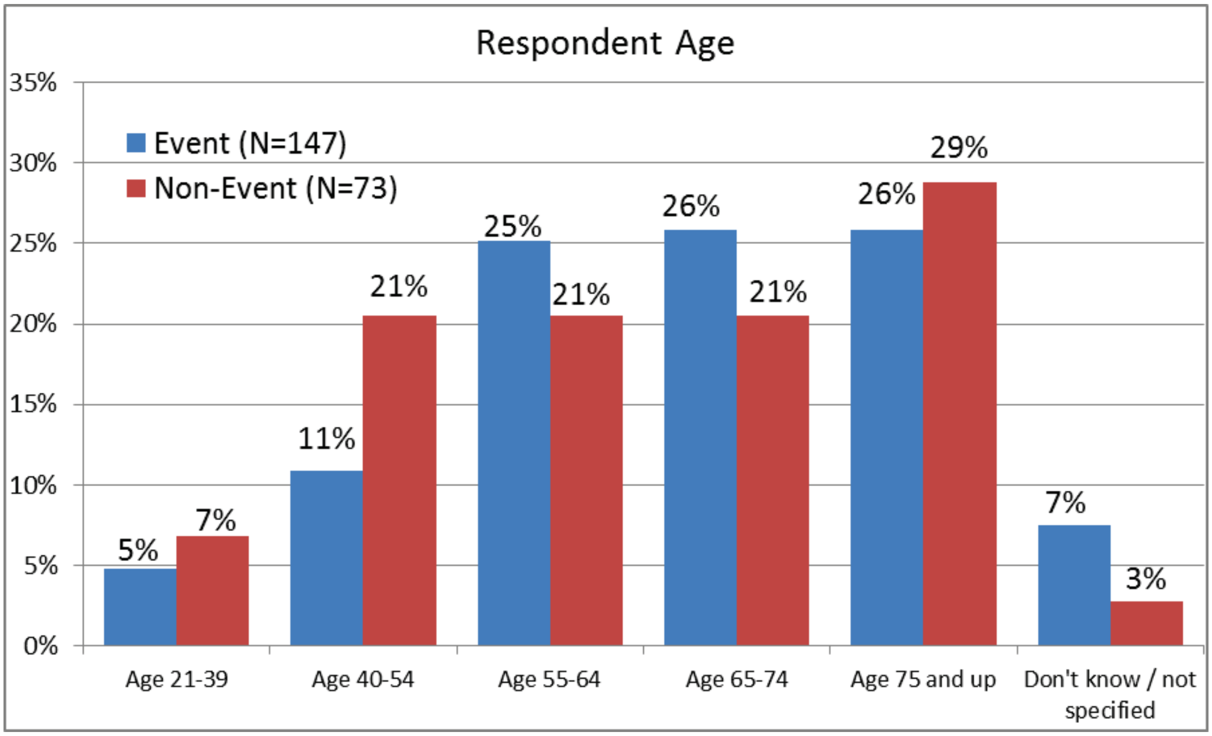


Figure 33. Age Distribution of Event and Non-Event Participants

Table 12 shows additional household descriptors from Duke Energy customer records: marital status, children in the household, income percentiles, education and ethnicity.

Table 12. Household Demographics

	Event (N=147)	Non-Event (N=73)
Marital Status: married	60.5%	69.9%
Marital Status: single	2.7%	1.4%
Marital Status: unknown	36.7%	28.8%
No children in household	85.0%	84.9%
One or two children in household	11.6%	13.7%
Three or more children in household	0.7%	1.4%
Children in household: unknown	2.7%	0.0%
Income percentile 1-25%	15.6%	20.5%
Income percentile 26-50%	20.4%	24.7%
Income percentile 51-75%	29.9%	15.1%
Income percentile 76-89%	21.1%	26.0%
Income percentile 90-99%	10.2%	13.7%
Income percentile unknown	2.7%	0.0%
Education: college graduate or better	42.2%	34.2%
Education: less than college graduate	51.7%	64.4%
Education: unknown	6.1%	1.4%

Ethnicity: Caucasian	76.9%	84.9%
Ethnicity: Non-Caucasian	15.6%	15.1%
Ethnicity: Unknown	7.5%	0.0%

Note: This data comes from Duke Energy customer records; these questions were not asked in this survey.

Table 13 presents data from Duke Energy customer records about survey participants' dwellings.

Table 13. Characteristics of Respondent Dwellings

	Event (N=147)	Non-Event (N=73)
Home owner	90.5%	94.5%
Home renter	3.4%	2.7%
Home ownership unknown	6.1%	2.7%
Single family structure	90.5%	94.5%
Multi-family structure	4.8%	4.1%
Home structure unknown	4.8%	1.4%
Home built 1949 or earlier	4.8%	2.7%
Home built during 1950's	8.8%	8.2%
Home built during 1960's	13.6%	15.1%
Home built during 1970's	19.0%	28.8%
Home built during 1980's	16.3%	15.1%
Home built during 1990's	13.6%	6.8%
Home built during 2000-2006	0.7%	0.0%
Home built during 2007-2012	0.0%	0.0%
Home age unknown	23.1%	23.3%
Lived in home 0-5 years	7.5%	8.2%
Lived in home 6-10 years	14.3%	8.2%
Lived in home 11-20 years	34.7%	41.1%
Lived in home 21-30 years	21.1%	20.5%
Lived in home more than 30 years	19.7%	21.9%
Lived in home unknown length of time	2.7%	0.0%
Estimated home value less than $100,000	5.4%	8.2%
Estimated home value $100,000-$149,999	16.3%	20.5%
Estimated home value $150,000-$199,999	15.6%	23.3%
Estimated home value $200,000-$274,999	17.7%	19.2%
Estimated home value $275,000-$349,999	15.0%	9.6%
Estimated home value $350,000 or more	22.4%	15.1%
Estimated home value unknown	7.5%	4.1%

Note: This data comes from Duke Energy customer records; these questions were not asked in this survey.

Final Report

Process and Impact Evaluation of the Residential Energy Assessments Program (Personalized Energy Report®) in the Carolina System

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

March 29, 2013

Submitted by

Nick Hall
and Brian Evans

TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

Subcontractors:
May Wu, Michael Ozog
Integral Analytics, Inc.

Pete Jacobs
BuildingMetrics, Inc.

Matthew Joyce

TECMARKET Works

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Executive Summary

Key Findings and Recommendations

This section presents the key findings and recommendations identified through this evaluation of Duke Energy's Residential Energy Assessments Program: Personalized Energy Report® (PER) in the Carolina System. This report covers participants that participated in the program through the paper survey and the online survey (OHEC). The program evaluation covers the period of time from April, 2011 through June, 2012 (n=19,054 participants. Table 1 presents the estimated overall ex post net energy impacts from the billing analysis. The billing analysis approach used to assess energy savings provides a direct net (net of short term freeridership, short term participant spillover and participation in other Duke Energy programs) energy impact estimate[1] by employing quasi-experimental analysis designs.

Table 1. Estimated Overall Impacts

	Net Savings
Annual Savings Per Participant Per Year	
kWh	521
kW	0.0865

The billing analysis gives the estimated overall net kWh savings per participant but is incapable of estimating coincident net kW reduction. As a result, kW was calculated based upon the kWh savings and the kW/kWh ratio from the engineering analysis. Additionally, the billing analysis gives estimated net impact of both CFLs and recommendations together. The main goal of the engineering analysis, aside from providing the kW/kWh ratio, is to offer insight into individual gross energy impact measure contributions to overall savings. All official impact results are net savings and are based on the outcome of the billing analysis.

The billing analysis was unable to differentiate between savings resulting from CFLs and savings resulting from audit recommendations. Comparing the net savings from the engineering estimates, which only include CFLs, to the overall savings from the billing analysis showed that audit recommendations comprise 52% of the total program savings. This weight was used to determine a weighted average EUL that is applicable at the program level to feed the DSMore table seen in Appendix I: DSMore Table.

From the Management Interviews

- The program exceeded goals in 2011, achieving 277% of goal in North Carolina, 199% of goal in South Carolina, and a combined 256% of goal for the Carolina system. Despite significantly higher goals for 2012, performance is on track for this year as well. As of September 17, 2012 performance stood at 96% of goal in North Carolina, 84% of goal in South Carolina, and a combined 93% for the Carolina System.

[1] The evaluation did not document net long term spillover or short and long term market effects savings. These savings are in addition to those identified in this report but are beyond researchable issues associated with this evaluation.

- CFL bulb shipments are tracking accordingly. With a six pack of CFLs sent for every report completed, North Carolina customers received 17,804 six-packs of CFLs in 2011 and an additional 16,831 six-packs of CFLs so far in 2012. South Carolina customers received 4,727 six-packs of CFLs last year and an additional 4,336 so far this year. Total shipments for the Carolina system in the last two years equal 22,531 six-packs of CFLs for 2011 and 21,167 to date for 2012.
- Since the last process evaluation on the Personalized Energy Report program in 2010, the program has seen mailer response rates averaging 18%. The Duke Energy program manager attributes these strong response rates to the sharp targeting of customers who are likely to participate.
- The program is running well with no issues reported. Duke Energy and all vendors are performing as required. Communication and collaboration are excellent.
- The program will be closed down at the end of 2012 when resources will be refocused on other Duke Energy programs.

From the Participant Surveys

- North Carolina and South Carolina customers are equally satisfied with Duke Energy, with a mean satisfaction rating of 8.9 for each state and for the Carolina System overall.
- Customers in North Carolina and South Carolina are highly satisfied with the program as well, giving average satisfaction ratings of 9.0 and 9.1 respectively. This yields an average satisfaction rating of 9.1 for the overall Carolina System.
- Carolina System customers rated their satisfaction with the 13-watt and 20-watt CFLs provided by the program with an average satisfaction score of 8.7.
- Fifty percent of survey respondents indicated their primary motivation for participating in the program was to save on energy costs. Receiving free CFLs was the second strongest motivating factor at 25%.
- When measured on a 1-10 scale, customers look favorably upon the Personalized Energy Report survey questionnaire, indicating it was easy to understand (9.4), the questions made sense (9.2) and were easy to answer (9.3). Customers also strongly agreed the resulting Personalized Energy Reports were easy to read (9.2) and that the reports helped them to understand their household energy use (8.7).
- Using the same 1-10 scale customers rated the believability of the home energy use comparisons at 8.3. Although this is a strong score and represents that customers put a considerable amount of trust in the reports' findings, it was among the lowest scores for any portion of the report. Thus, compared to other portions of the report, it may indicate an area that customers feel provides an opportunity for improvement. Feedback from those who scored the believability at 7 or less suggests that credibility concerns arise from 1) a lack of methodological understanding about how the data was collected and compared; 2) a lack of understanding about how their homes and their behaviors impact energy consumption; 3) a belief that their situations are unique and should not be compared. However, because the score is above 8 on a 10 point scale, TecMarket Works

is not concerned about an apparent lack of trust in the information provided. This is a high trust score and reflects positively on the program.

- For 7 out of 13 of the energy saving tips mentioned in the PER reports, 80% or more of respondents said that they were already taking such actions prior to reading the reports. Despite the preponderance of energy saving activities happening prior to receipt of the reports, all energy saving tips enjoyed a high level of influence at a mean of 8.3 or greater, except for the "Use of portable heaters during winter," which scored 6.8 on the 10 point scale. When influence scores are considered in conjunction with before and after behavior scores, it appears that for a majority of the population the Personalized Energy Reports did more to reinforce existing behaviors than to encourage new behaviors.
- The survey also sought to determine if respondents changed any of other habits as a result of receiving the Personalized Energy Report. North Carolina customers took more than three times as many additional energy saving actions as their South Carolina counterparts. When considered on a percentage basis, 35% of North Carolina respondents reported taking additional actions compared to just 10% of South Carolina respondents.
- Overall customer interest in a specialty CFL program had a mean interest score of 7.0. More than 40% of respondents indicated the highest level of interest (10) and 59% of respondents indicated very high interest (8, 9, or 10).

Process Evaluation Recommendations

Because the program is closing after December 2012, no specific recommendations are made for its improvement. However, recommendations based on management and customer feedback may be applicable to other Duke Energy programs, particularly those that seek to deploy similar data collection and reporting tools. With that mind, we make the following suggestions based on management interviews and customer survey findings.

From the Management Interviews

- Combining the self-reported data obtained from Personalized Energy Report survey questionnaires with the home energy consumption comparisons used by the My Home Energy Report program (rather than the regional averaging method used by Aclara for this program) may yield more accurate and believable information for future iterations of customized energy reports.
- The use of remote proofing software would eliminate the need for emailing or overnight mailing copies of a file, which can result in multiple versions of the same file, each containing different sets of changes. Instead, remote proofing software enables multiple people in multiple locations to view the same file at the same time, make edits and suggestions, and share them with the team.

From the Participant Surveys

- Energy savings tips seem like "*yesterday's news*" to customers who are already familiar with many of the recommendations offered in the Personalized Energy Reports. While widespread awareness of the most common energy efficiency measures speaks well of

Duke Energy's efforts to educate its customers and of the customers' ability to educate themselves, it may hint at the possibility of losing influence among customers who have heard it all before. Duke Energy may be able to retain customer interest and stimulate even further energy savings by creating a list of second tier recommendations that include "fresh" suggestions for energy saving actions to be undertaken after the basic tips described in the current reports have been completed.

- Home energy comparisons generate credibility issues with some recipients of the Personalized Energy Reports. Duke Energy may be able to increase credibility among customers by further explaining the methodology behind the comparisons and by highlighting the benefits of comparison even when not all homes in the groupings are identical.
- The survey showed twice as many people said that they participated in the program to learn how to save on energy costs than because they wanted to receive free CFLs. This lends support to the idea that increased energy savings may be sufficient motivation for signups in future iterations of the survey and report as aspects of other Duke Energy programs. It appears that saving money is a much strong driver of participation that the receipt of free CFLs. Further investigation may be warranted.
- Among current PER participants, energy efficient CFL or LED outdoor floodlights appear to be the best candidate for a specialty CFL program, having the highest interest (52%) of any bulb type.

Significant Impact Evaluation Findings: Billing Analysis

A net energy impact billing analysis was conducted to estimate the energy savings from the program. The billing analysis relies upon a statistical analysis of actual customer-billed electricity consumption before and after participation in the PER, compared to the change in savings over that same period for a matched comparison group[2] to estimate the impact for the CFLs and recommendations from the audit.

The estimated net impacts are presented in the "Impact Estimates: Billing Analysis" section of the report, and a summary of the results is shown below:

	95% Confidence Interval		
	Lower Bound	Estimate	Upper Bound
Per Participant Annual Savings kWh - PER	261	521	758
Per Participant Percentage Savings - PER	-1.1%	-2.2%	-3.2%

Significant Impact Evaluation Findings: Engineering Analysis

- Mean wattage of a replaced bulb is 63 watts for the 13-watt CFL and 71watts for the 20-watt CFL.
    - See Survey Data on page 78.

[2] The comparison group consists of all pre-program energy use for all PER participants within each targeted state so that the comparison group is a cluster of non-program impacted energy use homes for non-participants that are demographically, psychographically, attitudinally and pre-energy–use profile matched to the test group. This type of comparison group analysis represents a best practice approach within the energy program evaluation field.

- An ISR of 87.6% was reported for the 13-watt CFL and 82.0% for the 20-watt CFL.
    - See In Service Rate (ISR) Calculation on page 79.
- Average daily hours of use are 2.93 and 2.88 for 13-watt and 20-watt CFLs respectively.
    - See Table 27 on page 79.

Introduction and Purpose of Study

Summary Overview

This document presents the process and impact evaluation report for Duke Energy's Personalized Energy Report (PER) program as it was administered in North Carolina and South Carolina. The evaluation was conducted by TecMarket Works, BuildingMetrics, Integral Analytics, and Matthew Joyce, subcontractors to TecMarket Works.

Summary of the Evaluation

TecMarket Works performed a process evaluation comprised of management interviews to review program operations and administration, and a customer survey to determine satisfaction levels and identify any program implementation issues.

The impact findings presented in this report were calculated using monthly billing data and participant survey data as presented in Table 2 below.

Table 2. Evaluation Date Ranges

Evaluation Component	Dates of Analysis
Participant Surveys	Surveys conducted from 10/12/12 through 10/27/12
Management Interviews	September – October, 2012
Engineering Estimates	October – November, 2012
Billing Analysis	September – October, 2012

Evaluation Objectives

The objective of this evaluation is to determine the effectiveness of and customer satisfaction with Duke Energy's Personalized Energy Report program as it was administered in the Carolina System, and to determine estimated energy impacts.

Description of Program

Duke Energy's Personalized Energy Report (PER) program offers a customized energy report to residential customers to help them better understand their home energy usage and to identify ways to save energy. The program presents customers with a 30-question paper survey about their homes and energy use. The answers in turn are used to generate the customized reports. As an incentive for participating in the program, customers are offered a free package of 6 CFLs. A copy of the customer survey is included in Appendix G: Personalized Energy Report Questionnaire, while an example of the Personalized Energy Report is included in Appendix H: Personalized Energy Report Sample.

Program Goals and Participation

The program saw exceptionally strong performance in 2011, achieving 277% of goal in North Carolina, 199% of goal in South Carolina, and a combined 256% of goal for the Carolina system. Despite significantly higher goals for 2012, performance is on track for this year as well. As of September 17, 2012 performance stood at 96% of goal in North Carolina, 84% of goal in South Carolina, and a combined 93% for the Carolina System.

CFL bulb shipments are tracking accordingly. With a six pack of CFLs sent for every report completed, North Carolina customers received 17,804 six-packs of CFLs in 2011 and an additional 16,831 six-packs of CFLs so far in 2012. South Carolina customers received 4,727 six-packs of CFLs last year and an additional 4,336 so far this year. Total shipments for the Carolina system in the last two years equal 22,531 six-packs of CFLs for 2011 and 21,167 to date for 2012.

Table 3. Program Performance through September 17, 2012

State	Time Period	Goal	Final Count (Reports/CFL 6 Packs)	% of Goal	Letters Mailed	Response Rate
NC	2011	6,425	17,804	277%	87,891	20%
NC	2012	17,600	16,831	96%	96,960	17%
SC	2011	2,375	4,727	199%	23,165	20%
SC	2012	5,150	4,336	84%	26,316	16%
Total	2011	8,800	22,531	256%	111,056	20%
Total	2012	22,750	21,167	93%	123,276	17%

Table 4. Program Participation

Program	State	*Participation Count From: April 26, 2011 To: December 16, 2011
Personalized Energy Report	NC	17682
Personalized Energy Report	SC	4700
Personalized Energy Report	**TOTAL**	**22382**

*Many customers had to be dropped from the engineering sample if, for various reasons, they were ineligible to participate in the phone survey. To aid reconciliation between the engineering and billing analyses, these customers were also excluded from the billing data sample. The total number of participants is, however, used for the total program savings extrapolation portion of the engineering estimates. This table includes every participant from the sample date range. That is why it shows a greater number of total participants than the billing analysis.

Note on Evaluation Methodology and Net to Gross

The analysis used in this study is based on improvements made within the field of energy program evaluation over the last year. Specifically, studies conducted prior to this year used standardized billing analysis techniques linked to net analysis adjustment methods to estimate net impacts for all measures without differentiating between low-cost standard consumable measures (part of normal purchase behaviors because first cost, product availability and transaction barriers are not significant) and measures with significant acquisition barriers. In the last year our field has differentiated analysis approaches associated with normal low-cost item purchase behavior measures (CFLs, aerators, shower heads, caulking, etc.) from products that have significant cost and other purchase barriers (furnaces, air conditioners, compressors, etc.). Impact analysis approaches associated with low-cost low-barrier products that have few if any significant purchase barriers can produce net savings directly from a billing analysis that controls for weather and pre-existing (before the program) changes in market conditions over the evaluation period. In these approaches, the use of a rolling pre-program billing period, consisting of all participants' consumption before they enroll in a program can be effectively used as a control group and as a result, that analysis produces net savings without identifying gross savings. For these analyses there is no need to adjust savings to account for freeriders. However, for large impact measures that are procured only a few times during a lifetime, the same analysis approach produces gross savings that have to be adjusted for freeriders. This advancement in the field of evaluation has resulted in the analysis used in this study and as a result, the results provided are net of freerider savings and also include impacts associated with short-term spillover.

Prior to this change in the evaluation approach, impact evaluations employed one of four different strategies for estimating impacts. These are described in Appendix J: Previous Impact Evaluation Approaches on page 143.

TecMarket Works adopted the controlled fixed effects billing analysis with and without net adjustment approach as a standard practice in 2012. With this adoption, TecMarket Works acknowledges that the 2011 Home Energy House Call evaluation studies that subtracted the savings of self-expressed freeriders for minor measures essentially double-counted freerider adjustments and provided a net savings estimate that is lower than what the program achieved. While that study was conducted using the industry's standard best-practice analysis approaches of 2011, the field has since changed in its acceptance of this practice and TecMarket Works agrees with this change. As with all fields, the field of energy efficiency program evaluation is evolving. Our field is establishing protocols that reflect improvements in the ability to estimate net energy impacts. As the evaluation field develops and adopts more reliable net energy analysis approaches, these approaches will be incorporated into our industry's protocols and standard practices. For example, the state of Indiana has (in 2012) adopted the approach that recognizes standard market operational practices (such as the pre-program period for participants) as the baselines for conducting energy impact analysis in which the results are net savings without the need for freerider adjustments. This protocol is included in the Indiana and Delaware[3] Evaluation Frameworks and is now being used as a standard practice in other states.

[3] The Delaware Evaluation Framework is pending final approval. When it is made public, it will be available at: http://www.dnrec.delaware.gov/energy/information/otherinfo/Pages/Evaluation.aspx.

TecMarket Works has abandoned the practice of adjusting minor or low-cost standard market products to account for freeriders when pre-program energy use practices are set as the net baseline analysis platform.

Methodology

Overview of the Evaluation Approach

This process evaluation had four components: management interviews, participant surveys for the process evaluation, and a billing analysis and an engineering analysis for the impact evaluation.

Study Methodology

Management Interviews

TecMarket Works conducted interviews with Duke Energy's PER program manager, as well as with managers from McKay Press, which prints and mails solicitation letters and customer home energy reports; Aclara Software which processes the survey and performs usage analytics, and AM Conservation, which handles CFL fulfillment. The interviews covered program design, execution, operations, interactions between organizations, data transfer methods, and personal experiences in order to identify any implementation issues and discuss opportunities for improvement. The interview instrument can be found in Appendix A: Management Interview Instrument.

Participant Surveys

This survey targeted Duke Energy customers who completed PER questionnaires and received Personalized Energy Reports between April 26, 2011 and December 16, 2011. The survey was conducted by phone by TecMarket Works' staff from a randomly generated sample of 18,951 customers from North Carolina and South Carolina, with 157 survey respondents. The phone survey instrument can be found in Appendix B: Participant Survey Instrument.

Billing Analysis

For this analysis, billing data were obtained for all participants in the program between April, 2011 and June, 2012[4]. For PER, there were a total of 19,054 usable accounts after processing[5], of which 15,270 were from North Carolina, and 3,784 were from South Carolina. A panel model specification was used that analyzed the monthly billed energy use across time and participants. The model included terms to control for the effect of weather on usage, the effect of impact from other Duke Energy offers, the effect of normal non-program induced energy use changes, as well as a complete set of monthly indicator variables to capture the effects of non-measureable factors that vary over time (such as economic conditions and season loads).

Engineering Analysis

Engineering algorithms taken from the Draft Ohio Technical Resource Manual (TRM) were used to estimate savings. These unit energy savings values were applied to customers in the engineering analysis sample.

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[4] Note there is no participation data available in 2012 given no campaign activities until July 2012.

[5] Useable accounts are those accounts which have billing data for both a portion of the pre- and post-participation period, as well as monthly kWh greater than 0 and less than 10,000 kWh. Usable accounts exclude outliers such that absolute value of DFBetas < 2*sqrt(n), with n = total number of observations. It was not required that the data covers the complete evaluation period, only that there is at least one observation in each period.

Data collection methods, sample sizes, and sampling methodology

Management Interviews

Four management interviews were conducted with program implementation staff and management to obtain their observations about the programs operations and challenges. We conducted phone interviews and follow up conversations with the Program Manager at Duke Energy, and the client managers at Aclara Software, McKay Press, and AM Conservation.

Participant Surveys

A sample list of customer records was randomly pulled by TecMarket Works from a list of 18,951 Duke Energy customers who participated in the program between April 26, 2011 and December 16, 2011. Surveys were conducted by telephone with 157 respondents. Customers who could not be reached upon the first call were phoned again for a maximum number of four attempts.

Billing Analysis

The billing analysis used consumption data from all complete data provided for the PER participants in North Carolina (15,270 customers) and South Carolina (3,784 customers) that participated between April, 2011 and June, 2012. Exceptions were made to aid reconciliation between the engineering and billing analyses. Those customers that were deemed ineligible to participate in the phone survey, and therefore did not feed the engineering data, were also excluded from the billing data sample.

Engineering Analysis

Phone surveys were conducted with a random sample of 157 participants.

Number of completes and sample disposition for each data collection effort

Management Interviews

During September and October 2012 TecMarket Works interviewed four program managers and vendors for this evaluation. This represents a sample rate of 100%.

Participant Surveys

TecMarket Works conducted a phone survey from a randomly generated sample of 18,951 customers (15,200 in North Carolina and 3,751 in South Carolina) with 157 respondents and an overall sample rate of 0.008%.

Table 5. Summary of Data Collection Efforts

Residential Energy Assessment: Personalized Energy Report				
Data Collection Effort	**State**	**Size of Population**	**# of Successful Contacts**	**Sample Rate**
Management Interviews	NC, SC	4	4	100%
Customer Survey	NC	15,200	77	0.005%
	SC	3751	80	.02%
	Carolina System	18,951	157	0.008%

Billing Analysis

N/A (did not sample, used a census of all participants)

Engineering Analysis

A total of 157 participants responded to the phone survey.

Expected and achieved precision

Participant Surveys

The survey sample methodology had an expected precision of 90% +/- 6.5% and an achieved precision of 90% +/- 6.5%.

Billing Analysis

All savings estimates from the billing analysis were statistically significant at the 95% confidence level.

Engineering Analysis

Engineering estimates rely on participant survey responses. Sampling procedures for the participant survey had an expected precision of +/- 6.5% at 90% confidence and an achieved precision of +/- 6.5%.

Description of baseline assumptions, methods and data sources

Baseline assumptions were determined through phone surveys with customers providing self-reported values of baseline lamp watts and operating hours. Robust data concerning HVAC system fuel and type was available from Duke Energy's Home Profile Database (appliance saturation survey type data) in the Carolinas. Interaction factors derived from this data were used in favor of deemed values from secondary sources as they recognize only Duke Energy customers and, therefore, more accurately represent the participant population. A breakdown of these factors by system and fuel type can be seen in Appendix F: Impact Algorithms.

Description of measures and selection of methods by measure(s) or market(s)

The energy efficiency kits contain the following:

- Three 20 watt CFLs
- Three 13 watt CFLs

Use of TRM values and explanation if TRM values not used

The HVAC interaction factors were developed using customer specific HVAC system information collected through Duke Energy's appliance saturation survey in the Carolinas as they more accurately represent the participant population than the deemed values.

Threats to validity, sources of bias and how those were addressed

Billing Analysis

The specification of the model used in the billing analysis was designed specifically to avoid the potential of omitted variable bias by including monthly variables that capture any non-program effects that affect energy usage, as well as other Duke offers. The model did not correct for self-selection bias because there is no reason to as long as the program remains voluntary.

Engineering Analysis

The participant responses are self-reports and therefore may be affected by self-selection bias, false response bias or positive result bias. If these biases are present, the savings achieved can be expected to be higher than those reported in the impact evaluation.

Management Interviews

Program Background

Duke Energy's Personalized Energy Report (PER) program provides residential customers with a customized energy report to help them understand how they are using energy and to identify ways to save energy in their homes. The reports are created after customers complete a 30-question paper survey about their homes and energy use. Customer answers to these questions are used to generate the customized energy reports. In addition to receiving the personalized reports, customers are also offered a free package of six CFLs to encourage participation.

The Personalized Energy Report itself is a four page document that displays customers' annual energy usage by month. It includes:

1. A table showing actual kWh usage for that month and approximate monthly energy expenses (Aclara software assumes average energy rates),
2. A chart showing kWh usage for each month. Months are colored to indicate winter heating and summer cooling months,
3. House electricity usage disaggregated into eight end use categories displayed proportionate to the customer's survey responses. Categories are: Lighting, Cooking, Food Storage, Cooling, Heating, Water Heating/Laundry, Pool/Hot Tub, and Other
4. A figure comparing the home's energy usage with the low-to-high range of energy usage by similar households, and
5. Rebate information and general energy saving tips.

A sample customer questionnaire can be seen in Appendix G: Personalized Energy Report Questionnaire, while an example of a Personalized Energy Report can be seen in Appendix H: Personalized Energy Report Sample.

The PER program has three main objectives. 1) to provide residential customers with energy efficiency information relevant to their homes; 2) to distribute CFLs to customers to achieve energy savings towards Duke Energy's program goals; 3) to collect self-reported data on customer homes and energy usage.

While the program has been highly successful, it is being discontinued, or "sunset," at the end of 2012. Duke Energy has determined that the program has run its course. Self-reported customer data from the PER program will be directed toward My Home Energy Report (MyHER), a separate program that provides residential customers with home energy comparisons.

Operational Roles

Program operational roles are assigned as follows: Duke Energy provides overall program oversight, as well as marketing. McKay Press prints and mails solicitation letters, personalized survey questionnaires, and final customer home energy reports; iKindred scans the paper surveys; Aclara Software processes the completed surveys and performs usage analytics. AM Conservation handles CFL fulfillment. Each role as it occurs in the process is discussed below.

Duke Energy determined the questions to be used in the survey and designed its layout. The utility also worked with Aclara on the data presentation in the energy report. To market the program, Duke Energy sends out one primary mailing per year. It also sends one reminder mailing approximately three months later. For each primary mailing campaign, Duke Energy's program manager determines the schedule and works with Duke Energy's Market Analytics division to select which customers are to be targeted based upon customer demographics and psychographics, similarity to past respondents, level of energy usage, and PRIZM segments.

To increase response rates, customers are divided into two categories based upon income. Each group receives a slightly different mailing, with the first paragraph of the marketing copy taking two different forms. The first paragraph of the letter sent to more affluent customers reads: "Informed customers like you are turning to smart ways to use energy at home. Here's your chance to reduce your energy use without sacrificing comfort. It starts with a free Personalized Energy Report." The letter sent to lower income customers reads: "Are you looking for ways to save money? Duke Energy can help. Our free Personalized Energy Report is a great way to start." The remainder of the letter reads the same for both groups.

Duke Energy sends its segmented customer lists to McKay Press. McKay Press prints the solicitation letters and customized surveys with the customer's name, address, and a bar code representing the customer's account number (see sample in Appendix H: Personalized Energy Report Sample). McKay then mails the surveys to customers along with the appropriate letter.

Participating customers answer the survey questions using bubble-in responses. Their completed paper surveys are mailed to scanning company, iKindred, a subcontractor to Aclara. The scanned surveys are in turn sent to Aclara, which processes the survey responses using their proprietary analytic engine and combines the resulting data with up to 24 months of the customer's billing history, provided by Duke Energy, to create the personalized reports and generate appropriate tips.

The resulting PDF files are quality checked by Aclara to ensure that: graphics are displayed correctly, charts show values within reasonable limits, and that the customer's home state is correctly referenced in the report. Aclara then sends PDF files for the Personalized Energy Report to McKay Press for printing and mailing to customers. McKay's quality assurance measures include a camera matching system that confirms the reports are inserted into the correctly addressed envelope. In the rare event that the camera matching fails, McKay performs hand checks to ensure correct mailings. After the mail drop, McKay sends the postal receipt to Duke Energy. Aclara and McKay report that all processes and mail drops have been working smoothly.

Aclara also sends the processed customer data back to Duke Energy for uploading to the customer's online "My Account" dashboard on the website. Duke Energy forwards the customer's information to AM Conservation, the fulfillment vendor that ships the six-pack of CFLs to the customer. Until April of 2012, fulfillment operations were provided by Niagara Conservation. At that point Duke Energy changed fulfillment providers to AM Conservation. Duke Energy program managers report that the transition went well and fulfillment efforts are going smoothly so far. Because this process evaluation was conducted after the change in vendor, only AM Conservation was interviewed. The new fulfillment vendor reports that operations are running well and that Duke Energy is providing adequate notice to ensure that sufficient supplies of CFLs and adequate numbers of staff members are on hand to ensure timely shipping.

AM Conservation sends out the CFLs to customers who have completed the survey. It also maintains a toll free number for questions about the CFLs, or to report broken bulbs. The AM Conservation account manager reports that the incidence of broken CFLs is very low, less than 1%. AM Conservation is contractually obligated to send the bulbs out within nine days, but generally sends them out within one to two days via FedEx Smart Post. Once the CFL orders have been fulfilled, AM Conservation uploads the shipment information into an online order tracking system that is updated regularly with FedEx package tracking information. This tracking information is accessible to customers who can check the status of their CFL deliveries, as well as being accessible to Duke Energy program managers who can run reports on bulb shipments and deliveries. These reports are used to credit the program with progress toward its goal.

As of October 8, 2012, AM Conservation had shipped customers of this program 77,336 six pack kits, which contained a total of 464,016 CFLs. Additional bulb deliveries are credited to the program via earlier shipments through Niagra, the old fulfillment vendor.

Communication and Working Effectiveness

All parties we interviewed spoke positively of the quality of working interactions and the effectiveness of their communications. No significant problems or issues were reported, and the Duke Energy program manager expressed satisfaction with the performance of all vendors engaged on this program.

Program Success

Since the last process evaluation on the Personalized Energy Report program in 2010, the program has seen response rates from the mailer averaging 18%. The Duke Energy program manager attributes these strong response rates to the sharp targeting of customers who are likely to participate. Prior to 2010, response rates were even higher, in the 20-24% range. The program manager indicated that the Duke Energy Market Analytics group attributed the decline in response rates to market saturation for CFLs, mostly by other Duke Energy programs. In at least some instances, the PER program manager believes the free six-pack of CFL incentive offered by her program was trumped by other Duke Energy CFL programs that offered free CFLs without the effort involved in completing the survey. Nonetheless, the 18% average response rates served to ensure the program achieved its annual numeric targets.

Future Improvements

Despite the continuing high response rates, Duke Energy plans to close down the PER program at the end of 2012. The company plans to shift its data collection efforts to new platforms and programs, such as the My Home Energy Report program. Nonetheless, the PER team did make a few suggestions for improving future efforts in whatever program they may be applied.

Because the data obtained by the PER surveys regarding customer homes are self-reported, they are considered to be more accurate than data obtained from public records concerning a home's square footage, age, and heating source. The more accurate the data are, the more accurate the comparisons that can be made with the energy usage of other customer homes. As a result, the program manager indicates that Duke Energy is considering ways to incorporate PER data collection methods into MyHER and other programs that rely upon public data for comparison purposes. Duke Energy is still determining whether the best approach will be to continue data collection in its current form of the 30 question survey or perhaps another approach such as soliciting self-reported answers to a question or two per month over an extended period of time.

Also under discussion is the appropriate incentive for completing the self-report survey. Discounted specialty CFL bulbs are being considered, but so too is the use of no incentive at all beyond the increased accuracy of the home energy comparisons, which may be sufficient to spur the customers to fill out the survey. For instance, if a customer logs into the online services web portal and has not completed the PER survey then the pie chart displaying percentages of energy use is greyed out, while next to the greyed out display is a link saying "If you would like this information, click here to complete a short survey." First time online services customers also get a pop up intercept survey.

While the data collection instrument and process used by the PER program are working well, the comparisons made between the customer's energy usage and the usage of others are no longer as accurate as possible. Currently the tool used by Aclara to generate a comparison bar in the Personalized Energy Report displays the customer's energy usage compared to the average home. Aclara derives this average energy usage based upon regional clusters of information and averaged energy rates. As a result, it tends to portray the customer's current performance more favorably than do comparisons drawn by other methods, such as those used by MyHER, which compare individual energy usage to a tighter pool of data drawn from the customer's surrounding community and using specific rate factors. Thus, after the sunset of the PER product at the end of the year, the program manager encourages a shift to this more accurate method of data comparison.

Because operations of the program involve repeated hand-offs of data, different people at each company are naturally involved in the process at different times. As a result, when issues arise, those people directly involved tend to be the ones to resolve the problem. However, as one team member suggested, the limited nature of the problem solving does not mean that other people should not be made aware of the solutions. For this reason, this team member suggests that in the future, debriefing meetings should take place after notable issues have been resolved, or quarterly team meetings should be held to ensure that all players are up-to-date.

Another recommendation for future programs involved the use of remote proofing software, such as Kodak Insight. This type of software eliminates the need for emailing or overnight mailing copies of a file, which can result in multiple versions of the same file, each containing different sets of changes. Instead, remote proofing software enables multiple people in multiple locations to view the same file at the same time, make edits and suggestions, and share them with the team. While perhaps not applicable to the PER program, given its imminent cessation, the use of such software may prove efficacious for Duke Energy in the future.

Evaluation and Recommendations

Evaluation
Overall the Personalized Energy Report program is very well run and strongly successful in its objectives of: gathering self-reported data regarding customer energy usage; providing residential customers with energy efficiency information relevant to their homes; and distributing CFLs to customers to achieve energy savings towards Duke Energy's program goals.

Duke Energy and its vendors communicate effectively and work operations function smoothly and efficiently. Direct mail response rates are high at 18% on average. The program exceeded its goals for 2011 and is on track to meet or exceed them for 2012.

Recommendations
Because the program is closing at the end of 2012 no specific recommendations are made for its improvement. However, we do encourage consideration of the management-generated suggestions noted in Future Improvements above as they may be applied to future incarnations of this program in other forms.

Participant Surveys Results

The Personalized Energy Report program, as implemented in the Carolinas by Duke Energy, offers residential customers a customized energy report to help them better understand their home energy usage and identify ways to save energy. In order to receive the report customers must fill out a 30-question survey describing their homes and their energy use behaviors. These surveys are then returned to Duke Energy, which analyzes the responses and generates the reports.

To determine the report's effectiveness in conveying information and spurring customers to take action as well as to ascertain customer satisfaction with the report and the program, TecMarket Works conducted a phone survey pulled from a random sample of 18,951 Duke Energy customers from the Carolinas System who participated in the program between April 26, 2011 and December 16, 2011. TecMarket Works obtained 157 completes with usable responses, but some questions do not have responses from the entire survey population, so the total number of respondents for a given question may be fewer than 157. N sizes are discussed as appropriate throughout.

The survey was aimed at addressing the following key topics:

- How customers learned about the program and their reasons for participation
- Customer impressions of the different aspects of the report, include data presentation, data accuracy, and believability
- Frequency of energy saving actions
- Influence of the PER report on customers to take energy savings actions
- Customer satisfaction
- Customer interest in participating in a specialty CFL program

Program Awareness and Participation

Program Awareness

Customer mailings from Duke Energy are the primary channel for generating customer awareness about the program, and this is directly reflected in the survey results. As seen in Figure 1, 57% of survey respondents indicated they learned about the program via monthly bill inserts. An additional 27 customers (17%) indicated they received a notice in the mail when asked to explain their reason for choosing the "Other" category. Combined, these two mailing options total 74% of responses citing how customer learned of the program. Other channels had single digit response rates, the largest being learning about the program from a friend, family member or co-worker (5%). Referrals via other Duke Energy programs were negligible at 2%.

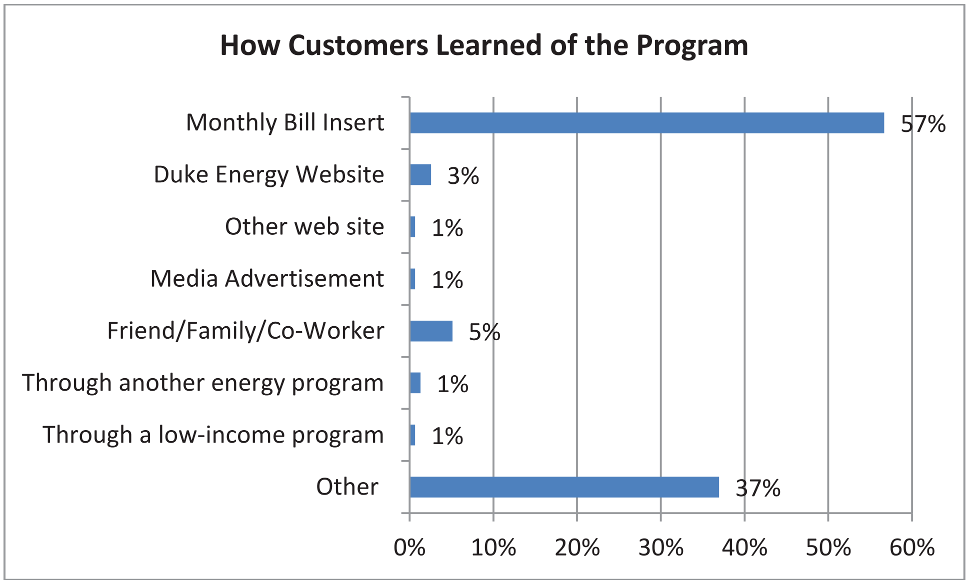


Figure 1. Channels for Program Awareness

Prior to learning about the program, 11% of survey respondents said they were considering getting a home energy audit, and 2% said that if the Personalized Energy Report had not been offered they would have purchased a home energy audit within the next year. These low percentages indicate that the program's marketing efforts are doing an effective job of attracting customers who have never before considered a home energy audit.

When these customers were asked how much they would pay for a home energy audit, their responses ranged from $0 to $800 for an average of $120. When high and low responses are discarded the average is $75. One percent of respondents had already purchased a home energy audit, but could not recall the purchase price.

Reasons for Participation

When queried about their reasons for participating in the program, half (50%) of those surveyed indicated their primary motivation was to save on energy costs. Receiving free CFLs was the second strongest motivating factor at 25%, as shown in Figure 2. Environmental concerns and past experience with this or other Duke Energy programs were of comparatively little importance, scoring 1% each.

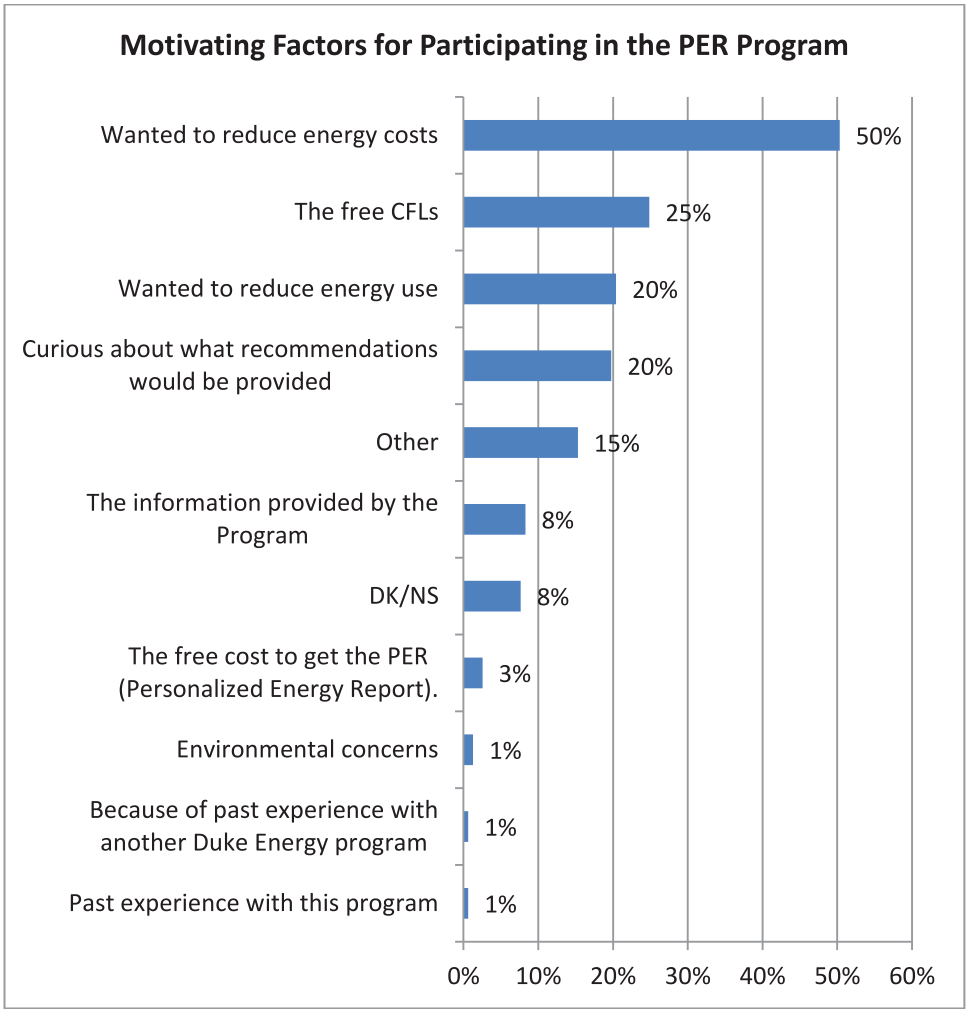


Figure 2. Motivating Factors for Program Participation

Twenty four survey respondents (15%) cited "Other" motivations for participation. Those reasons primarily focused upon a desire to save energy and a curiousity about how their energy use compared to others. Verbatim responses are shown below.

- "I wanted to see how accurate Duke's results would be."
- "I am conscientious about energy use."
- "Comparison with similar houses"
- "Ease of participation"
- "I have a medical condition that affects my vision and wanted to learn more about CFLs."
- "I wanted to compare the energy use of our old heat pump with that of our new one."
- "I wanted to find out how much energy we use."
- "I wanted to know why my energy bill kept fluctuating. I wanted to figure out where I was wasting energy."
- "I wanted to see how I was using my electricity and make sure I was using everything wisely."
- "It just seemed like a good thing to do."

- "Looking for information on new items"
- "My son signed me up for it."
- "We wanted an energy cost comparison."
- "Boredom"
- "I don't remember signing up for it, it just came."
- "I recently put in a new heat pump and I wanted to see if it was saving energy."
- "I thought that I had to do the survey when it came in the mail"
- "I am an architect and want to help out in saving energy."
- "Just wanted to get some info on our home."
- "To see how we compared to others."
- "I wanted to cooperate with Duke on their recommendation."
- "We wanted to make sure our house is energy efficient."
- "I wanted to see how our new system is working."
- "My wife wanted me to."

Customer Impressions of the Survey and Report

TecMarket Works next asked a series of questions to gather comments and feedback from customers about their impressions of the survey and the subsequent Personalized Energy Reports. Sixty percent of respondents recalled filling out the PER survey. These customers were asked to use a 1-10 point scale to rate their agreement with five statements about the survey and the report, with 1 indicating that they strongly disagreed and 10 indicating they strongly agreed. As shown in Figure 3, customers gave strongly favorable responses to all five questions, indicating the survey was easy to understand (9.4), the questions made sense (9.2) and were easy to answer (9.3). Customers also strongly agreed the Personalized Energy Reports were easy to read (9.2) and that the reports helped them to understand their household energy use (8.7).

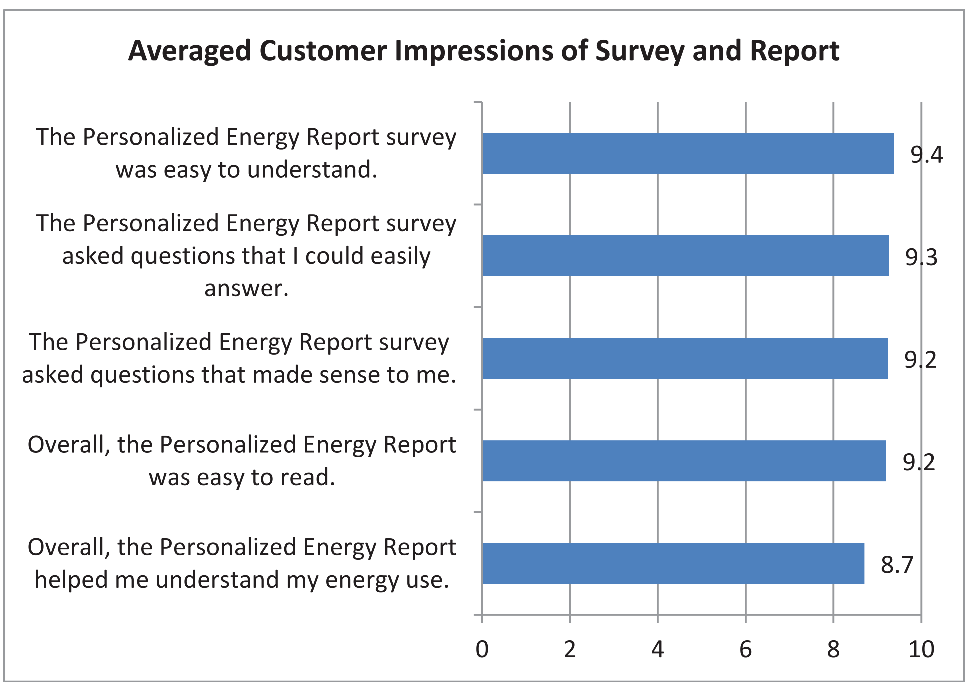


Figure 3. Averaged Customer Impressions of Survey and Report

When customers rated their agreement as a 7 or less on the 10 point scale they were asked to provide comments about how the surveys and reports could be improved. Suggestions for improvement included a request for less technical explanations, more accurate results, and more specific targeted areas, such as heat pumps. Verbatim comments are shown below.

Surveys

- Don't Know/Not Sure (6)
- "The report could have used simpler language." (3)
- "I have epilepsy and don't understand things easily" (2)
- "I just don't think Duke's results were accurate, based on my home."
- "Please provide an on-site energy audit."
- "Some questions were things that the average homeowner would not know off the top of head"
- "I wish the report survey questions were more detailed."

Personalized Energy Reports

- Don't Know/Not Sure (19)
- "Again, I just didn't think it was accurate."
- "Could be broken down more. Doesn't understand why the bill is so high. I live in a high efficiency home."
- "Did point out things. Children don't realize how much their use really costs."
- "I can't figure out what we're doing wrong/why our bills are so high."
- "I didn't understand it."
- "I don't know how it could be improved unless Duke did an infrared study of my home to see where I am using energy."
- "I have epilepsy and don't understand things easily"
- "I just didn't understand the technical terminology."
- "I was confused about what it said."
- "I'm not sure. Maybe make it easier for old people to understand. I think you younger people understand everything better. I guess you could get a young person to explain it all to me."
- "It required undivided attention to properly read it and understand all that was in there - as a firefighter, I don't often have that degree of undivided attention."
- "It seemed there was a lot of repetition."
- "My power bill just keeps going up and up in cost and I have no idea why. I am never home so there is no reason my bills should be so high."
- "Nothing new that we didn't already know."
- "Our energy use goes up and down because we have a poultry farm. When we have chickens, our energy use is pretty high."
- "Please add more specific target areas - heat pump for instance."
- "Provide better accuracy. The report had the square footage of our house completely wrong."
- "The report could be specific about the energy I use at home."
- "The report could have used simpler language."

Monthly Electric Usage and Charges

Fifty seven percent of survey respondents recalled reading the section of the report starting with the table and bar chart showing month-to-month electric usage and charges for the past year. This group of respondents was asked to the use the 10 point scale to rate their agreement with four statements. As shown in Figure 4, customers rated the reports very highly, agreeing that the table and approximate bill were easy to understand (9.3), the monthly variations made sense (9.2), the monthly usage and approximate bill were close to actual bills (9.1) and that they gained knowledge from the monthly usage table (8.2).

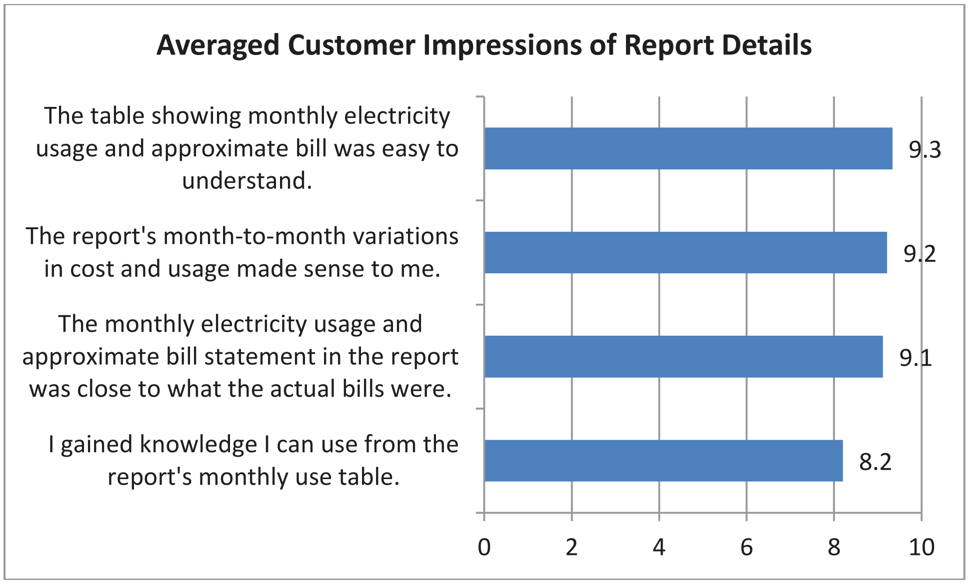


Figure 4. Averaged Customer Impressions of Report Details

Among those rating their agreement as a 7 or less the following comments were offered:

Table Showing Monthly Electric Usage and Approximate Bill

- "It could have been more accurately based on my home. Duke should have taken into account the different heating devices I use in my home and the fact that I turned my heating system off for two months."
- "The report's language could have been less technical."
- "It's been too long to recall the details."
- "I didn't understand it."

Monthly Electric Usage and Approximate Bill

- "Usage too high. The estimated bills were at least a couple dollars higher per day."
- "Usage too high. It was off by $35."
- "Usage too low. It was off by 20%."
- "Usage too low. My bills are higher, not sure how much"
- "Usage too low. Don't know how much."

Month to Month Variations in Cost and Usage

- "I know that our electricity usage fluctuates month to month but I was confused about the report."
- "Put amount paid for KW hour"
- "I just don't think Duke had it right. I think they just pushed the numbers up."

Knowledge Gained from Monthly Use Table

As a follow up to the question asking for the 1-10 rating about the knowledge learned from the report, the survey asked respondents to cite examples of what they had learned. Typical replies included: becoming more aware of energy use, learning tips to reduce energy use, realizing energy use varies by month, realizing the importance of turning off or unplugging devices when not in use, and learning which items use the most energy. Verbatim comments are shown below.

- "Compared to similar homes, my energy use was 50% more. I learned 'tips' and techniques on how to improve energy usage, like setting thermostat and leaving it on a comfortable setting instead of turning it up and down all the time, opening shades. I also learned to clean filters every 30 days."
- DK/NS
- "How much it would be monthly during the summer and winter, seasonal."
- "I am just watching it more, and being more aware of our use."
- "I am more aware of our highest months we use the most energy in and to try and conserve in those specific months more."
- "I don't remember."
- "I learned about conserving, the amount and usage, and monitoring our thermostat."
- "I learned about hot water, lights, and well water, and how much those things contribute to my bill. I also learned that I needed to have a lot of insulation."
- "I learned about the difference in energy use between CFLs and standard bulbs. The report also really educated me about the importance of turning off devices that I am not using, especially my cable box and DV-R. I had not known previously that those devices could use so much power when I was not using them."
- "I learned about turning off lights and using CFLs and securing windows and air drafts."
- "I learned about using CFLs to save energy costs."
- "I learned different ways to save money."
- "I learned how much electricity I use."
- "I learned how much you use based on the different seasons."
- "I learned how to govern the use of our electricity."
- "I learned how to save energy by turning off lights and appliances when I am not using them."
- "I learned not to change my thermostat settings quite so often in order to save energy."
- "I learned not to leave lights on, and use the CFL bulbs."
- "I learned that I need to better insulate my home."
- "I learned that if I cut back and unplugged a lot of devices, my bills would be lower. I have a lot of computers. Also, the CFLs helped me save a lot of energy."
- "I learned that I'm not doing too bad with the energy that I'm using."
- "I learned that it's the small things that add up, like leaving lights and the TV on."

- "I learned that most of my costs come from heating and cooling. I also learned about water usage."
- "I learned that my home is pretty efficient."
- "I learned that my house rated in the high range for use and I had too many items running all the time."
- "I learned that our energy bill was higher in the summer than in the winter (due to a pool pump)."
- "I learned that our energy consumption varies month to month due to extra people staying in the home."
- "I learned that using CFLs and turning off certain items will help me save money. Also, to purchase Energy Star-rated appliances."
- "I learned that we use more energy during colder weather."
- "I learned to avoid running appliances during peak hours."
- "I learned to turn my thermostat down when it was cool or up when it is hot, and to turn off my lights more."
- "I learned to turn off lights when leaving a room."
- "I learned which months we are using more power in."
- "I need to cut power back in the summer. It was easy to understand goals."
- "I need to my replace windows to help with efficiency."
- "I really can't remember but I'm sure that I learned something from it."
- "I take most of it for granted. I have to pay more attention."
- "I think I was pleased by my energy usage. It was in the lower percentage section."
- "I thought I was doing better than I was. I was shocked and ashamed. I made improvements to the house as a result of the report. I use my dryer less. I will be putting up a clothes line. I am re-installing my storm door and replaced some windows."
- "I was confused about the report so I couldn't really gain any knowledge."
- "I was told about weatherization to help keep my bills low."
- "I'm using more energy than other people around me. I put insulation and new windows in part of the house and hope to get to the rest of the house soon."
- "It was a good reminder to switch to CFLs."
- "My bills are going up."
- "My dryer and water heater use the most power."
- "My house is not very energy efficient because of the construction. I have vaulted ceilings. I learned I am not very conservative when I thought was, but it's the house too."
- "Nothing in particular."
- "That I have a very energy efficient home."
- "That our home is really efficient."
- "That the efforts that I have been making aren't quite enough."
- "That we are doing pretty good."
- "That we were using too much electricity. And that our 14-year-old heating and AC system is probably costing us extra money."
- "The data was all in one place graphically. Someone did the work for us. And since we're on the equal payment plan, it's not as easy to check."
- "The peaks I have in summer and winter are somewhat extreme."

- "The report taught me what items use the most energy."
- "The summer months and coldest winter months will kill you on the bills."
- "There are too many people in the home who don't have concern about the electric bill. My son and his kids live with me."
- "We are leaving lights on when we don't need them."
- "What time of year I had peak power use."
- "Winter and summer were equal draws."

Sharing of Knowledge

Having ascertained what customers had learned from the reports, TecMarket Works next asked them if they had shared what they learned with others. Of the sixty people who responded to this question, half (50%) indicated that they had spoken with others about what they'd learned. When asked who they had spoken with, respondents predominantly indicated spouses, children, and parents, with occasional mentions of friends, neighbors, and students. Their specific responses are noted below.

- "No" (30)
- "Yes" (2)
- "My wife" (6)
- "My sister" (4)
- "My family" (3)
- "My friends" (2)
- "My mother"
- "My husband"
- "My son"
- "My daughters"
- "My mom. They're on Blue Ridge instead of Duke."
- "Talked with my Dad about it."
- "I told my family to try to conserve, especially in summer. My house receives full sun and sits on a hill. My A/C units are 13 or 14 years old, so that probably has a lot to do with costs."
- "My children and my boyfriend."
- "My husband compared reports with his sister."
- "Yes, we discussed it with some neighbors, relatives, and people who live in rental properties that we own."
- "I am a high-school teacher, so I shared it with my class."
- "I recommended the program to others."
- "I talked to a few people I know at church."
- "I talked with my wife about it. She also saw the report and is a big advocate of saving energy and energy costs."
- "I told my wife. I knew that next month will go down. So my wife has extra expenses in the budget for herself, since the spring and fall bills are the lowest."

Household Electricity Use

Forty three percent of survey respondents recalled reading the section of the report covering household electricity usage. When these customers were asked to use the 10 point scale to rate a series of statements, they returned the following results. Respondents strongly agreed that the pie chart was easy to understand (9.3), the breakdown of energy made sense (9.0), and that the cost breakdowns by energy consumption (8.7) and specific household activity (8.7) gave them new knowledge and awareness (8.7). These findings can be seen in Figure 5.

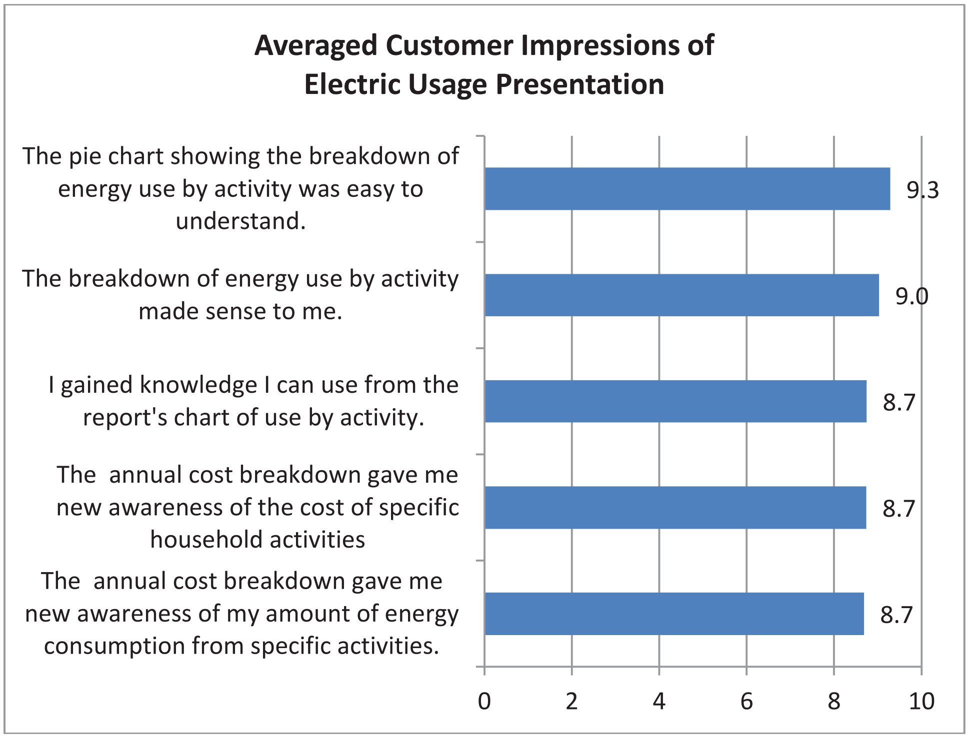


Figure 5. Averaged Customer Impressions of Electric Usage Presentation

While these strong results leave fairly little room for improvement, those people rating their agreement at less than 7 offered the following responses:

Pie Chart

- "The report could have explained the pie chart a little better."
- "Just better explanation."
- Don't Know/Not Sure (3)

Breakdown by Activity

- "I can't understand how much my dryer uses and my heat and so on."
- "I was confused and I can't tell you why because I don't know how or why I'm confused."
- Don't Know/Not Sure (5)

Energy Consumption by Activity

- "I already knew this, because I work for another power company."
- "They could have gotten their facts straight in regards to our home."

- "I didn't understand how they broke it down."
- "I don't remember."
- "Nothing"
- Don't Know/Not Sure (6)

Energy Cost by Activity

- "I didn't figure how they could determine how it was used."
- "I already knew about this."
- "Provide fresh ideas. My own research had already made me aware of many energy-saving tips."
- "I don't remember."
- Don't Know/Not Sure (5)

Chart of Use by Activity

- "There was nothing Duke Energy could do about this."
- "Provide fresh information that savvy customers can use."
- "You can't really. I 'gained knowledge' about how the house is using electricity but I don't see how I'm going to put that information to any use. I mean, I'm still going to use the appliances and watch TV when I want."
- "I don't remember."
- "There's nothing really that you can do. I have to look at where I'm spending the most money and use less power."
- Don't Know/Not Sure (3)

What Customers Learned About Energy Consumption and Cost

When asked to specify what they had learned about their energy consumption from specific activities, customers indicated that they learned how much energy they use month to month, that usage varies, and which items use the most energy. They also learned to change their behaviors and reschedule activities when possible. Verbatim remarks are noted below.

- "Heating and cooling use the most energy."
- "I can tell when school is out and the kids are home in the summer--there's more use of electricity."
- "I just got a better understanding of where all the electricity I use is going."
- "I learned which areas of my home use the most energy."
- "I learned about avoiding using energy during peak times and that energy efficient appliances will make a difference in energy use."
- "I learned about the benefits of changing light bulbs to CFLs, using my ceiling fan, and raising my thermostat in the summer."
- "I learned about the relative cost of various activities."
- "I didn't realize how much heat and cooling was pulling, or how much lights were costing."
- "I learned how much energy is being used for different activities but I'm not sure how that is going to help me."

- "I learned how much hot water costs, especially showers and running washing machine. It's more than I would have expected."
- "I learned how much I use month-to-month, and how much I could save."
- "I learned I should impose 'rules' for my daughters, who are in their early 20s."
- "I learned that Duke Energy claims that we're using so much power on certain activities, but I disagree."
- "I learned that heating and cooling are huge energy users."
- "I learned that I was wasting energy, specifically my misuse of the clothes dryer."
- "I learned that our energy consumption varies month to month due to extra people staying in the home."
- "I learned that there was not much more that I could do to reduce my energy use."
- "I learned that we need alter certain household habits to save energy."
- "I learned to be more careful about turning lights and the TV off regularly."
- "I learned to cut back on certain usage of specific items like the AC unit."
- "I learned to reschedule some activities."
- "I learned where I was using energy. Water heating and laundry really stood out."
- "I learned where our energy was going, such as our pool."
- "I learned where we used the most energy like on heating, AC, and lights."
- "I learned which major appliances use the most energy."
- "I learned, again, about saving on my energy bill by turning off things I am not using."
- "I liked learning 'tips' on activities."
- "I understand that the more power I use, the higher the bill is going to be, and I know that I use more energy at some times than others."
- "I was most excited to find out how much energy is being used by the pool pump. I liked the breakdown."
- "I was surprised to learn how much energy the water heater and refrigerator use."
- "It is best to turn off lights when not in use, close off rooms when not used, do laundry at night and do larger loads."
- "It let me know that at certain times of day, I should keep windows covered or uncovered."
- "It made me think more about what I was turning on and how long things were being used."
- "It was more of a cost comparison. The report supported my assumptions. It also helped to identify areas where we could take steps to reduce costs."
- "Mainly I just became aware of how much energy is being used for the individual activities."
- "My bills keep going up and I hardly use much energy."
- "My electricity towards lights was less than I thought while electricity consumption for the hot water heater was much higher than I had thought."
- "Nothing"
- "That our grandson's gaming is using energy. We now unplug the system when he's not using it."
- "The amount of energy my hot water, washer and dryer consume. I hadn't thought they factored in that much."

- "The dryer and water heater are using most power."
- "The house is efficient."
- "The report confirmed that what we were already doing was good."
- "To turn lights off."
- "Turn off appliances and lights when not using them. I learned that we can save when we do laundry at night."
- "We are a retired couple. We are very conscious of daytime and night-time energy use."
- "We're leaving lights on too often."
- "What each thing (activity) is costing me, such as laundry."
- "I don't remember." (5)
- DK/NS (2)

When asked to specify what they had learned about their energy costs from specific activities, customers said they learned the relative cost of various activities, which items cost the most to use, when to use appliances to save money, and how to save money by changing their behaviors. Some people felt pleased with their previous decisions, such as purchasing energy efficient appliances, while other people didn't believe the breakdown of where they were spending money. Verbatim comments are shown below.

- "Again, I learned I should impose 'rules' for my daughters, who are in their early 20s."
- "Again, it made me more aware of hot-water use, as well as the energy that heating and cooling use."
- "Heating and cooling. I thought other areas were just average uses."
- "I became more aware of how much energy certain appliances used, so I could start monitoring that more closely."
- "I could see how much money Duke Energy thinks we're spending on certain activities but I don't believe it."
- "I learned about individual appliance usage."
- "I learned how certain activities affect our energy bill and how easy it is to cut them out of the equation."
- "I learned how much running different things cost me, like the water heater and refrigerator."
- "I learned that certain items cost more to run."
- "I learned that I was using way too much energy and needed to cut back."
- "I learned that our energy consumption varies month to month due to extra people staying in the home."
- "I learned that some activities, especially ones involving hot water, use more energy than others."
- "I learned to avoid running appliances during peak hours."
- "I learned to be more aware of things on a day-to-day basis."
- "I learned to be more careful about turning lights and the TV off regularly."
- "I learned to turn more stuff off when I'm not using it."
- "I learned which areas I could reduce usage, such as ceiling fans and TVs."
- "I liked finding out how much we're spending on running the pool pump and other activities."

- “I need to conserve more.”
- “It made me aware of which appliances cost the most to use.”
- “It showed me where I should be compared to where I was on the scale.”
- “It taught me about the amount of power for TVs, computers and such.”
- “Mainly I just became aware of how much energy is being used for the individual activities.”
- “My electricity towards lights was less than I thought while electricity consumption for the hot water heater was much higher than I had thought.”
- “Some things cost more.”
- “That purchasing all new energy efficient appliances really paid off.”
- “That there are things that we can do to get our energy bill lower but there isn't much that we can do because my husband and I are disabled and we're home all day and need power to run certain things.”
- “The dryer and water heater are costing me more than everything else.”
- “The report confirmed that what we have done in the past is keeping our energy costs at a minimum.”
- “Turn off appliances and lights when not using them. I learned that we can save when we do laundry at night. I guess it really shows what how much each activity costs us.”
- “We learned to save dishwasher and laundry for larger loads. We pull out the broom instead of the vacuum when possible. We don't run machines unless necessary.”
- “We learned to tolerate hotter temperatures before turning on our air conditioner. The house could get up to 80 degrees and still be comfortable until about noon if we kept the windows open and used our overhead fans. We ran our AC less in the morning and more in the evening, when there's less activity on the electric grid. We also began doing laundry later at night. We saved energy and money this way.”
- “We need to unplug things that we're not using.”
- “We try to keep the temperature down in the winter and up in the summer, and be more aware of the light use.”
- “Nothing” (6)
- “I don't remember.” (4)
- DK/NS (4)

When asked to specify what they had learned from the Personalized Energy Report customers reported learning that it takes multiple efforts to save energy, that little things make a difference such as turning off and unplugging items when not in use, and making other changes in energy use habits. They also indicated they were thinking about or taking actions to replace items as small as light bulbs and as large as heat pumps. One person said they still didn’t understand why bills were going up, while another said they appreciated the information in the report so much that they refer back to it periodically to see what else they can do to save energy. Verbatim comments are noted below.

- “During the daytime, I need to bump the thermostat up from 72/73 to 74/75.”
- “How to conserve”
- “I don't know why my bill keeps going up.”
- “Just good to know.”

- "I just learned to be more cautious and aware of what we're doing."
- "I learned information about the type of lighting and what it costs."
- "I learned that I use a lot of energy."
- I learned that I use too much energy."
- "I learned that I was wasting a lot of money. I learned which items could be unplugged to save energy."
- "Cooking seemed to also be a big draw. It made me sit back and contemplate having a gas line put in for water, range, dryer, if that would be more cost/energy efficient over the long run."
- "I learned that our energy consumption varies month to month due to extra people staying in the home. I also learned that our home uses less electricity than similar homes in the area."
- "I learned that the new AC we put in in August of 2012 will help lower our energy bill but I pretty much already knew that."
- "I learned that we need to make changes to our habits and home in order to save money."
- "I learned to avoid running appliances during peak hours."
- "I learned to be more careful about turning lights and the TV off regularly."
- "I learned to turn off lights and turn down my thermostat."
- "I learned to turn the lights off when I leave a room."
- "I learned to unplug items when not in use."
- "I learned where in my home energy was being used."
- "I learned which items I can cut to save money."
- "I learned which times of year I am using more than the average. It made me ask myself questions about my energy use."
- "I need new windows."
- "I targeted energy savings by using more energy efficient lighting. I also replaced an old heat pump, which reduced energy usage quite a bit."
- "I thought I was doing better than I was doing."
- "If there is a way to use our dryer and water heater less, that would lower our bill."
- "It made us aware of the energy our heat pump and hot water heater consume."
- "It was a great to see a basic breakdown of electricity usage (get to see how much is used for heating, cooling, light use, hot water, etc.)."
- "Mainly I just became aware of how much energy is being used for the individual activities."
- "My A/C also stood out, as did heating."
- "Nothing"
- "That the house is efficient and that purchasing all new energy efficient appliances really paid off."
- "That there are different things that I can do to get our bill lower."
- "That we are energy efficient."
- "To put in different light bulbs, use lower wattage and longer life bulbs, and turn off lights and appliances when not in use."
- "Turn off appliances and lights when not using them. I learned that we can save when we do laundry at night."

- "Was higher than it should have been - it got me to work to lower my energy usage"
- "We are leaving on too many lights and we need to get energy efficient AC. We need to unplug things more often."
- "We have already covered it."
- "We learned various ways to conserve energy. We've occasionally re-read the report to make sure we're doing things right."
- "We needed to make multiple efforts to save energy. I got rid of an old refrigerator. I also will be getting more insulation in attic to cut on heating/cooling costs."
- "What my lights and water was using."
- "What things are using the most energy"
- "When kids walk out of the room, I cut off TV and lights. They need to teach energy conservation with water conservation."
- "Conserve"
- "I don't remember." (3)
- DK/NS (3)
- "DK/NS, but it helped."

Comparison with Other Homes

Exactly half (50%) of survey respondents recalled reading the section of the report that compares their annual household energy use with similar homes in the area. Among those customers, the average agreement rating for the believability of the comparisons was 8.3, while customers rated their new awareness as a result of the comparison at an average of 8.5 as shown in Figure 6.

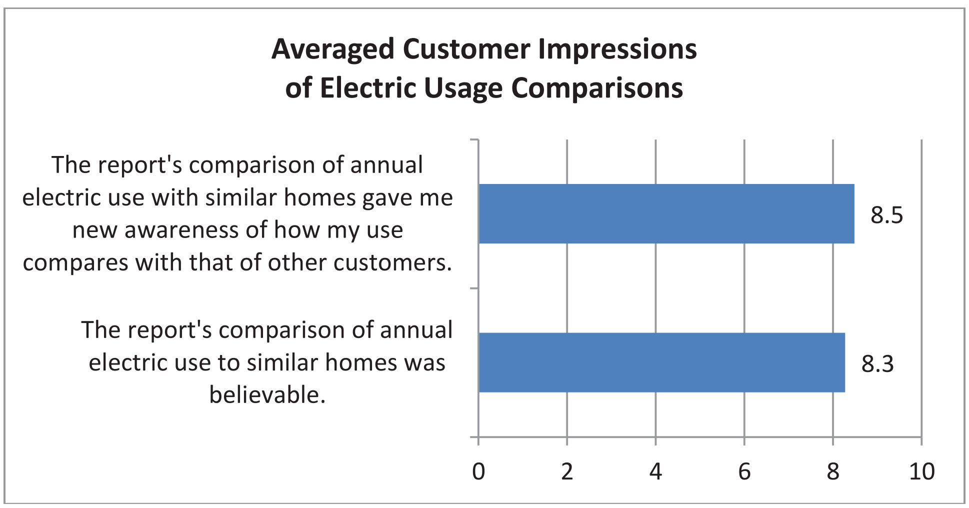


Figure 6. Averaged Customer Impressions of Electric Usage Comparisons

Although these agreement scores are respectable, they are among the lowest scores of all report attributes questioned during the survey, indicating that this portion of the report may be an area that customers feel provides an opportunity for improvement. To ascertain what could be improved, all customers who returned an agreement score of 7 or less were asked to provide comments. Their feedback suggests that the home energy use comparisons have a credibility problem among those who ranked their agreement lower on the 10 point scale. Concerns ranged from skepticism and ignorance to disbelief and denial. Reasons for those concerns arose from 1) a lack of methodological understanding about how the data was collected and compared; 2) a lack of understanding about how their homes and their behaviors impact energy consumption; 3) a belief that their situations are unique and should not be compared; and 4) an unarticulated disregard for the data as presented. Verbatim responses are noted below.

- “I just don't see how Duke Energy can compare one house to another.”
- “I couldn't tell whether the homes that mine was compared to were truly similar.”
- “Since they got the initial stats on my house wrong, it followed that the whole report could be tainted.”
- “The comparison was drawn with homes of similar square footage, but we only use about less than half of our square footage.”
- “The report doesn't compare like-age houses, just those of similar size. Newer homes tend to be more efficient.”
- “My bill is over $100 more than that of similar homes. I find it hard to understand why.”
- “As an architect I was skeptical about what was used in the comparison. There are many variants in home.”
- “I don't know, I'm not sure about it. Our energy bills are so high and we don't know why.”
- “I don't remember.”
- “I feel like our bills are pretty low and that we're fairly energy efficient and the report said that we're not.”
- “I just don't believe that we're using that much more power than similar homes in the area.”
- “I think that a lot of other things play a factor in the annual electric use. Maybe what we did or didn't do, maybe we’ve got more kids leaving stuff on, etc.”
- “I think we should be lower than what it said because we only have an AC unit, heater and TV. We don't use much electricity.”
- “I'm not sure because I don't really know what other people are using and we don't have a very big house to compare to.”
- “It’s an unusual home so it's hard to compare in that region. We have a three-floor chalet with high ceiling.”
- “Mine was higher than others and I don't think that's right because my neighbors have an electric furnace and I use a kerosene heater.”
- “We keep thermostat very low and the house very insulated. I think you made an error because we shouldn't be using more power than other customers.”
- “Well, I just don't believe it. There's no reason in particular, I just don't.”
- “I had to discount the validity of the report once I saw that my home's baseline numbers were incorrect.”
- “The report could compare familiar neighboring homes.”
- “I didn't believe the comparison so I didn't get a new awareness of how our use compares with other customers.”
- “I don't believe the information that was sent to me.”
- “I don't know where the data comes from when the report compares our house to other houses. Do these homes have zip codes? Are they the same age? I'm not sure of where the comparison comes from.”

- "I don't remember."
- "Since I didn't believe the report, I didn't get any awareness of how our use compares with that of other customers."
- "What was it based on? Orientation, number of windows, square footage vs. cubic footage, use of a heat pump vs. furnace?"
- DK/NS (5)

What Customers Learned Overall About Their Energy Consumption

When asked to specify what they had learned overall about their energy consumption customers responded with the remarks below. These ranged from comparative statements about how their consumption compares to others to comments about factors impacting energy use, such as square footage, age of the home, insulation, and behavior. Their verbatim comments are listed below.

- "We are more aware of what areas we're spending most of our energy on, and how we can become more energy-efficient."
- "At the time, our use was a little higher than homes of other size. It compelled me to take steps to get energy use/costs down."
- "How much an older house can be losing energy everywhere, through cracks, leaks, and appliances. It compels me to upgrade to newer standards."
- "I believe that my use was going towards the high end."
- "I learned that Duke is trying to help us save energy."
- "I learned that I need to cut back on the amount of energy we use."
- "I learned that I need to do some efficiency upgrades to our house."
- "I learned that I needed to do a lot better at saving energy."
- "I learned that I use a lot of power."
- "I learned that I use slightly more than an average amount of electricity."
- "I learned that I was doing a very good job of managing electrical costs. I rated in the low end of things."
- "I learned that I was using a little bit less energy than other people with similar homes in the area."
- "I learned that I wasn't consuming as much energy as other people."
- "I learned that I'm a bit heavy-handed with the thermostat."
- "I learned that my energy consumption was really high and I needed to reduce it."
- "I learned that newer homes are more energy-efficient."
- "I learned that we consumed an average amount of energy."
- "I learned that we were using less energy than comparative homes."
- "I was surprised that the previous owner had close to double the electric use that I had."
- "It has to do with the size of the house in the AM and PM."
- "My wife uses the lights too much."
- "That I was in the lower part of the chart."
- "There are things I can do to reduce energy use, especially replacing windows. I have put that off but need to do as soon as possible."
- "We all need to conserve more."
- "We are energy-efficient."
- "That I'm losing too much heat/cool air through my old windows."

- DK/NS
- "I learned about areas where I may have been over-using energy."
- "I learned that bigger houses use more electricity and the importance of insulation in energy conservation."
- "I learned that if I followed the tips, like good insulation, I will see difference in bill."
- "I learned that we need to be using less power."
- "I learned to adjust my actions that affect energy usage. I am doing better now than a few years ago."
- "I use less electricity than the other customers with similar homes."
- "I use less energy than my neighbors."
- "I was a little higher than others and it concerned me."
- "I was thinking about getting electric heat. I learned what electric heat would cost from what it showed for my neighbor. But I realized it wouldn't save me any money."
- "I watch the meter. If it's spinning fast, unplug something. I dry clothes at night and don't dry clothes and run the oven at the same time."
- "I'm about average."
- "I'm below average but still a bit high. We use a lot of hot water."
- "I'm lower than others."
- "I'm really not sure any more. It's been too long."
- "It gave me information about how much energy is being used for each activity."
- "It showed that we were higher in some areas and lower in others."
- "It was distorted because my home was listed as having smaller square footage than it has so the comparison wasn't an accurate. I did call Duke and made them change it but they said it wouldn't show for a couple of months so I don't know yet."
- "Mine was a little higher than others so I need to tighten up."
- "My house is an older home and I don't know if they compared it with newer or older model houses. My energy use said it was higher than others."
- "Our energy usage is below that of similar homes. Also, the number of people staying in the home in our home makes a larger difference in the power bill."
- "Our house uses more energy than other customers' houses."
- "That my household was using more than the people around me"
- "That we are higher than other people."
- "That we use a lot of electricity."
- "That we use less electricity than other people in similar homes."
- "That we're doing pretty good with the space that we have. There is some confusion about how many meters are being read for the audit report. My shop and house meters are on same bill while the barn meter is on a separate bill."
- "We are leaving on too many lights and we need to get energy efficient AC. We need to unplug things more often. We have inefficient windows and siding."
- "We are more energy efficient than other homes."
- "We are more frugal than other customers."
- "We are on the high side for energy usage. We now unplug appliances and are using the CFLs."
- "We're doing pretty good compared to other similar houses."

- "We use more energy than others because we have people working all different shifts so someone is always home, and we have a large pool that uses a lot of energy."
- "We were lower than others."
- "When people are home, we used more. Even so, I found out I was around average for a house my size."

Energy Saving Tips

Frequency of Energy Saving Actions

When survey respondents were asked if they recalled reading the section of the report featuring energy savings tips, 60% indicated that they did. We then asked this group of respondents to discuss the energy saving actions taken in their homes. The most popular energy saving action reported was "Closing window curtains at night during the winter" with 83% of respondents taking the action and another 4% indicating that they did not have curtains or blinds. "Opening window curtains in the daytime in winter" scored almost as high with 81% indicating that they take action. "Closing window curtains in daytime in the summer" scored the third highest number of responses with 73% of customers reporting that they do so. The least common action taken was testing the seals on refrigerator doors with a dollar bill with only 27 people (17%) saying they had done so. These findings are presented in Table 6 and in Figure 7.

Table 6. Respondents Taking Energy Saving Actions

	Number of Respondents				Percentage of Respondents			
	Yes	Don't Have or Not Applicable	No	DK/NS	Yes	Don't Have or Not Applicable	No	DK/NS
*Close window curtains at night in winter	131	7	19	*	83%	4%	12%	*
*Open window curtains in daytime in winter	122	0	29	*	81%	0%	19%	*
Close window curtains in daytime in summer	115	6	34	2	73%	4%	22%	1%
Use exhaust fans in the summer	91	0	46	0	66%	0%	34%	0%
Dry loads consecutively to improve efficiency	102	12	36	7	65%	8%	23%	4%
*Use ceiling fans in the winter	100	8	49	*	64%	5%	31%	*
*Turn down heat when leave home in winter	92	17	48	*	59%	11%	31%	*
Rinse dishes before putting them in dishwasher	91	51	14	1	58%	32%	9%	1%
Re-schedule heat-generating activities on summer afternoon	72	0	80	5	46%	0%	51%	3%
Lighten dryer loads to improve efficiency	71	13	61	12	45%	8%	39%	8%
*Use a portable heater in the winter	69	19	69	*	44%	12%	44%	*

*Turn up thermostat when leave home in summer	69	20	68	*	44%	13%	43%	*
Test seals on refrigerator door	27	0	126	4	17%	0%	80%	3%

* *This question did not allow for Don't Know/Not Sure (DK/NS) responses.*

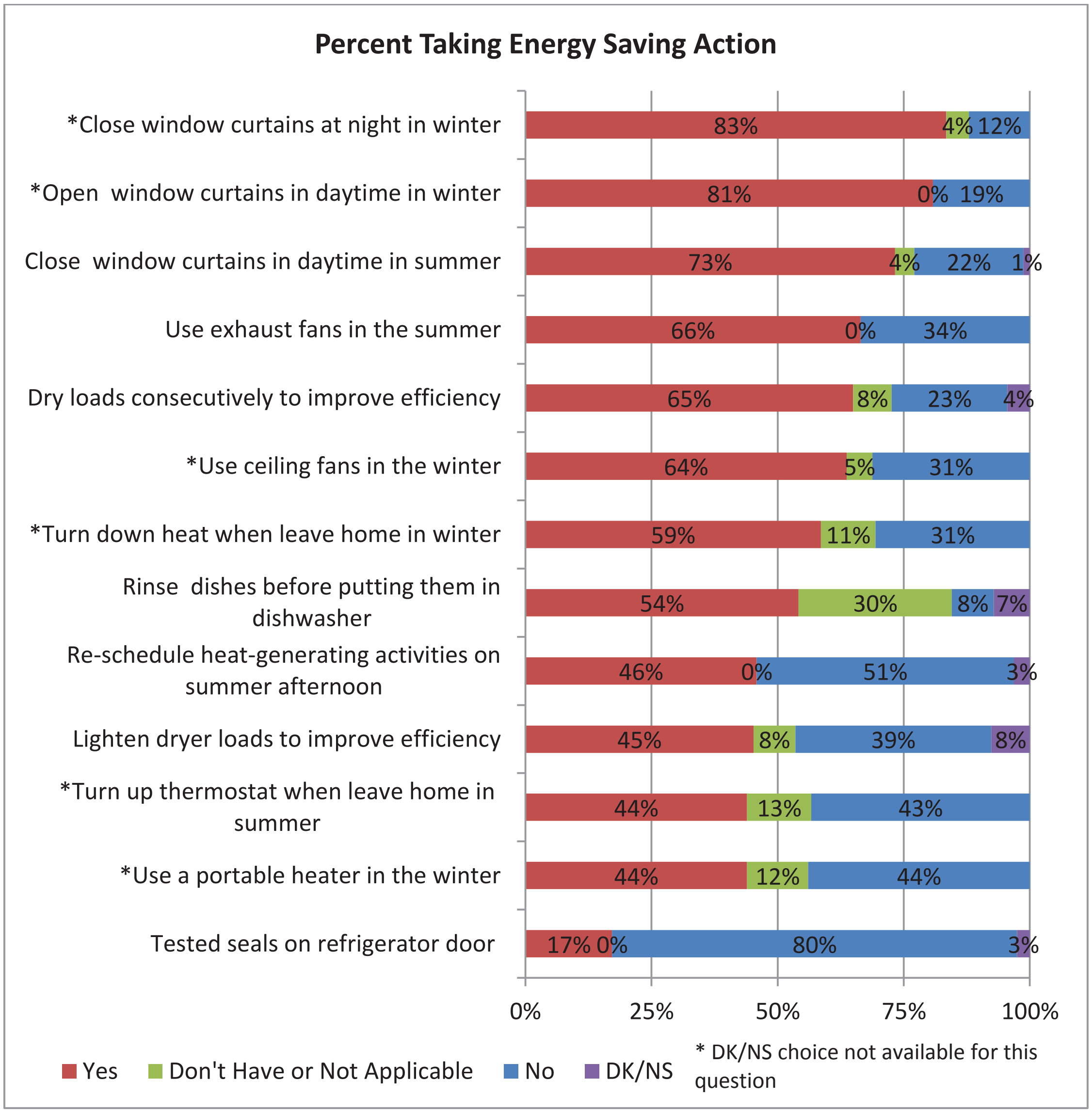


Figure 7. Percent of Respondents Taking Energy Savings Actions

The survey also delved deeper on several energy-saving behaviors, such as rinsing dishes prior to placing them in the dishwasher. Of the 54% of respondents who acknowledged this behavior, 51% reported using hot water to rinse their dishes, compared to 49% who used cold water. Likewise, the survey revealed that of the 46% of respondents who reschedule heat-generating activities on summer afternoons, 42% said they rescheduled cooking, 21% rescheduled cooking, 18% clothes drying, and 16% dishwashing. When asked to clarify which types of exhaust fans they use in summer, 15% said kitchen fans, 19% said bathroom fans, 29% said they used both types of fan, and 3% used the "Other" category to report the use of attic fans.

Pre- and Post-Report Energy Saving Actions

The survey followed these baseline behavior questions by asking respondents if they were performing these energy saving actions prior to or after reading the Personalized Energy Report. For all actions that we asked about a majority of customers indicated that they were already taking the action before reading the Personalized Energy Report. For 7 out of 13 of the energy saving actions 80% or more of respondents reported that they were already taking action prior to reading the reports.

When considered by percentage of respondents, the Personalized Energy Reports were most influential in encouraging people to test the seals on their refrigerators doors with 44% of respondents to that question doing so. However, only 27 people responded to that question. When considered by the greatest number of respondents, “Lightening drying loads to improve efficiency” was the most popular action taken by customers after receiving the PER. In that case, 26 out of 71 people (37%) reported doing so for the first time. But when tallies for “After” responses are combined with the number of responses for “Before but I do this more often now” then “Rescheduling heat-generating activities on summer afternoon” garnered the highest number of responses (33), making it the energy saving action most influenced by the Personalized Energy Report. These findings are compared in Table 7 and Figure 8.

Table 7. Respondents Taking Action Before and After Receiving Personalized Energy Report

	Number of Participants					Percentage of Participants			
	Before	Before, but I do this more often now	After	DK/NS	Total N Size	Before	Before, but I do this more often now	After	DK/NS
Tested seals on refrigerator door	15	0	12	0	27	56%	0%	44%	0%
Lighten dryer loads to improve efficiency	40	5	26	0	71	56%	7%	37%	0%
*Turn down heat when leave home in winter	*	*	24	*	92	*	*	26%	*
Dry loads consecutively to improve efficiency	70	11	21	0	102	69%	11%	21%	0%
Re-schedule heat-generating activities on summer afternoon	47	9	14	1	71	66%	13%	20%	1%
Use a portable heater in the winter	56	3	9	1	69	81%	4%	13%	1%
Turn up thermostat when leave home in summer	56	5	8	0	69	81%	7%	12%	0%
Close window curtains in daytime in summer	92	12	10	1	115	80%	10%	9%	1%
Use ceiling fans in the winter	78	12	9	1	100	78%	12%	9%	1%
Rinse dishes before putting them in dishwasher	78	5	5	2	90	87%	6%	6%	2%
Close window curtains at night in winter	118	6	6	1	131	90%	5%	5%	1%

Use exhaust fans in the summer	81	5	5	0	91	89%	5%	5%	0%
Open window curtains in daytime in winter	99	15	6	1	121	82%	12%	5%	1%

** This question worded Did you take this action after: Yes or No.*

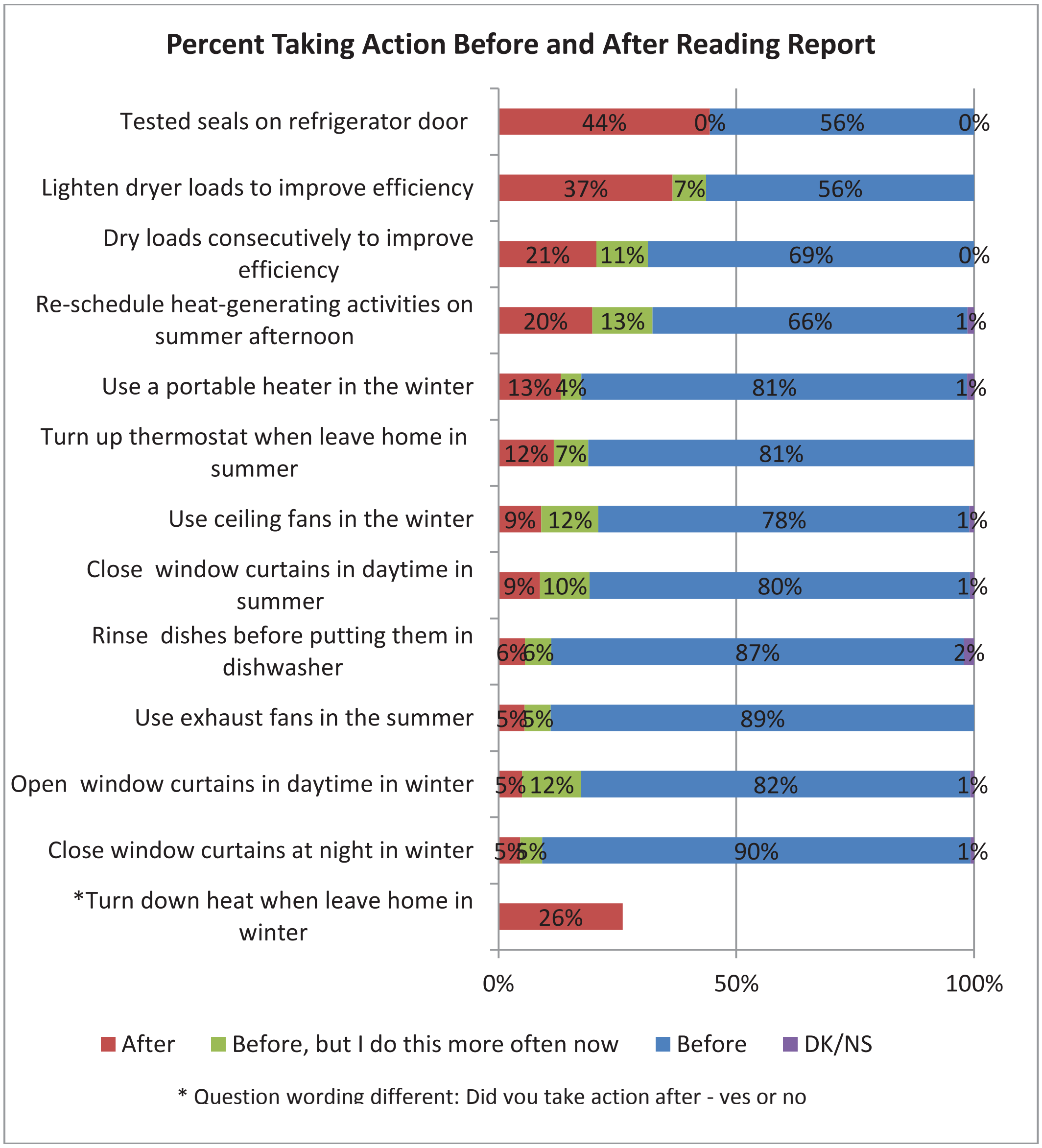


Figure 8. Percent Respondents Taking Action After Receiving PER

Report Influence on Energy Saving Actions

Participants were also asked to rate the influence, on a 1-to-10 scale, that the energy saving tips presented in the Personalized Energy Reports had on their decisions to take the recommended actions. According to those surveyed, the PER recommendations were most influential on the "Testing of refrigerator door seals" with a mean influence score of 9.8. However, as noted above, this action had the lowest number of people responding to the question. “Closing window curtains on winter nights” (mean 9.2) and “Lightening dryer loads to improve efficiency” (mean 9.0) rounded out the top three. All energy saving recommendations enjoyed a high level of influence at a mean of 8.3 or greater, except for the “Use of portable heaters during winter,” which scored 6.8 on the 10 point scale. The full spectrum of influence scores for all energy saving actions is noted in Figure 9.

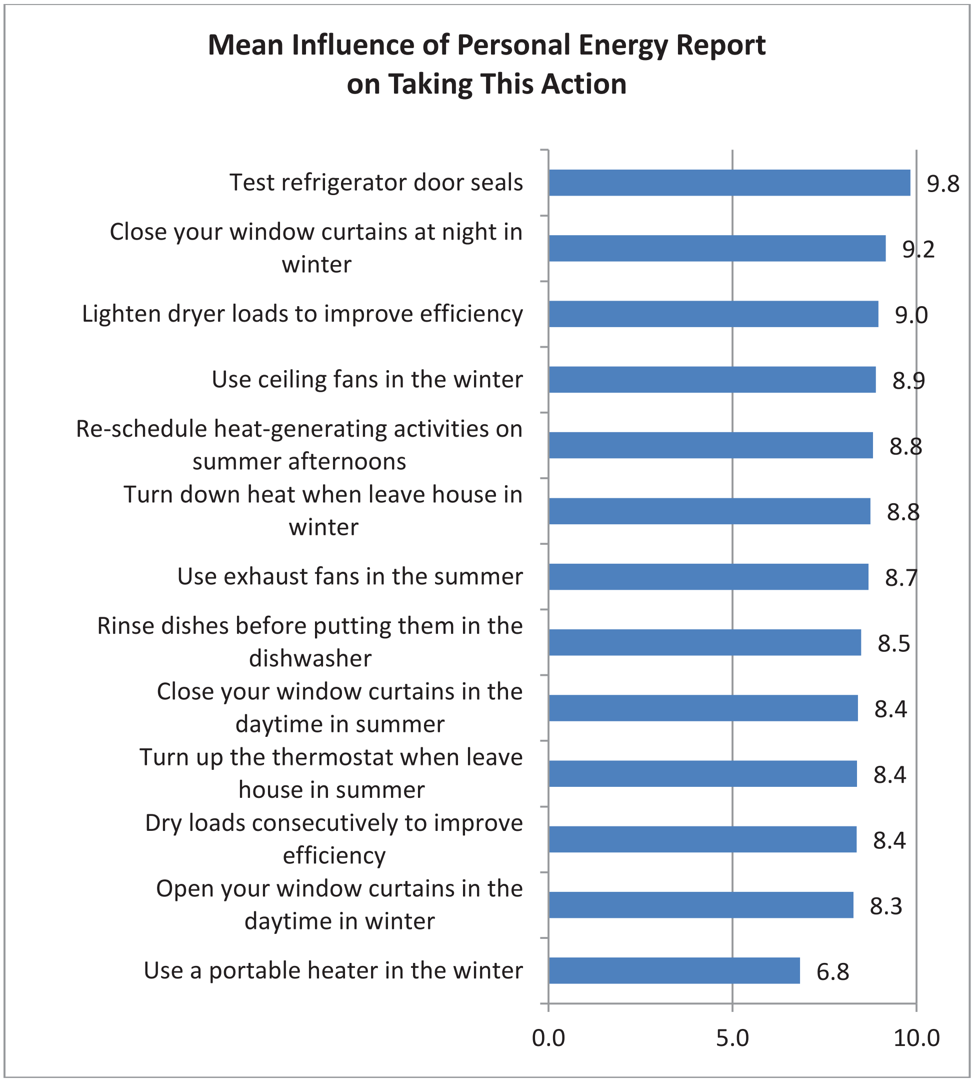


Figure 9. Mean Influence of PER on Taking Energy Saving Actions

When influence scores are considered in conjunction with before and after behavior scores, it appears that for a majority of the population the Personalized Energy Reports did more to reinforce existing behaviors than to encourage new behaviors. Nonetheless, the overall influence of the reports is strong.

Additional Changes in Habits

The survey also sought to determine if respondents changed any of other habits as a result of receiving the Personalized Energy Report. Thirty eight percent of the total survey population reported doing so. When considered on a state by state basis, more respondents from North Carolina (43%) reported doing so than their counterparts from South Carolina (34%) as shown below in Table 8.

Table 8. Number of Respondents Changing Energy Habits

	Number of Respondents				% Respondents		
	Yes	No	DK/NS	N	Yes	No	DK/NS
NC	33	40	4	77	43%	52%	5%
SC	27	52	1	80	34%	65%	1%
Total	60	92	5	157	38%	59%	3%

A follow up question asked customers to describe the additional changes they made as a result of receiving the Personalized Energy Report. Their comments included: adjusting the direction of overhead fans, using less HVAC, insulating walls, sealing doors and windows and keeping them closed when not in use, purchasing Energy Star appliances, installing timers on lights and using more CFLs, washing laundry in cold water and taking shorter showers. Below are their verbatim responses.

North Carolina

- "Just trying to turn things off when I am not using them."
- "I alternate the direction of the overhead fan blades depending on the season and make sure to turn off lights when leaving rooms."
- "I am watching the heat and AC temperature more."
- "I clean out my fridge more often."
- "I don't change my thermostat settings up and down as much. I also try to keep the blinds closed and tighten up my doors. In the winter, I stuff my crawlspace vents with paper. I have also thought about getting a newer water heater."
- "I got a new fridge."
- "I have been making a gradual switch-over to using CFLs."
- "I have been trying to install more CFLs when old light bulbs burn out."
- "I have been trying to keep the doors to the house closed more. We are very conscious about not holding the door open for 5 or 10 minutes while we unload groceries, for example."
- "I have cut down on my use of the hair dryer. I go through a lot of night lights and have LED lights from Lowe's--at least 2 dozen. My wife likes ambient light."
- "I have tried to change over to CFLs exclusively, except for some decorative bulbs."
- "I have used some of the CFLs Duke sent me."
- "I installed some weather stripping in my windows."
- "I just replaced my fridge and installed new insulation."
- "I keep the thermostat a little cooler and bundle up more."
- "I keep the upstairs deck door locked in summer to keep cool air in."
- "I leave lights on less often and turn off things when not in room."

- "I replaced a storm window. I change filters for my air handler every 30 days. I had previously used 90-day filters but the 30-day ones are still cheaper when you add them up, and you have clean filters more often."
- "I replaced every bulb with CFLs."
- "I started keeping the curtains closed and added outlet gaskets to curb outside air infiltration."
- "I try to keep my lights off when not needed."
- "I turn the lights off when I leave a room."
- "I use CFLs."
- "I'm turning lights and electrical items off when not in use. Also, I'm more conscious of heating and AC use."
- "I've installed a timer on my outdoor flood lights."
- "We are more conscious of turning lights off when they're not needed."
- "We got a new washer and dryer."
- "We have been turning off our lights when not needed."
- "We have stopped taking longer showers and tried to use less hot water in the showers. We also don't wash our clothes quite as often, using warm water in the wash. In the winter, I leave my curtains open to let the heat in. I have been reducing my use of my dishwasher and washing my dishes in warm water instead of hot water. I have started turning off or unplugging TVs and other appliances."
- "We started turning the TV off at the power bar and switched to CFLs. We turn off the heat and lights when not needed."
- "We switched to CFLs."
- "We use CFLs in almost all lighting. We converted even some decorative lights."
- "We've unplugged electrical items that aren't being used."

South Carolina

- "Fixed door seals with caulking, regulate the temperature more and a new roof put on."
- "I air-dry my towels."
- "I am using the CFL bulbs and trying to upgrade the hot water heater, heat pump and AC."
- "I change my air filter on the first of the month."
- "I have started using CFLs."
- "I installed a few ceiling fans."
- "I put wet clothes in the dryer for a while and then hang-dry the clothes."
- "I replaced my refrigerator."
- "I resealed the door to stop air from coming in and I put up heavy drapes in windows during the winter. I also use the CFLs Duke sent me in most all my lights."
- "I shut off the TV when no one is watching."
- "I stopped over-riding the auto on the thermostat when I'm uncomfortable."
- "I try to pay more attention to my thermostat. I kept it higher this summer and used less AC."
- "I use less lights and I unplug my TV and appliances when I'm not using them."
- "I used spray foam to insulate my walls. I closed vents under my house to conserve in heating/cooling seasons. I leave doors shut and open windows in nice weather."

- "I will be replacing the windows with insulated glass."
- "I've unplugged quite a few things that we don't use."
- "We added insulated windows. I put in outlet and switch gaskets. I had the insulation checked in the attic and under the house and was told that it was excellent and I had the exterior doors checked."
- "We are just being constantly aware of it now."
- "We are using all CFL bulbs."
- "We bought more CFLs."
- "We got more CFLs. We do our laundry loads in cold water instead of warm or hot."
- "We have been keeping lights off, unplugging appliances. We have stopped leaving the outdoor floodlight on."
- "We have replaced regular bulbs with the CFLs."
- "We purchased a new Energy Star clothes washer and also wash the clothes in cold water."
- "We unplug extra things that we're not using."
- "We use the washer and dryer during off-peak hours."
- "We wash clothes in cold water."

Additional Actions Taken

To capture data on energy saving activities beyond those suggested in the Personalized Energy Reports the survey asked respondents if they had made any other additional changes in their homes as a direct or indirect result of receiving the reports. Upon analysis, a sizeable difference in the number additional energy savings actions emerged, with North Carolina customers taking more than three times as many additional actions than their South Carolina counterparts. When considered on a percentage basis, 35% of North Carolina respondents reported taking actions compared to just 10% of South Carolina respondents. This brings the Carolina System to an average of 22% of respondents taking additional actions, as shown in Table 9 and Figure 10.

Table 9. Number of Respondents Making Other Changes

	Number of Respondents				Percentage of Respondents		
	Yes	No	DK/NS	N Size	Yes	No	DK/NS
NC	26	47	4	77	34%	61%	5%
SC	8	69	3	80	10%	86%	4%
Total	34	116	7	157	22%	74%	4%

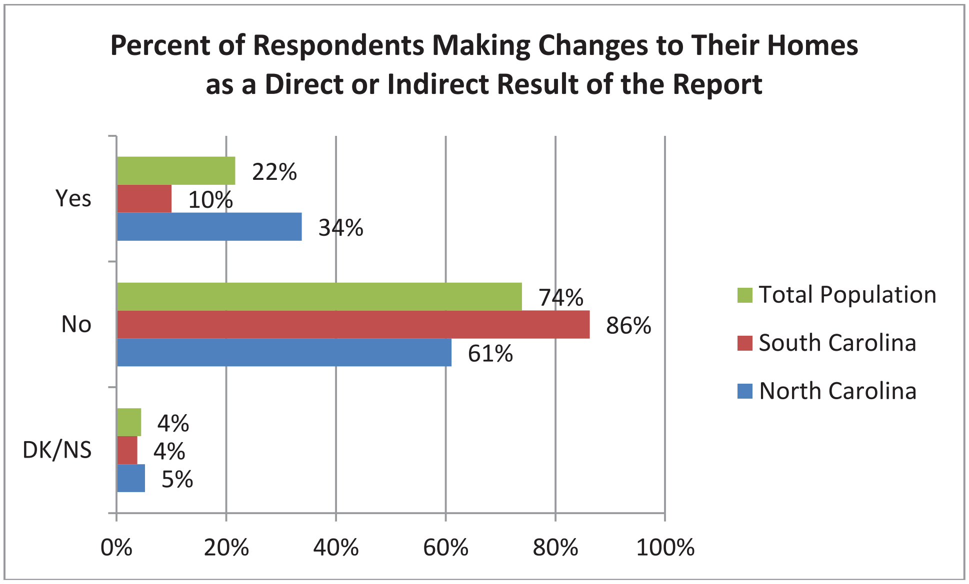


Figure 10. Percent of Respondents Making Other Changes

When queried about the specific energy saving actions that they had taken after receiving their Personalized Energy Reports, customers gave replies such as: getting a new roof, installing new heat pumps, furnaces and AC units, adding exhaust fans, installing new windows and storm doors, servicing HVAC unit, and moving a water heater. Verbtain responses are noted below.

Additional Energy Actions in North Carolina

- "I added an extra exhaust fan to a second bathroom in my home."
- "I bought an Energy Star-rated washer & dryer."
- "I have installed some energy-efficient windows."
- "I installed a new fridge."
- "I installed a new heat pump, air conditioner, and fridge."
- "I installed new windows and a new heat pump."
- "I installed storm doors."
- "I moved the water heater from a drafty spot near the garage door to one that's away from drafts."
- "I purchased a new furnace/central air system."
- "I put a new threshold under the door jamb and installed a new storm door."
- "I put insulators behind my outlets."
- "I replaced the filter in my air vent."
- "I switched to CFLs."
- "I'm rotating the overhead fan blades by season, added outlet gaskets, and I turn off the coffee pot, toaster, and other appliances when not in use."
- "I've installed more light timers."
- "My husband switched us to CFLs (and hid the old incandescents so I couldn't find them)."
- "We added a new storm door."
- "We decided on other changes that need to be done in next 2 months, involving weather stripping and doors."

- "We got our refrigerator serviced."
- "We had a new roof added and we're hoping to install new windows."
- "We have installed new energy-efficient windows and a new storm door."
- "We installed an attic fan."
- "We installed weather stripping around doors. We added insulation in our crawlspace (R13). We have changed our hot water hours of operation/use in kitchen and our appliance use (oven/stove)."
- "We replaced our front door's frame and re-aligned our two back doors."
- "We stopped using our heating system and air conditioning for a period to save on our bill."
- "We've better sealed up our windows and doors."

Additional Energy Actions in South Carolina

- "I changed out 7 windows for more energy efficient ones."
- "I enclosed my carport."
- "I had my A/C checked and serviced."
- "I have been watching my temperature and thermostat more."
- "I installed new windows, some new appliances."
- "I re-wired my home and reduced the number of outlets on breakers (fridge, freezer, washer, dryer are on their own breaker)."
- "We installed a new water heater in September of 2011."
- "We installed new energy efficiency light fixtures and more CFLs."

To determine the influence that the Personalized Energy Report had on these actions, customers were asked to use a 1-10 scale to rate that influence, with 1 meaning no influence and 10 meaning very influential. As shown in Figure 11, customers in North Carolina returned a mean influence of 8.1 on the 10 point scale, while South Carolina customers gave a mean influence of 7.1, one full point lower. The average influence for the Carolina System is 7.9.

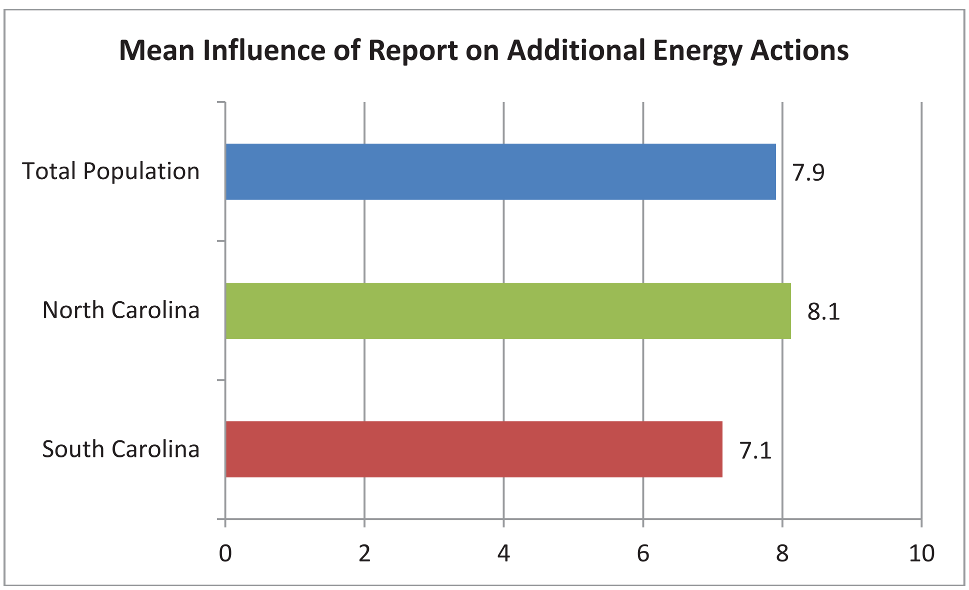


Figure 11. Mean Influence of PER on Additional Energy Saving Actions

Sign Ups for Equal Payment Plan

Another section of the Personalized Energy Report suggested that customers sign up for Duke Energy's Equal Payment plan. When asked if they had done so, 2 customers (2%) reported doing so, while similar numbers of customers said they were already on the program (2%) or could not recall the section (2%). Of the 93% of customers who said no, 19 customers (23%) said they were now considering doing so, compared to 65 people (77%) who were not. When asked to explain why not, a preponderance of customers said they preferred to pay their bills in full each month or they were concerned about large payments coming due during the true up period at the end of the year. A few respondents did not understand the concept of an equal payment program, such as those who thought it would make their bills more variable, those who thought that paying an average bill each month meant paying more for the year, and those who wondered how it would save them money. Verbatim comments are noted below.

- "I prefer to pay my bill each month as it comes." (20)
- "We are happy with it that way." (3)
- "Unnecessary" (3)
- "I don't want any surprises at the end of the year." (3)
- "I have no problem paying my bills so I didn't feel it was necessary."
- "I know how to control my heat and electricity use without Duke's help."
- "DK/NS, Not sure about it. If it is a way to save money, I would consider it."
- "I am too far behind on my bill to qualify for the program. But I would like to be on it. However, I am always about two bills behind."
- "I don't remember what the Equal Payment Plan is."
- "I just prefer to have the actual reading on my bill and pay for the actual use for month, rather than having an average."
- "I prefer my current billing system. As is, I look forward to the lower energy bills that come when spring arrives."
- "I prefer to pay as I go. I like the occasional lower bill and then that extra money is in my bank account accruing interest."
- "I think the monthly bills are reasonable/manageable."
- "I was previously enrolled in the Equal Payment Plan. The large payment due at the end of year was prohibitive and untimely."
- "I would just prefer to pay when the bill comes. I don't want to overpay or underpay and have to make up the difference at the end of the year."
- "I wouldn't like paying the price difference if there was one."
- "I'm afraid of a possible balloon payment coming due in December."
- "It gives less motivation to conserve when you don't see seasonal fluctuation between bills. I would just fix on / factor in the monthly utility cost rather than try to work to lower the costs and usage."
- "It is going to be higher, better to stay the same."
- "It is too variable."
- "My household is going through a period of transition."
- "Our bill is very affordable and we're able to take care of it as we go."
- "I'm not sure it would benefit me."

- "The estimate runs too high."
- "Considered it in the past but I think it would cost me more than what I'm doing right now."
- "I had already been signed up for a program like that but then it was cut. I thought that they'd sign me up for the Equal Payment Plan because I was signed up for something like it in the past. I guess I forgot about signing up for the program until you mentioned it."
- "I keep trying to lower my bill. I don't want to be locked into something. I want to see the actual amount each month."
- "We have been on it in the past and at this time in our lives we just prefer to pay what the bill is and be done with it."
- "I travel quite a bit so would rather just pay the bill in full each time."
- "I would be paying out more than I used per month and I'd rather have that money in my account where it accrues interest."
- "The average bill would come out higher than our yearly cost."
- "We had it before and it was about the same as our normal bill."
- "I just budget for the maximum bill."
- "My sister has it and doesn't seem to like it. She had to pay extra money at the end. Seems not to be good for people who use gas."
- "We were on it in the past and I wasn't pleased with the program."
- "I enjoy getting the occasional low bill."
- "I was on it before. I prefer to take care of the larger bills as they come."
- "Because if I have a set bill I won't pay attention to what my energy use is."
- "Because our bills aren't too high so we can just pay them."
- "It would not have saved me money."

Future Purchases of High Efficiency HVAC

One section of the Personalized Energy Report described the Smart $aver program and mentioned the availability of rebates for high efficiency heat pumps and air conditioners. Seventy four percent of respondents recalled reading that section, and of those only 6% indicated they would be likely to consider purchasing a new or replacement heat pump. This compared to 6% who were unsure, 55% who said no and a surprising 32% who indicated that they had recently made a similar purchase. Average likelihood for considering a new high efficiency heat pump and air conditioner are show in Table 10.

Table 10. Mean Likelihood of New High Efficiency Heat Pumps or AC Units

Likelihood of considering purchase of	Mean
High efficiency heat pump	6.0
High efficiency air conditioner	6.6

Customer Impressions of the Report

To discern customer impressions of the Personalized Energy Report we asked them to rate their agreement with several statements using the 1 to 10 scale, with 1 meaning that you "strongly disagree" and 10 meaning that you "strongly agree."

Virtually all respondents agreed that the Personalized Energy Reports look professional with an average agreement of 9.6 on the 10 point scale. Nearly as many survey respondents felt the reports were trustworthy, yielding an average rating of 9.3. Agreement was lower, but still respectable at 8.2 when people were asked to rate their agreement with the report increasing the likelihood of their taking the recommended actions. The average rating dropped by another half point to 7.7 when respondents were queried about the report providing new and previously unconsidered ideas. This last finding corresponds with the earlier noted comment about the majority of customers indicating they were already taking the energy saving actions prior to reading the report.

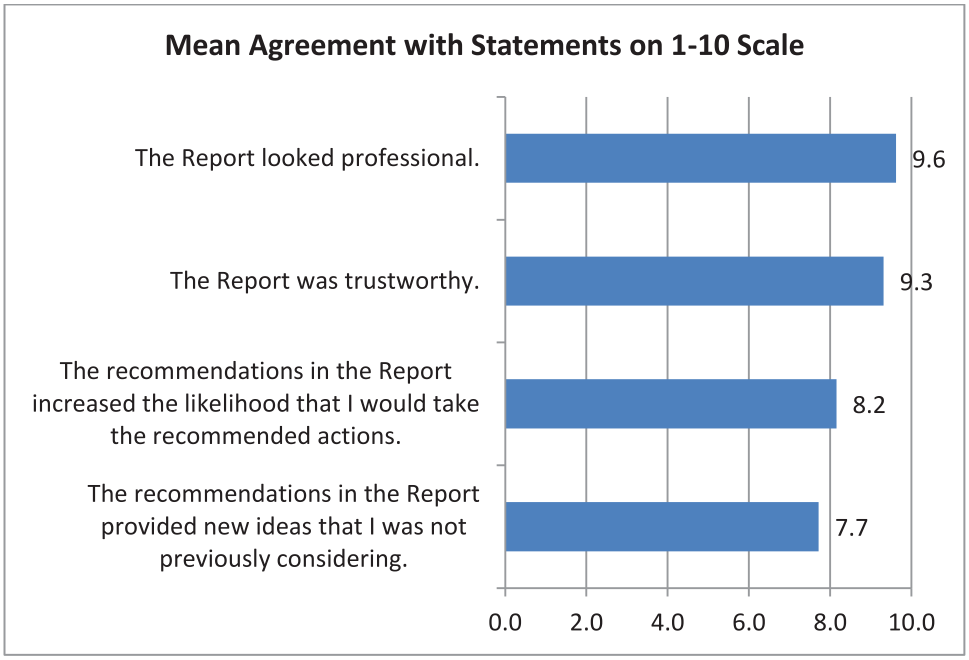


Figure 12. Customer Impressions of the Personalized Energy Report

If customers conveyed agreement commensurate with a rating of 7 or less, they were prompted to provide feedback on potential means of improvement. Their responses are as follows:

Actionable Recommendations

When asked how the Personalized Energy Report can make recommendations in a way that increases the likelihood of adoption, customers offer the following verbatim suggestions:

- “We were already doing most of the things that were recommended.” (2)
- “By me doing more to take action on the recommendations.”
- “I prefer things the way they are and resist making changes to my home.”
- “It would have to show all bills for a comparison.”
- “Duke could have made recommendations that were specific to me and based on my actual energy habits.”
- “I am not interested in doing any upgrades that are cost prohibitive. I don't want to do any upgrades to the house that won't pay off in the next few years (I'm 88). I am satisfied with what has been done to upgrade the house.”

- "I was already doing most of the recommendations."
- "I would be more inclined to take the recommended actions if I felt they applied specifically to my home."
- "It couldn't have."
- "Motivate the customer to take action on the recommended actions."
- "My wife is home all day now because she's retired and we have a swimming pool which is why we are using more energy now."
- "No significant actions were warranted."
- "Nothing."
- "The price tag on options plays a part in taking the action. I would like a new stove but can't afford it yet."
- "The recommendations were great, but in this economy, it's hard to do many of these things. I just have to do a little bit here and there."
- "We're too old to be doing a lot of these things on our own."
- "You can lead them to water but you can't make them drink."
- DK/NS (5)
- "I don't remember." (2)

New Ideas

When asked how the new ideas and recommendations in the report could be improved, customers offered the following verbatim suggestions.

- "I was already very conscious of my energy use."
- "Duke could have made recommendations that were specific to me and based on my actual energy habits."
- "I already had most of these things in mind."
- "I already use energy-saving ideas."
- "I don't think Duke could have done much more. The advice was good, but I just didn't need it, because I was already doing what the report recommended."
- "I learned about energy consumption from appliances and hot water, but hoped for more accurate gauge with other homes."
- "I was already following the recommendations."
- "It could be specific about the energy use in my house."
- "It couldn't. We already had a lot of awareness. My husband worked for Whirlpool for a long time, so we already know a lot about energy. Our home is already very efficient."
- "Provide new ideas. Through my own previous research, I was already aware of many of the suggestions they were going to make."
- "Because I am a retired electrician and I already knew about energy use."
- "I already knew and was doing the things they recommended."
- "I already knew the recommendations."
- "I don't remember."
- "I had already thought of the recommendations."
- "I read about things in the paper and try to keep up on the latest energy saving tips."
- "I think there were only 1 or 2 new recommendations that we didn't know."

- “I was already aware of many of the suggestions.”
- “I was already considering doing most of what was recommended.”
- “I was already doing many of the suggestions.”
- “I was considering the ideas listed.”
- “I'm not sure that you can improve this. I used to be an electrician so I keep up on the energy saving tips that come out.”
- “It didn't really tell me new information. It was the overall information that helped.”
- “It made many suggestions that we are already doing.”
- “It was very inclusive. I already have been taking energy-saving measures.”
- “Some were new, some I already knew.”
- “There weren't many recommendations and many of them were things that I was already considering/doing.”
- “We didn't get many recommendations because the house is very efficient.”
- DK/NS (8)
- “Nothing.” (3)

Trustworthiness

When asked how to improve the trustworthiness of the Personalized Energy Report the following suggestions were offered:

- “The report did seem trustworthy. Most of what they said was true, but whether or not it applied to me was another story.”
- “Trustworthiness can be gained by eliminating errors of fact.”
- “I just didn't believe that we use more electricity than similar houses in the area.”
- “I'm just not sure that the report is trustworthy because Duke Energy is in the business of selling power. A family member is in heating and cooling and they say that the house is wonderfully insulated and the heating/cooling system is the most efficient for this size house.

Professionalism

When asked how to improve the professionalism of the Personalized Energy Report customers had no suggestions.

Customer Satisfaction

Satisfaction with CFLs

Each six pack of CFLs shipped to the customer included 13-watt and 20-watt CFLs. To determine customer satisfaction with these bulbs the survey asked respondents to use a 1-10 scale with 1 indicating that they were very dissatisfied, and 10 indicating that they were very satisfied. As seen in Table 11 customers in North Carolina and South Carolina were equally satisfied with the 13-watt CFLs, giving a mean rating of 8.7. However, North Carolina customers were slightly more satisfied with the 20-watt CFLs than their South Carolina counterparts, returning mean satisfaction ratings of 8.9 and 8.7 respectively. When combined for the entire Carolinas System, these scores render an average satisfaction of 8.7 for both 13-watt and 20-watt CFLs.

Table 11. Overall Satisfaction with 13-watt and 20-watt CFLs

Mean Customer Satisfaction	NC	SC	Total Population
with the kit's 13-watt CFLs	8.7	8.7	8.7
with the kit's 20-watt CFLs	8.9	8.5	8.7

Customers giving a rating of 7 or less were asked to explain their responses. Their verbatim feedback is as follows:

13- watt CFLs - Carolina System Summary

- "Bulbs not bright enough" (9)
- "Take too long to brighten up" (8)
- "Dislike quality of light" (5)
- "Don't fit in certain fixtures" (2)
- "Burn out too quickly" (2)
- "Mercury content" (2)
- "Broken when received"
- "Break too easily"
- "Made in China"
- "CFLs are designed to work best in upright position, which is not how my fixtures are. Cold air affected their usefulness."
- "My electricity usage from lights was the smallest piece of pie on the chart. Why does Duke think that I need CFLs?"
- "I love the old incandescents, don't like the new ones."

13- watt CFLs - North Carolina Verbatim Responses

- "Two were broken when received."
- "I am afraid of the mercury content. Some of the CFLs don't fit in smaller lamps."
- "I love the old incandescents, don't like the new ones."
- "Some of the CFLs don't fit well with the covers on my fixtures."
- "The 13-watt bulbs take too long to brighten up."
- "The bulbs take too long to brighten up."
- "The CFLs are not bright enough."
- "The CFLs emit an unpleasant bluish hue and take too long to brighten up."
- "The CFLs hurt my eyes. I have cataracts."
- "The CFLs are made in China."
- "Two burned out quickly."

13- watt CFLs - South Carolina Verbatim Responses

- "I do not like the quality of light."
- "The CFLs are extremely delicate and get damaged more easily. Warm up time takes too long. They last as long as they say. CFLs are designed to work best in upright position, which is not how my fixtures are. Cold air affected their usefulness. Plus the light quality seems to be cloudy. Would like to use LEDs once the 'bugs' are worked out."

- “The CFLs are not bright enough.”
- “The CFLs burnt out and they are too dim.”
- “The CFLs take a while to come on and get bright. Then when they do, they are still not bright enough. I can't use those bulbs for reading.”
- “The CFLs take too long to warm up.”
- “The light 'color' was not what we were used to. It was too harsh.”
- “The light is too dim. Also, my electricity usage from lights was the smallest piece of pie on the chart. Why does Duke think that I need CFLs?”
- “The light isn't bright enough and it is off-colored. I find it somewhat headache-inducing.”
- “They aren't as bright as the old ones.”
- “They don't come on fast, slow to come on.”
- “They don't heat up fast enough and are too dim. Also, the disposal of the CFLs is a hassle.”
- “They're not bright enough.”

20- watt CFLs - Carolina System Summary

- “Bulbs not bright enough” (10)
- “Take too long to brighten up” (6)
- “Dislike quality of light” (4)
- “Don’t fit in certain fixtures” (1)
- “Burn out too quickly” (2)
- “Mercury content/bulb disposal” (2)
- “Dislike CFL appearance” (2)
- “I want bulbs that are made in America.” (1)

20- watt CFLs -North Carolina Verbatim Responses

- “CFLs emit an unpleasant bluish hue and take too long to brighten up.”
- “I want bulbs that are made in America.”
- “I would prefer brighter light output.”
- “One burned out. The CFLs also seemed dimmer than what I was used to--not quite equivalent to a normal 75-watt bulb.”
- “The CFLs are too different. They took getting used to.”
- “The CFLs burned out. I did not like them.”
- “The CFLs have clearance issues in my fixtures. Otherwise, I am completely satisfied.”
- The light is too dim.”
- “They are too dim. I don't like the curly bulb.”
- “They take too long to reach full brightness.”

20- watt CFLs - South Carolina Verbatim Responses

- “The light is too dim.” (6)
- “I do not like the quality of light.”
- “The CFLs take too long to warm up. When I removed one it broke and now I'm concerned about being poisoned.”

- "The color of the light was too harsh and cold."
- "The light isn't bright enough and it is off-colored."
- "They don't come on fast, slow to come on."
- "They don't heat up fast enough and are too dim. Also, the disposal of the CFLs is a hassle."

Satisfaction with the Program

Using the same 1-10 scale, customers were asked to rate their satisfaction with the Personalized Energy Report program. Survey analysis shows that customers in North Carolina and South Carolina are highly satisfied with the program, giving average satisfaction ratings of 9.0 and 9.1 respectively. This yields an average satisfaction rating of 9.1 for the overall Carolina System as shown in Table 12.

Table 12. Customer Satisfaction with Personalized Energy Report Program

Mean Customer Satisfaction	NC	SC	Total Population
With The Personalized Energy Report Program	9.0	9.1	9.1

Customers rating their satisfaction as a 7 or less were asked to provide feedback they shared the following:

North Carolina Verbatim Responses

- "I assume I looked at it and read it, but I didn't make any significant changes."
- "I think the program needs to be more specific about the home in the report."
- "I wish I could have gotten it earlier."
- "Try harder to reduce errors and provide fresh ideas."
- "Use an accurate measure of the house's square footage."
- "We could be doing this survey closer to when I did the program."
- "We have already covered most of it. Unless Duke could break down my energy use more accurately, I'm not sure how else it could be improved."
- DK/NS

South Carolina Verbatim Responses

- "I didn't understand why it said we are so high. We don't use much energy."
- "I really don't understand why our bills are still so high."
- "There were many suggestions that I already knew about."
- DK/NS
- "DK/NS. I was not overly satisfied with the program, but I was satisfied."

Satisfaction with Duke Energy

Finally, respondents were asked to rate their overall satisfaction with Duke Energy on the 1 to 10 scale. As seen in Table 13, North Carolina and South Carolina were equally satisfied with Duke Energy, with a mean satisfaction rating of 8.9 for each state and for the Carolina System overall.

Table 13. Overall Customer Satisfaction with Duke Energy

Mean Customer Satisfaction	NC	SC	Total Population
With Duke Energy	8.9	8.9	8.9

From those customers giving a response of 7 or less the survey collected the following feedback:

North Carolina Verbatim Responses

- "Duke could make it easier to talk to an actual person when I call for help. The automated phone system does not answer my questions."
- "Duke has made a lot of changes since the merger. We got hit with a monthly late fee, even though we were paying our bills on time. Duke is tacking on fees for customers who are unemployed and struggling. I paid the fine and come January I will be asking for it back. If Duke is going to punish me for not paying my bill on time, even though I paid on time, that is very unfair. Duke needs to be aware that people in North Carolina are struggling to pay bills because they are without jobs. I expect the late fees to be refunded."
- "I would like Duke to verify the amounts of energy they charge people for. Also, improve customer service and eliminate the automated call answering."
- "I would like to save on energy more"
- "Let us talk to somebody. The service is awful."
- "Lower prices."
- "Please lower energy rates."
- "Please make these follow up surveys more specific about our individual experiences with the various programs."
- "The price per KWH keeps going up. Duke needs to stabilize the price."
- "There is always room for improvement."

South Carolina Verbatim Responses

- "Customer service. A while ago we had gone out of town for 6 weeks and before we left we unplugged everything, turned the water heater off, and the heat down but our power usage was exactly the same when we were gone. That's extremely suspect and no one in customer service could explain it. Also Duke had hired someone to trim the trees across the street and they cut off half of each tree so they died. Then my neighbors had to hire someone to cut down the dead tree."
- "Fewer and shorter power outages during ice storms."
- "Gave a 7 because of the price increases."
- "I don't like what they're saying about Duke Energy in the Greenville News (my local paper)."
- "I give them a 1 because my bill is so high and keeps going up, and a 10 for everything else like the power lines and maintenance."
- "I use to work for Duke Energy. The company has changed. I don't like the president."
- "I would prefer fewer power outages. Perhaps maintenance of power lines can to be improved or they can bury the power lines. I preferred the power company that I used in the north because there are almost no power outages."

- "It seems like Duke Energy works to get the power back on in the trailer park last during ice storms, like other customers matter more to them."
- "Nobody likes a company that they have to send money to every month. The rates keep going up. Bring back the program where Duke provides a low interest loan for new energy efficient heat pumps and then customers pay back the loan on the bill over time."
- "Nothing"
- "Rates are way too high. I am a widow and find it's hard to pay so much."
- "Recently we had a leak in our water heater. We got our bill and it was a lot higher than usual. Shortly after we got our water bill and that was about 3 times higher than normal. When I called customer service or billing for advice or help with paying the bill they said that they would have to speak with whoever installed the new water heater and then get back to us, which they haven't. They just made me feel bad because it was like I don't matter."

Interest in Specialty CFL Bulbs

TecMarket Works asked survey participants to gauge, on a 1-to10 scale, whether they would be interested in a specialty bulb discount CFL program that included dimmable, three-way, spotlight, recessed, outdoor flood, or candelabra CFLs. TecMarket Works also asked each respondent to indicate whether or not they would be interested in each specific type of specialty CFL.

Overall interest in Specialty Bulb Program

Overall customer interest in a specialty CFL program had a mean interest score of 7.0, with North Carolina reporting a mean interest of 6.5 and South Carolina showing a mean interest of 7.4. As shown in Figure 13, more than 40% of respondents indicated the highest level of interest (10) and 59% of respondents indicated very high interest (8, 9, or 10). However, 20% of respondents also clustered at the low end of the range, rating their interest in such a program as 1 on the 10 point scale. The full distribution of interest is shown in Figure 13.

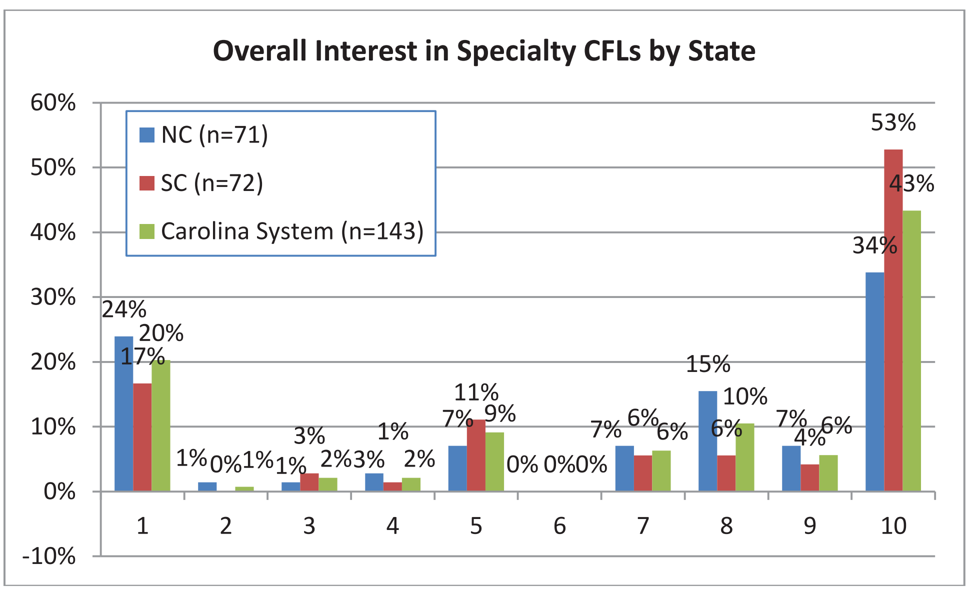


Figure 13. Distribution of Interest in Specialty Bulb Direct Mail Program

Interest in Specific Specialty Bulb Types

As seen in Figure 14, CFL programs that offer outdoor floodlights were the most popular type of bulb type among North Carolina and South Carolina customers, with an average interest of 52% for the Carolinas System as a whole. No other bulb type garnered a majority interest, but candelabra and three-way bulbs had the next highest levels of interest among all surveyed customers (41% and 36% respectively). The largest difference in interest between customer groups was for spotlight bulbs, which saw a 20% spread between North Carolina (29%) and South Carolina (9%).

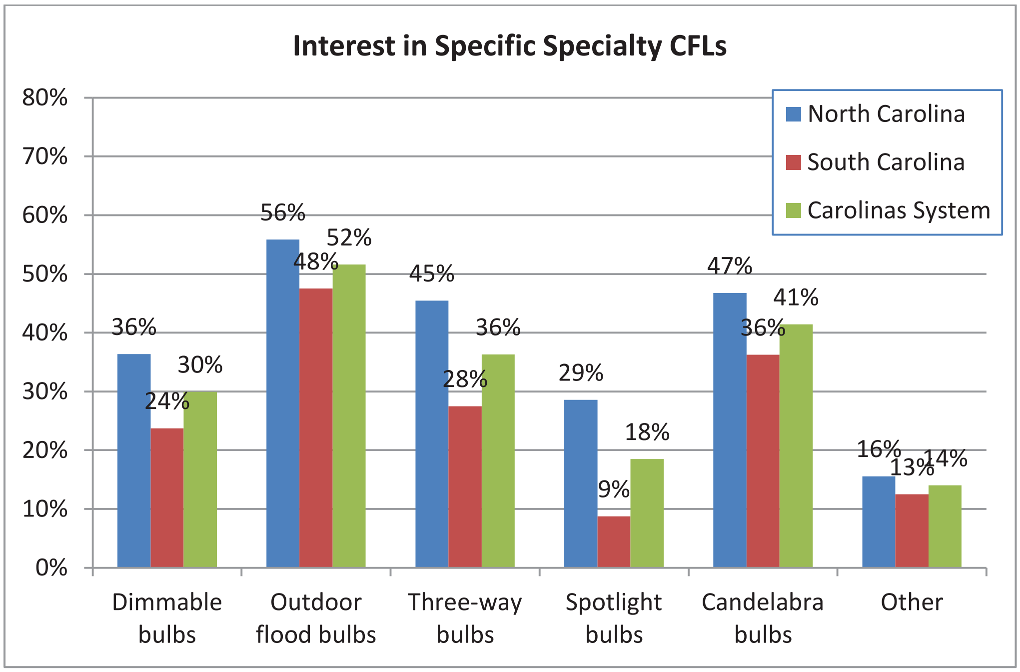


Figure 14. Interest in Specific Specialty Bulb Types

Estimated Bulb Hours and Available Sockets

TecMarket Works next asked those respondents who indicated an interest in a specific specialty bulb type to estimate the average hours of use that bulb type would likely receive in their homes. As shown in Table 14, three-way bulbs have the highest estimated hours of use at 4.5 and other outdoor floods have the lowest estimated hours of use at 3.4 (among specific bulb types). When estimated hours of use are compared to customer interest in a specific bulb type, it appears that the average number of hours of use has relatively little impact on customer interest.

Table 14. Estimated per bulb hours of usage for participants indicating an interest in each Specialty CFLs

Bulb Type	Number of customers indicating interest in specialty CFLs	Percent of customers indicating interest in specialty CFL	Average hours of usage per day per bulb
Three-way	57	36%	4.5

Dimmable	47	30%	4.3
Spotlight	29	18%	4.2
Candelabra	65	41%	3.6
Outdoor Flood	81	52%	3.4
Other	22	14%	3.3

TecMarket Works also asked survey respondents if they had any specialty bulbs currently installed in their homes, and, if so, how many of those specialty sockets were already filled with a CFL. The results show the estimated number of sockets available in homes that reported having specialty bulbs regardless of their interest in a CFL discount specialty bulb program.

The difference in the numbers of respondents in the second column of Table 14 and the "n" value in the second row of Table 15come from the fact that some respondents who are interested in a specialty bulb program do not currently have specialty bulbs installed in their home, and other respondents who do have specialty bulbs installed are not currently interested in any specific specialty bulb CFL discount program. Table 15 shows an estimate of the maximum number of sockets available for each CFL specialty type if targeting customers regardless of interest in specialty CFLs.

Among current PER participants, outdoor floodlights appear to be the best candidate for a specialty CFL program, having the highest interest (52%) of any bulb type, a relatively high estimated hours of use per bulb (3.4), and the second highest number of estimated sockets per participant with specialty bulbs (2.28). Spotlight and "other" bulbs had the lowest relative interest and numbers of available sockets per all redeemers.

Table 15. Estimated number of current Specialty bulbs in use by participants

Bulb Type ->	Out-door	Dim-mable	Three -way	Spotlight	Candelabra	Other	Overall
Number of Respondents	117	42	62	27	87	36	371
a) Total number of bulbs reported to be in participant homes	438	265	167	141	793	170	1974
b) Average number of bulbs in homes of customers with specialty bulbs *(Number of Participants/a)*	0.66	0.24	0.35	0.15	0.49	0.20	2.10
c) Average number of bulbs in home per all respondents *(a /177)*	2.47	1.50	0.94	0.80	4.48	0.96	11.15
d) Reported Number of specialty bulbs already CFLs	35	16	28	14	85	24	202

e) Reported Percent of specialty bulbs that are already CFLs *(d/a)*	8.0%	6.0%	16.8%	9.9%	10.7%	14.1%	10.2%
f) Average Number of estimated Incandescent-filled Specialty Sockets, for participants with specialty bulbs *((a – d)/Number of Participants)*	3.44	5.93	2.24	4.70	8.14	4.06	4.78
g) Average Number of estimated Incandescent-filled Specialty Sockets, for all participants *((a – d) / 177)*	**2.28**	**1.41**	**0.79**	**0.72**	**4.00**	**0.82**	**10.01**

Evaluation and Recommendations

Evaluation

Overall Personalized Energy Report program participants hold high levels of customer satisfaction with the data collection instrument, the Personalized Reports, the CFLs, and with the program overall. They are also highly satisfied with Duke Energy. Their feedback reflects their appreciation of a well-designed and well-run program that has reached a solid level of maturity.

Recommendations

Because the program is being sunset after December 2012 no specific recommendations are made for its improvement. However, recommendations based on customer feedback may be applicable to other Duke Energy programs, particularly those that seek to deploy similar data collection and reporting tools. With that in mind, we make the following suggestions based on customer survey findings.

- Energy savings tips seem like “yesterday’s news” to a sizeable number of customers who are already familiar with many of the recommendations offered in the Personalized Energy Reports. While widespread awareness of the most common energy efficiency measures speaks well of Duke Energy’s efforts to educate its customers, it may hint at the possibility of losing influence among customers who have heard it all before. Duke Energy may be able to retain customer interest and stimulate even further energy savings, by creating a list of second tier recommendations that include “fresh” suggestions for energy saving actions to be undertaken after the basic tips described in the current reports have been completed.
- Home energy comparisons generate credibility issues with some recipients of the Personalized Energy Reports. Duke Energy may be able to increase credibility among customers by further explaining the methodology behind the comparisons and by

highlighting the benefits of comparison even when not all homes in the grouping are identical.

- The survey shows that twice as many people said that they participated in the program to learn how to save on energy costs than because they wanted to receive free CFLs. This lends support to the idea that increased energy savings may be sufficient motivation for signups in future iterations of the survey and report as aspects of other Duke Energy programs. Further investigation may be warranted.
- Among current PER participants, outdoor floodlights appear to be the best candidate for a specialty CFL program, having the highest interest (52%) of any bulb type, a relatively high estimated hours of use per bulb (3.4), and the second highest number of estimated sockets per participant with specialty bulbs (2.28).

Savings Distributions

There are some risks associated with relying on self-reported behavioral changes because the foundation of the savings estimates are based solely on the participant's responses with no means to verify that the respondent has installed the kit's measures and is using them effectively. In the case of this evaluation, it was determined that the engineering estimates derived from this methodology were unreliable for use as a gross or net program-wide estimation approach and they were not used to estimate impacts in favor of a more reliable billing analysis approach.

There is no adjustment approach required to estimate net savings by factoring out the impacts of freeriders. The quasi-experimental design used in this study provides direct net savings. To estimate short term net savings that exclude short term or longer term market effect only spillover savings need to be added to the program wide net savings estimate.

Net to Gross Analysis

Net to gross figures are applied to the engineering estimates only and not used to estimate program or per participant net savings. The billing analysis does not require a net to gross adjustment because it provides gross savings less freerider impacts directly as a result of the analysis approach employed (quasi-experimental design). This information is provided for management consideration only as it applies to how products and services are being adopted and used in the market. These adjustments are already embedded in the program and per-participant energy savings presented from the billing analysis approach.

CFL Freeridership

TecMarket Works utilized three questions from the participant survey to estimate CFL freeridership. The first question asked survey respondents whether or not they had installed CFLs prior to participating in the program, and if so, how many they had installed. The second question asked respondents if they had planned on buying any CFLs before participating in the program. The third question used for a given participant depended on their responses to the second question: how many CFLs they plan to buy in the next three months, how many CFLs they would have purchased in the next three months if they hadn't received free CFLs from Duke Energy, or how long it would have taken them to purchase more CFLs if Duke Energy hadn't given them six for free. Figure 15 diagrams the decision tree which determines which question is used for each respondent.

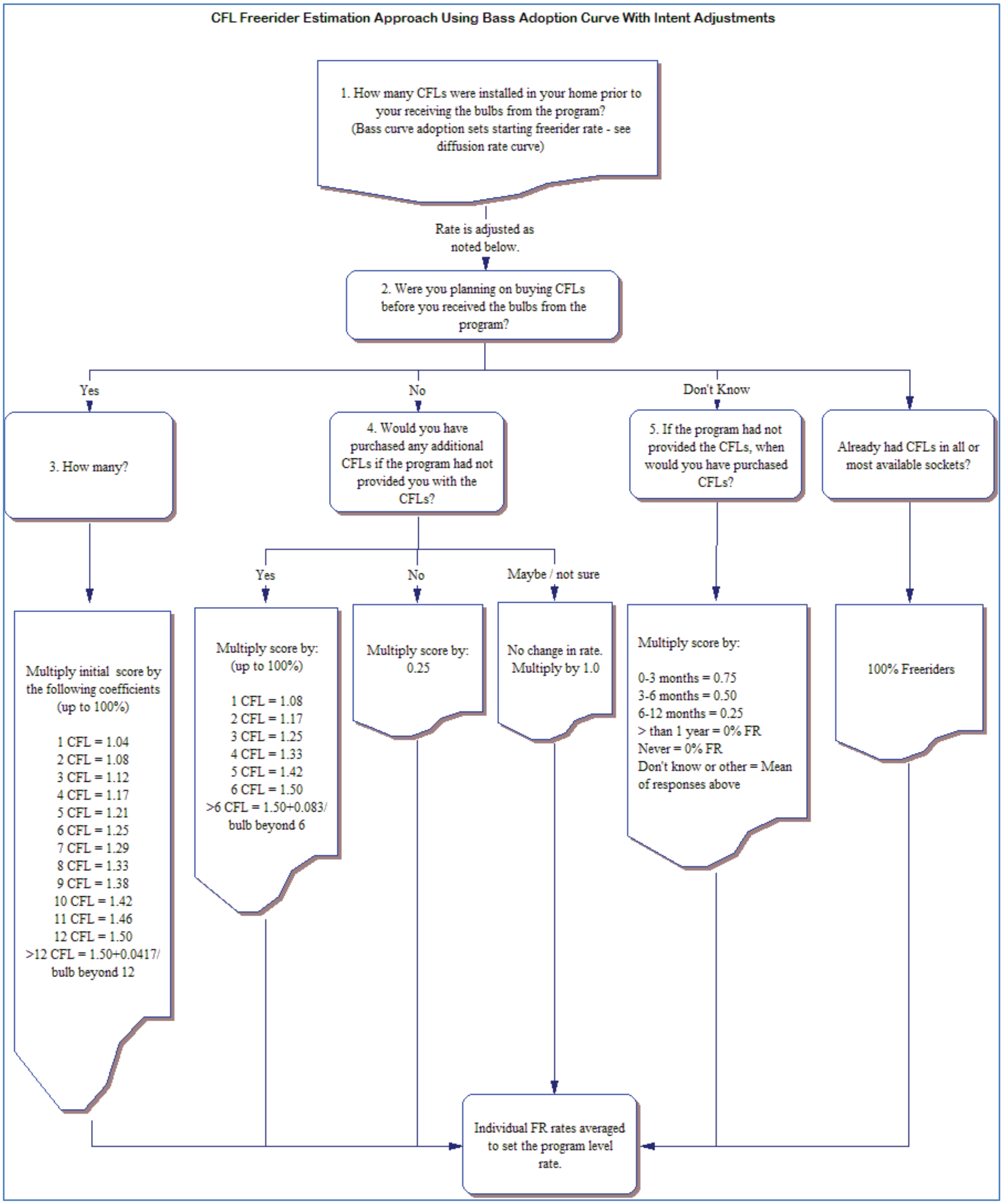


Figure 15. Flowchart for Assigning Freeridership Scores
Note: see Appendix B: Participant Survey Instrument for program specific question wording.

Quantities of pre-installed CFLs in the Carolinas range from 1 to 35 among the 52.7% (77 out of 146) of respondents who installed at least one CFL provided by the PER program and indicated that they also had CFLs installed before participating.

Freeridership ratios for each customer are based on survey responses and are assigned using a Bass curve based on diffusion of innovation product adoption concepts. Zero pre-installed CFLs correspond to an assigned freeridership score of zero percent, and fourteen or more CFLs correspond to a freeridership level of 100 percent. This allows higher credit for savings to participants with the lowest pre-existing use of CFLs and lower savings to those with a history of CFLs. The curve reflects the condition that if a customer has never used a CFL in the past, they are not historic CFL users and all CFLs they acquire through the program are net energy bulbs. That is, all the energy savings from those bulbs are net savings that would not have occurred without the program. Likewise, if a customer has already purchased and installed 14 or more bulbs, they are committed CFL users and the program's bulbs are providing no net energy savings. These customers are all freeriders. Between these two extremes are people who are at various levels within the Bass adoption process. These customers are assigned NTG ratios in accordance with the degree of pre-program behaviors. This distributes very little savings to the customers who are already using CFLs in many of their fixtures, but who have not fully converted to CFL use in most fixtures. Likewise the Bass curve provides higher levels of NTG savings (but not full savings) to those customers who have tried a few CFLs or who have partially adopted their use. Both of these adoption concepts represent the dominate theories with the product adoption literature and provide similar results within a net energy impact analysis framework. In this analysis the inflection point of the Bass curve is seven CFLs, which is the typical level of CFL penetration among these participants. This inflection point means that there is little impact on net energy savings if the adoption process is faster or slower than projected in a typical Bass curve. That is, a shorter adoption period will give more savings to people with less than average adoption rates, but less savings to those with longer adoption periods, which act to cancel each other out and provide the same net analysis results. Thus, we are confident that this net analysis represents a reliable method of crediting net program impacts for multiple adoption products such as light bulbs.

A graph of this curve is shown in Figure 16, with the corresponding freeridership levels by CFL count shown in Table 16. This approach to estimating freeridership is consistent with the field of product adoption and diffusion research and represents a standard approach within the field of product adoption research. It also recognizes that the more CFLs a home has, the less likely the addition of new Duke Energy CFLs will have an impact on product adoption and use behaviors.

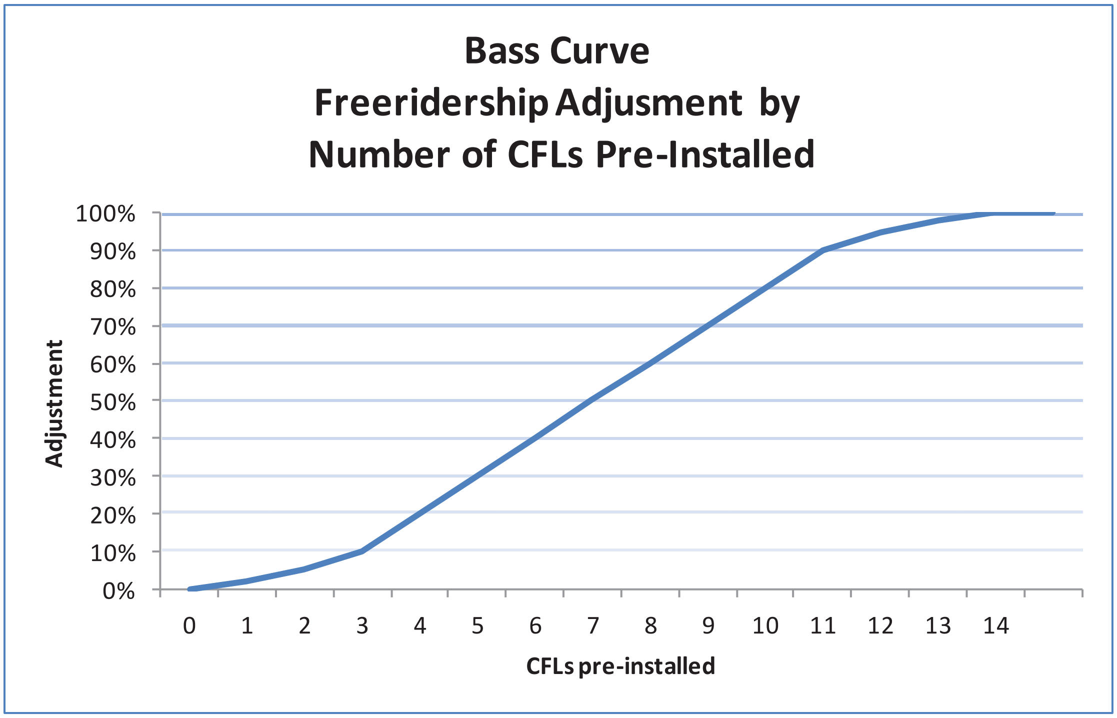


Figure 16. Bass Curve Freeridership Adjustment by Number of CFLs Pre-Installed

Table 16. CFL Freeridership Adjustment Determined by S Curve[6]

Number of CFLs pre-installed	Freeridership Pre-installation adjustment factor	Number of customers with number of pre-installed CFLs (total n=144)
0	0%	69
1	2%	6
1.5	3.5%	2
2	5%	12
2.5	7.5%	4
3	10%	6
4	20%	7
5	30%	3
6	40%	10
7	50%	1
8	60%	4
9	70%	1
10	80%	5
12	95%	6
13	98%	1
14 or more	100%	7

Note: two respondents did not know how many CFLs they had installed before the program and are not included in Table 16.

[6] Fractional values in this table are due to interpolating ranges given by respondents ("1 or 2" is reported as 1.5, and "2 or 3" is reported as 2.5).

The Bass Curve provides the foundational freeridership scores for participants in the program. These are further modified based on whether or not respondents indicated they had planned on purchasing CFLs before receiving CFLs from Duke Energy's PER program. Table 17 shows the decision tree that determines which survey responses will be used to adjust the base freeridership score determined by the Bass Curve.

Table 17. Freeridership Multiplier Based on Measure Purchasing Plans

Did you plan on purchasing any CFLs before receiving the CFLs from Duke Energy's PER program?	Freeridership multiplier
Yes (n=53)	Weighted according to number of CFLs to be purchased in next 3 months – see Table 18 (reduces program savings)
No (n=56)	Weighted according to number of CFLs that would have been purchased in the next 3 months (if any) in the absence of the program – see Table 19 (can reduce or increase program savings)
Maybe / Don't Know (n=34)	Weighted according to when they would have purchased more CFLs in the absence of the program – see Table 20 (increases program savings)
No, already installed in all possible places (n=2)[7]	Automatic 100% freeridership score

Fifty-three respondents (36.6% of 145) were already intending to purchase CFLs before participating in the PER program. Their freeridership scores are adjusted upwards (reducing program savings) depending on how many CFLs they were intending to purchase, as seen in Table 18.

Table 18. CFL Freeridership Adjustment Determined by Plans to Purchase CFLs before the Program[8]

Number of CFLs intended to purchase in next 3 months	Freeridership multiplier (final freeridership score cannot exceed 100%)	Number of customers intending to purchase number of CFLs (n=53)
2.5	1.104	1
3	1.125	1
4	1.167	7
5	1.208	3

[7] Two respondents did not know how many CFLs they had installed before the program (see note at the bottom of Table 16). One of these respondents also indicated they were not going to buy more CFLs because "they already have them installed in every available socket", which means they are automatically assigned a 100% freeridership score. The other respondent who did not know how many CFLs they had previously installed was withheld from freeridership calculations since we do not have enough information to assign them a freeridership score. Thus, although 146 participants surveyed installed a CFL provided by Duke Energy's PER program, freeridership is calculated based on the results of the 145 surveys with complete enough responses to assign freeridership scores.

[8] Fractional values in this table are due to interpolating ranges given by respondents ("2 or 3" is reported as 2.5, and "5 or 6" is reported as 5.5).

5.5	1.229	1
6	1.250	6
7	1.292	1
9	1.375	1
10	1.417	1
12	1.500	4
18	1.750	1
No specific number / Don't know	1.000	26

Fifty-six respondents (38.6% of 145) were not intending to purchase CFLs before participating in the PER program; these respondents were asked if they would have purchased any CFLs in the absence of the program. Participants who would not have purchased any CFLs in the absence of the program (45 out of 56) have their freeridership scores adjusted down (increasing program savings), while those who would (5 out of 56) have their scores adjusted up (decreasing program savings). Participants who were not sure of a specific number (6 out of 56, including "maybe" and "don't know" responses) are not adjusted (multiplier is 1.0). The distribution and adjustment multipliers are shown in Table 19

Table 19. CFL Freeridership Adjustment Determined by Plans to Purchase CFLs in the Absence of the Program[9]

Number of CFLs intended to purchase	**Freeridership multiplier** (final freeridership score cannot exceed 100%)	**Number of customers intending to purchase number of CFLs (n=56)**
2	1.167	1
3.5	1.292	1
4	1.333	1
6	1.500	2
No specific number / Maybe / Don't know	1.000	6
Would not have purchased any	.250	45

Thirty-four participants (23.4% of 145) were not sure if they would have purchased more CFLs before participating in the PER program, and their freeridership scores are adjusted down (increasing program savings) based on how long they would have waited to purchase more CFLs if Duke Energy had not sent them six free ones as part of this program. These adjustment multipliers are shown in Table 20

Table 20. CFL Freeridership Adjustment Determined by When Participants Would Have Purchased CFLs in the Absence of the Program

When CFLs would be	**Freeridership multiplier**	**Number of customers intending to purchase CFLs**

[9] Fractional values in this table are due to interpolating ranges given by respondents ("3 or 4" is reported as 3.5).

purchased		within time period (n=34)
Next 3 months or less	.750	2
More than 3 months up to 6 months	.500	11
More than 6 months up to one year	.250	9
More than one year	Automatic 0% freeridership score	3
Never / only when incandescent bulbs are no longer available	Automatic 0% freeridership score	2
As needed / as budget permits / don't know	Multiplier based on mean multiplier of all other respondents in this table (.340)	7

TecMarket Works then multiplied the freeridership adjustment factor by the freeridership multiplier for each survey respondent. An average of the resulting freeridership percentage across 145 respondents who installed CFLs provided by Duke Energy produces an overall freeridership level of 18.4% for this program.

CFL Spillover

To calculate the spillover effect for the PER program, TecMarket Works assigned spillover scores based on responses to three questions, as seen in Table 21. Combinations of responses that are not listed in this table are assigned 0% spillover.[10]

Table 21. Spillover Factors for CFLs

Did you have any CFLs installed before the program?	Were you planning on buying <additional> CFLs before the program?	Have you purchased any CFLs since the program?	% Spillover
yes	no	yes	75
yes	maybe	yes	25
yes	don't know	yes	75
no	yes	yes	50
no	no	yes	100
no	maybe	yes	50
no	don't know	yes	100
don't know	yes	yes	25
don't know	no	yes	100
don't know	maybe	yes	50

Applying the factor scores found in Table 21 yields an overall spillover rate of 16.6% for the program. Final freeridership and spillover calculations for PER are shown in Table 22.

[10] If a respondent was assigned 100% freeridership, then they are automatically assigned 0% spillover.

Table 22. Freeridership and Spillover for CFL Bulbs

Measure (N=number of kit installations)	Number of participants with freeridership	Number of participants with spillover	Freeridership percentage (computed using Bass curve)	Spillover Percentage
CFL bulbs (N=146)	76	34	18.4%	16.6%

PER Program Net To Gross Discount for CFLs

The net to gross ratio is calculated as follows for the PER program:

NTGR = (1-freeridership) * (1+spillover)
= (1 - 0.184) * (1 + 0.166)
= 0.951

Total Discounting to be Applied = 1 - NTGR
= 1- .951
= 0.049
= 4.9%

Validity and Reliability of the Freerider Estimation Approach

There is significant debate within the field of evaluation pertaining to the reliability of self-report approaches for estimating freeridership levels. Self-selection and socially acceptable response bias act to increase apparent freeridership levels. Positive outcome bias, in which participants tend to take credit for actions that produce desired effects, and not take credit for actions that do not produce desired effect, may also have an influence on participant responses to survey questions. This bias, similar to the previous biases, would most likely act to drive apparent freeridership higher than actual levels. As a result the freerider ship estimates in this study should be considered conservative, with actual levels of freeridership probably lower than estimated. We do not know the degree of over-estimation of freeridership for this study. However, self-report approaches are the standard in our industry and are a common standard practice. There is some belief that adding additional freeridership questions to a survey to "triangulate response" act to improve the reliability of the estimate, however there is no evidence in the field of evaluation to support this assumption. In the opinion of TecMarket Works, adding question beyond those needed is more likely to reduce estimate reliability if the original questions are well constructed and objectively scored. TecMarket Work is confident that the questions used in this analysis represent the best and most reliable approach for scoring freeridership levels. However, we are not able to control for the different types of survey response bias and therefore suggest that the findings in this study be considered conservative.

Impact Estimates: Billing Analysis

This section of the report presents the results of a billing analysis conducted over the participants in the North and South Carolina PER program. For this analysis, billing data were obtained for all participants in the program between April, 2011 and June, 2012[11]. For PER, there were a total of 19,054 usable accounts after processing[12], of which 15,270 were from North Carolina, and 3,784 were from South Carolina. A panel model was used to determine program impacts, where the dependent variable was natural log of daily electricity consumption from April 2010 to August 2012.

The estimated PER savings obtained from the billing data analysis are presented below.

Table 23. Estimated Carolina PER Impacts: Billing Analysis

	95% Confidence Interval		
	Lower Bound	**Estimate**	**Upper Bound**
Per Participant Annual Savings kWh - PER	261	521	758
Per Participant Percentage Savings	-1.1%	-2.2%	-3.2%

This table shows that the PER program produced statistically significant savings for participants in the Carolinas.

Note that the billing data analysis includes variables to capture effect of participation in other Duke Programs after participation in PER. This is to explicitly control for any impact from other program participation.

For this analysis, data are available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of data, known as "panel" data, it becomes possible to control, simultaneously, for differences across households as well as differences across periods in time through the use of a "fixed-effects" panel model specification that provides net savings estimates that are already adjusted for freeridership and participant spillover that occurs during the analysis period. The approach does not include the program induced savings that are associated with short and longer term non-participant spillover or market effects. As a result, these savings should be considered conservative for an estimate actual achieved savings. The fixed-effect refers to the model specification aspect that differences across homes that do not vary over the estimation period (such as square footage, heating system, etc.) can be explained, in large part, by customer-specific intercept terms that capture the net change in consumption due to the program, controlling for other factors that do change with time (e.g., the weather). The model does control for what would have been done without the program within the participants' homes.

Because the consumption data in the panel model includes months before and after the installation of measures through the program, the period of program participation (or the

[11] Note there is no participation data available in 2012 given no campaign activities until July 2012.

[12] Useable accounts are those accounts which have billing data for both a portion of the pre- and post-participation period, as well as monthly kWh greater than 0 and less than 10,000 kWh. Usable accounts exclude outliers such that absolute value of DFBetas < 2*sqrt(n), with n = total number of observations. It was not required that the data covers the complete evaluation period, only that there is at least one observation in each period.

participation window) may be defined specifically for each customer. This feature of the panel model allows for the pre-installation months of consumption to effectively act as the comparison group for post-participation months. In addition, this model specification, unlike annual pre/post-participation models such as annual change models, does not require a full year of post-participation data. Effectively, the participant becomes their own comparison group, thus eliminating the need for a non-participant comparison or control group. We know the exact month of participation in the program for each participant, and are able to construct customer specific models that measure the change in usage consumption immediately before and after the date of program participation, controlling for weather and customer characteristics.

The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household.

Algebraically, the fixed-effect panel data model is described as follows:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it},$$

where:

y_{it}	=	energy consumption for home i during month t
α_I	=	constant term for site i
β	=	vector of coefficients
x	=	vector of variables that represent factors causing changes in energy consumption for home i during month t (i.e., weather, time, and participation)
ε	=	error term for home i during month t.

With this specification, the only information necessary for estimation is those factors that vary month to month for each customer, and that will affect energy use, which effectively are weather conditions and program participation. Other non-measurable factors can be captured through the use of monthly indicator variables (e.g., to capture the effect of potentially seasonal energy loads).

The effect of the PER program are captured by including a variable which is equal to one for all months after the household participated in the program. The coefficient on this variable is the savings associated with the program. In order to account for differences in billing days, the usage was normalized by days in the billing cycle and natural log was taken. The estimated electric model for the PER program is presented in Table 24.

Table 24. Estimated Savings Model for PER – dependent variable is natural log of daily kWh usage, April 2010 through August 2012 (savings are negative).

Independent Variable	Coefficient (% Savings)	t-value
PER participation – Carolina	2.18%	-4.06
Sample Size	494762 observations (19,054 homes)	
R-Squared	72%	

The estimated impact of 2.18% is multiplied by the average pre-program annual usage of 23,600 kWhs to achieve 521 kWh as annual savings. The distribution of the annual pre-program usage for participants is presented in Figure 17.

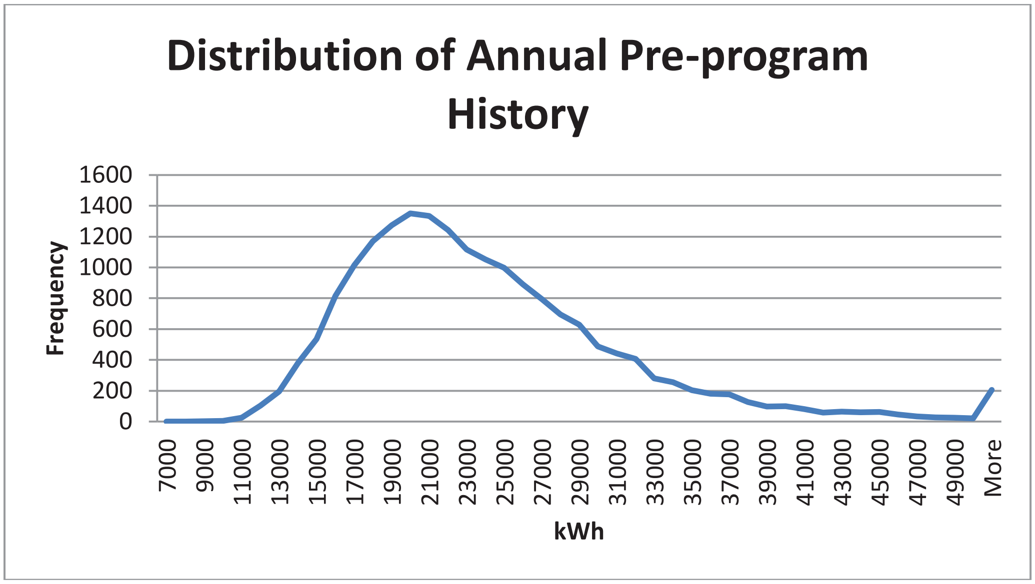


Figure 17. Distribution of Annual Pre-program History

The complete estimate model, showing the weather and time factors, is presented in Appendix D: Estimated Model.

Impact Estimates: Engineering Analysis

Savings values in this section are not official and are provided only for program's management information and their use to better understand the per measure adoption and use characteristics. The engineering analysis does not take into consideration the recommendations provided by the report, thus the billing analysis is required for an accurate calculation of the kWh savings. The net savings claimed by this program should be taken from the billing analysis results. These engineering estimates provide, for the billing analysis, a ratio of coincident kW reduction to kWh savings as it is incapable of analyzing kW. Additionally, the engineering estimates offer insight into individual measure contributions to overall savings.

Table 25 shows the savings per unit distributed for both the 13 and 20-watt CFLs and, in the final column, savings resulting from the entire six-pack of CFLs. Savings are adjusted downward for the ISR and incorporate the self-reporting bias applied to the hours of use as well as the freeridership and spillover percentages computed from participants' survey responses. All engineering savings estimates exclude audit recommendations as they were too seldom taken to collect sufficient data for statistical relevance through the phone survey.

Table 25. Adjusted Impact: kWh and Coincident kW per Bulb Distributed

Metric	13-watt CFL	20-watt CFL	Entire Six-Pack
Units	Bulb	Bulb	Six-Pack
Amount distributed	471	471	157
In service rate	87.6%	82.0%	
Gross kW per unit	0.0072	0.0074	0.0437
Gross kWh per unit	45.2	42.6	264
Freeridership rate	18.4%	18.4%	18.4%
Spillover rate	16.6%	16.6%	16.6%
NTG ratio	95.1%	95.1%	95.1%
Net kW per unit	0.0068	0.0070	0.0416
Net kWh per unit	43.0	40.5	250.6
Measure Life (years)[13]	5	5	5
EUL net kWh per bulb	215	203	1253

Survey Data

Property managers were asked how many CFLs distributed through Duke Energy's PER program they had installed in light fixtures. Additional, more specific information was collected through a phone survey of their tenants for each of the six bulbs, including type and wattage of the bulb that it replaced and the average hours per day that it is in use. TecMarket Works conducted the phone survey with a random sample of 157 participants from the Carolinas between October 12 and October 27, 2012. The compilation of this data is presented in Table 26 in its unadjusted form; that is before the self-reporting bias is applied to the hours of use. The adjusted values appear in Table 27.

Table 26. Unadjusted CFL Survey Data

[13] Consistent with prior evaluations of CFL programs for Duke Energy, a measure life of five years was used for installed CFLs. No derate was performed for post-EISA years.

Measure	Number of Installations	Average Wattage of Unit Removed	Average Daily Hours of Use
13W CFL	379	63	4.73
20W CFL	333	71	4.65

In Service Rate (ISR) Calculation

A total of 942 CFLs were distributed to survey participants, 471 13-watt and 471 20-watt. Respondents reported that 379 13-watt and 333 20-watt bulbs are currently installed in light fixtures, first year ISRs of 80.47% and 70.70% respectively. Using the 20-watt CFL as an example, the ISR is calculated to be 82.0% using the following formula:

ISR = first year ISR + (43% * remainder) = **70.70% + (43% * 26.30%) = 82.0%**

The remainder is the percentage of bulbs that are not installed in the first year (100% - 70.70% = 29.30%) less 3% for the 97% lifetime ISR[14]. In this case, the remainder is 26.30%. The 43% represents the percentage of the remainder that will replace an incandescent bulb rather than a CFL[15].

Self-Reporting Bias

Previous studies that have included both customer surveys and lighting loggers have shown that, comparing customers' self-reported hours of operation to the actual hours of operation, customers responding to the survey overestimated their lighting usage by 38%[16]. As this study did not employ lighting loggers, there is no data with which to make a comparison for this program specifically. Consequently, the self-reported hours of use obtained from the survey were reduced by the 38% established through the collection of data from previous programs.

Table 27 shows the unadjusted hours of use values along with the updated values after the self-reporting bias is applied. The final value for average daily hours of use is 2.51 and 2.50 for 13-watt and 20-watt CFLs respectively.

Table 27. Adjusted Average Daily Hours of Use

Adjustment	Magnitude of Adjustment	Average Daily Hours of Use (13-watt)	Average Daily Hours of Use (20-watt)
Unadjusted	N/A	4.73	4.65
Self-Reporting Bias	38%	2.93	2.88

[14] As established in the Nexus Market Research, RLW Analytics, and GDS Associates study, dated January 20th, 2009: "New England Residential Lighting Markdown Impact Evaluation".
[15] As established in the Nexus Market Research, RLW Analytics, dated October 2004: "Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs", table 6-4 where 24 out of 56 respondents indicated that they did not purchase the CFLs as spares.
[16] TecMarket Works and Building Metrics. "Ohio Residential Smart Saver CFL Program". June 29, 2010. Pg. 35. TecMarket Works and Building Metrics, "Kentucky ENERGY STAR® Products Program". Sept. 28, 2012. Pg. 66.

Total Program Savings Extrapolation

There were a total of 22,382 program participants that received a total of 134,292 CFLs from April 26, 2011 through December 16, 2011. This information is presented in Table 28. Multiplying the number of bulbs by the savings per bulb for the program from Table 25 produces the total annual program kW and kWh savings.

Table 28. Total Program Gross Savings Extrapolation

Measure	Participation Count	Number of Bulbs	Gross kWh	Gross kW
13-watt CFL	22,382	67,146	3,034,999	483
20-watt CFL			2,860,420	497

Appendix A: Management Interview Instrument

INSTRUMENT

Name: ____

Title: ____

Position description and general responsibilities:

____

____

We are conducting this interview to obtain your opinions about and experiences with the Personalized Energy Report program. We'll talk about the program and its objectives, your thoughts on improving the program, and the technologies the program covers. The purpose of this study is to capture the program's current operations as well as help identify areas where the program might be improved. Your responses will feed into a report that will be shared with Duke Energy and the state regulatory agency. I want to assure you that the information you share with me will be kept confidential; we will not identify you by name. However, you may provide some information or opinions that could be attributed to you by virtue of your position and role in this program. If there is sensitive information you wish to share, please warn me and we can discuss how best to include that information in the report.

The interview will take about an hour to complete. Do you have any questions for me before we begin?

Program Background and Objectives

1. Please describe your role and scope of responsibility in detail.
2. How long have you been involved with the program?
3. (PM only) Describe the evolution of the Program. Why was the program created, and has the program changed since it was it first started?
4. Have there been any recent changes been made to your duties since you started?
    a. If YES, please tell us what changes were made and why they were made. What are the results of the change?
5. In your own words, please describe the Program's objectives. (e.g. enrollment, energy savings, non-energy benefits)

6. (PM only) Can you please walk me through the program's implementation, starting with how the program is marketed and how you target your customers, through how the customer participates and finishing with how savings are verified?

    a. Marketing/Targeting: How & Who

    b. Enrollment/Participation

    c. Rebate processing

    d. Savings verification: How & Who

7. Of the program objectives you mentioned earlier, do you feel any of them will be particularly easy to meet, and why?

8. Which program objectives, if any, do you feel will be relatively difficult to meet, and why?

9. Are there any objectives you feel should be revised prior to the end of this program cycle? If yes, why?

Vendors (10 min)

10. (PM only) Do you use any vendors or contractors to help implement the program?

    a. What responsibilities do they have?

    b. Are there any areas in which think they can improve their services?

11. *(If not captured earlier)* Please explain how activities of the program's vendors, customers and Duke Energy are coordinated.

    a. Do you think methods for coordination should be changed in any way? If so, how and why?

Rebates

12. (PM only) How do you determine which pieces of equipment are included in the program? For example, how do you determine what level of efficiency the rebated equipment should have?

    a. Do you use any outside vendors or experts to help with this process?

    b. What should be changed about this selection process?

13. Describe your quality control and process for tracking participants, rebates, and other program data.

14. Do you believe that the program currently offers rebates on enough energy efficient products to meet your customers' needs?

    a. If not, what products would you like to add? Are these currently being considered?

15. Is the program offering enough of a rebate to motivate your customers to participate?

    a. If not, which rebates do you think should be changed, and why?

Contractor Training

16. Describe the contractor program orientation training and development approach.

    a. How do you ensure that contractors are getting adequate program training and updated program information?

    b. Can we obtain training materials that are being used?

    c. Are there any new areas where you think contractors could be trained?

17. Do you have any suggestions for improving contractor effectiveness?

Improvements

18. Are you currently considering any changes to the program's design or implementation?

    a. What are the changes?

    b. What is the process for deciding whether or not to make these changes?

19. Do you have suggestions for improvements to the program that would increase participation rates, or is Duke Energy happy with the current level of participation?

20. Do you have suggestions for increasing energy impacts *per participant*, given the same participation rates, or is Duke Energy happy with the current per participant impact?

21. Overall, what would you say about the PER program is working really well?

    a. Is there anything in this program you could highlight as a best practice that other utilities might like to adopt?

22. What area needs the most improvement, if any?

    a. (If not mentioned before) What would you suggest can be done to improve this?

23. Are there any other issues or topics we haven't discussed that you feel should be included in this report?

24. Do you have any further questions for me about this study or anything else?

25. Thank you!

Appendix B: Participant Survey Instrument

The questions below require mostly short, scaled replies from the interviewee, and not all questions will be asked of all participants. This interview will take approximately 30 minutes. Use four attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday.

Target - 80 surveys per state

Note: Only read words in bold type. Instructions are in italics.

Surveyor Name: ___________________________
Survey ID: ___________________________

State
( ) North Carolina
( ) South Carolina

Hello, my name is ______. I am calling on behalf of Duke Energy to conduct a customer survey about the Personalized Energy Report Program. May I speak with _____________ please?

If person talking, proceed. If person is called to the phone reintroduce. If not home, ask when would be a good time to call and schedule the call-back:

We are conducting this survey to obtain your opinions about the Personalized Energy Report Program. Duke Energy's records indicate that you participated in the Personalized Energy Report Program in [month / year]. If you qualify, we will send you a check for $20 for completing the survey. It will take about 30 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1. Do you recall participating in the Personalized Energy Report Program?
( ) Yes
( ) No
( ) DK/NS

If NO or DK/NS, ask:
1b. This program was provided through Duke Energy. In this program, you completed a short survey about your home. In return, you were provided with energy-saving recommendations for you and your home, and you were provided with a six-pack of free CFLs. Do you remember participating in this program?
( ) Yes

( ) No
( ) DK/NS

If No or DK/NS to question 1b, end interview and go to next participant.

2. How were you first made aware of the Personalized Energy Report Program?
[ ] Saw an insert in monthly bill
[ ] Saw information at the Duke Energy Website
[ ] Other web site
[ ] Saw an advertisement on radio, TV, or on the newspaper *ask*: **Where ?**
[ ] Friend/ Family Member/ Co-Worker
[ ] Through another energy program *ask*: **Which program ?**
[ ] Through a low-income program *ask*: **Which program ?**
[ ] Other please specify:

3. Before you heard about the Personalized Energy Report from Duke Energy, had you already been considering getting a home energy audit?
( ) Yes
( ) No
( ) DK/NS

4. Since you received the Personalized Energy Report from Duke, have you purchased a full home energy audit?
( ) Yes, I purchased it. *ask*: **How much did this cost you?: __________________**
( ) Yes, I had a free audit from Duke Energy
( ) Yes, I had a free audit through a government agency
( ) No
( ) DK/NS or Refused

If No to q4, ask:
4a. If the Personalized Energy Report from Duke had not been offered, would you have purchased a full home energy audit within the next year?
( ) Yes
( ) No
( ) DK/NS

If Yes to q4a, ask:
4b. How much would you have been willing to spend on a full home energy audit if you had not obtained the Personalized Energy Report from Duke Energy?

5. Please think back to the time when you were deciding to participate in the Personalized Energy Report program. What factor or factors motivated you to participate?
[ ] Curious about what recommendations would be provided
[ ] The free CFLs
[ ] The free cost to get the PER (Personalized Energy Report).
[ ] Wanted to reduce energy use

[ ] Wanted to reduce energy costs
[ ] The information provided by the Program
[ ] Past experience with this program
[ ] Because of past experience with another Duke Energy program *ask* : **What other Duke program ?**
[ ] Recommendation from other utility program *ask* : **What other utility program?**
[ ] Recommendation of family/friend/neighbor
[ ] Recommendation of someone else *ask* : **Who?**
[ ] Advertisement in newspaper *ask* : **Which newspaper?**
[ ] TV advertisement *ask* : **For what TV programs?**
[ ] Radio advertisement *ask* : **For what radio program?**
[ ] Environmental concerns
[ ] Other *Please specify*________________________
[ ] DK/NS

5. Do you recall filling out a survey about your home in order to receive your Personalized Energy Report and CFLs?
( ) Yes
( ) No
( ) DK/NS

Now I am going to ask you some general satisfaction statements about the survey and the report. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statements.

6. The Personalized Energy Report survey was easy to understand.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS
( ) NA

If 7 or less
6a. How could this be improved?

7. The Personalized Energy Report survey asked questions that made sense to me.
( ) 1
( ) 2
( ) 3

( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS
( ) NA

If 7 or less
7a. How could this be improved?

8. The Personalized Energy Report survey asked questions that I could easily answer.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS
( ) NA

If 7 or less
8a. How could this be improved?

Next, I would like to ask about the results you received in the Personalized Energy Report. This report included information about your month-to-month energy use, how you use electricity, how your home's energy use compares with that of similar homes, and money-saving suggestions and tips.

For the next several questions I'll read statements for you to respond to. Please indicate how strongly you agree or disagree by giving a number on the 1 to 10 scale, with 1 meaning that you "strongly disagree" and 10 meaning that you "strongly agree".

9. Overall, the Personalized Energy Report was easy to read.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6

( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
9a. How could this be improved?

10. Overall, the Personalized Energy Report helped me understand my energy use.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS
( ) NA

If 7 or less
10a. How could this be improved?

Next, let's talk about the actual report details – starting with the table and bar chart showing your month-to-month electricity usage and charges for the past year.

11. Do you recall reading this section?
( ) Yes, read it
( ) No, read it but don't recall anything
( ) No, didn't read it

If Yes, continue, if No skip to question 17
Using the 1 to 10 scale, with 1 meaning that you "strongly disagree" and 10 meaning that you "strongly agree", please rate the following statements.

12. The Personalized Energy Report table showing monthly electricity usage and approximate bill was easy to understand.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6

( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
12a. How could this be improved?

13. The monthly electricity usage and approximate bill statement in the Personalized Energy Report was close to what the actual bills were.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or lower
13a. Was the usage listed on the Personalized Energy Report higher or lower than your actual usage?
( ) Usage too high on Personalized Energy Report
How far off was it? : _________________
( ) Usage too low on Personalized Energy Report
How far off was it? : _________________
( ) DK/NS

14. The report's month-to-month variations in cost and usage made sense to me.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less

14a. How could this be improved?

15. I gained knowledge I can use from the report's monthly use table.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
15a. How could this be improved?

If 8 or more
15b. What did you learn?

If 8 or more
15c. Did you talk to anyone else about what you learned?

16. The Personalized Energy Report suggested that you consider the Equal Payment Plan. Did you sign up for the Equal Payment Plan in response to this suggestion?
( ) I was already enrolled in the Equal Payment Plan
( ) Yes, I recently enrolled
( ) No
( ) Don't recall reading this
( ) Was not on my report

If No, 'Don't recall reading this', or 'Was not on my report', ask:
16a. Are you considering enrolling in the Equal Payment Plan?
( ) Yes
( ) No, have not considered

If No to 16a
16b. Why not?

Now, let's look at the section of the report that discussed how your household uses electricity.

17. Do you recall reading this section?
( ) Yes, read it
( ) No, read it but don't recall anything

( ) No, didn't read it

If Yes, continue, if No skip to question 23
Using the 1 to 10 scale, with 1 meaning that you "strongly disagree" and 10 meaning that you "strongly agree", please rate the following statements.

18. The pie chart showing the breakdown of energy use by activity was easy to understand.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
18a. How could this be improved?

19. The breakdown of energy use by activity made sense to me.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
19a. How could this be improved?

20. The Personalized Energy Report's annual cost breakdown gave me new awareness of my AMOUNT OF ENERGY CONSUMPTION from specific activities.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6

( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
20a. How could this be improved?

If 8 or more
20b. What did you learn from the Personalized Energy Report about your energy consumption from specific activities?

21. The Personalized Energy Report's annual cost breakdown gave me new awareness of the COSTS FOR SPECIFIC HOUSEHOLD ACTIVITIES.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
21a. How could this be improved?

If 8 or more
21b. What did you learn from the Personalized Energy Report about the energy costs of specific activities?

22. I gained knowledge I can use from the report's chart of use by activity.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
22a. How could this be improved?

If 8 or more
22b. What did you learn from the Personalized Energy Report?

Next, let's look at the section of the report that compared your household's ANNUAL use of electricity with that of similar homes in the region.

23. Do you recall reading this section?
( ) Yes, read it
( ) No, read it but don't recall anything
( ) No, didn't read it

If Yes, continue, if No skip to question 26
Using the 1 to 10 scale, with 1 meaning that you "strongly disagree" and 10 meaning that you "strongly agree", please rate the following statements.

24. The report's comparison of annual electric use to similar homes was believable.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
24a. Why didn't you believe the comparison?

25. The report's comparison of annual electric use with similar homes gave me new awareness of how my use compares with that of other customers.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9

( ) 10
( ) DK/NS

If 7 or less
25a. How could this be improved?

If 8 or more
25b. What did you learn from the Personalized Energy Report about your overall energy consumption?

26. Do you recall reading about the Smart Saver Program, the program that provides rebates for high efficiency heat pumps and air conditioners?
( ) Yes
( ) No
( ) DK/NS

27. Are you considering purchasing a new or replacement heat pump?
( ) Yes
( ) DK/NS
( ) No (*check to see if they recently purchased one*)
( ) No, I recently purchased one

If yes or not sure,
27a. Using a 1 to 10 scale with 1 meaning "not at all likely" and 10 meaning "very likely", how likely are you to consider purchasing a high-efficiency heat pump?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

28. Are you considering purchasing a new or replacement Air Conditioner?
( ) Yes
( ) DK/NS
( ) No (*check to see if they recently purchased one*)
( ) No, I recently purchased one

If yes or not sure,
28a. Using a 1 to 10 scale with 1 meaning "not at all likely" and 10 meaning "very likely", how likely are you to consider purchasing a high-efficiency air conditioner?

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

NOTE: many of the following questions have an instruction to you in italics: (Check for increase in frequency). If, for example, they respond "Before", ask them "Do you do it more often now?"

Let's turn now to the report's energy saving tips for your home.

29. Do you recall reading this section?
( ) Yes, read it
( ) No, read it but don't recall anything
( ) No, didn't read it

30. When you leave your house in winter, do you turn down the heat?
( ) Yes, all the time
( ) Yes, some of the time
( ) No, thermostat is programmable
( ) No

If yes,
30a. Did you start doing this after you read about this on the report?
( ) Yes
( ) No
( ) DK/NS

If yes,
30b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9

( ) 10
( ) DK/NS

31. Do you use ceiling fans in the winter?
( ) Yes, all the time
( ) Yes, some of the time
( ) No, don't have ceiling fans
( ) No

If yes,
31a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
31b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

32. Do you use a portable heater in the winter?
( ) Yes, all the time
( ) Yes, some of the time
( ) No, don't have one
( ) No

If yes,
32a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:

32b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

33. Do you open your window curtains in the daytime in winter?
( ) Yes, all the time
( ) Yes, some of the time
( ) No, don't have curtains/blinds
( ) No

If yes,
33a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
33b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

34. Do you close your window curtains at night in winter?
( ) Yes, all the time
( ) Yes, some of the time
( ) No, don't have curtains or blinds

( ) No

If yes,
34a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
34b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

35. When you leave your house in summer, do you turn up the thermostat?
( ) Yes, all the time
( ) Yes, some of the time
( ) No, thermostat is programmable
( ) No

If yes,
35a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
35b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6

( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

36. Do you use exhaust fans in the summer?
If yes, clarify which rooms
( ) Yes, in kitchen
( ) Yes, in bathroom
( ) Yes, in both
( ) No, don't have fans that vent to outside
( ) No
( ) Other: _________________

If yes,
36a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
36b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

37. Do you re-schedule heat-generating activities in the summer afternoons, such cooking and bathing?
( ) Yes
( ) No
( ) DK/NS

If Yes,
37a. What activities do you reschedule?
[ ] cooking

[ ] bathing
[ ] dishwashing
[ ] clothes drying
[ ] Other

If yes,
37b. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
37c. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

38. Do you close your window curtains in the daytime in summer?
( ) Yes, all the time
( ) Yes, some of the time
( ) No, don't have curtains/blinds
( ) No
( ) DK/NS

If yes,
38a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
38b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2

( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

39. Have you lightened your dryer loads to improve efficiency?
( ) Yes
( ) No
( ) DK/NS
( ) Not Applicable

If yes,
39a. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
39b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

39c. Are you drying loads consecutively to improve efficiency?
An already warmed dryer will dry clothes faster
( ) Yes
( ) No
( ) DK/NS
( ) Not Applicable

If yes,

39d. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
39e. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

40. Do you rinse your dishes before putting them in the dishwasher?
( ) Yes
( ) No
( ) DK/NS
( ) Not applicable

If Yes,
40a. Do you use hot or cold water to rinse?
( ) Hot water
( ) Cold water

If yes,
40b. Did you start doing this before or after you read about this on the report?
( ) Before (*check for increase in frequency*)
( ) Before, but I do this more often now
( ) After
( ) DK/NS

If 'more often' or 'After', ask:
40c. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4

( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

In case the customer asks: When a refrigerator gasket (usually a rubber seal around the door) becomes hard or cracked, its seal is broken, and the unit's efficiency drops sharply. Test the door gasket for leaks by placing a dollar bill between the gasket and the door jamb and closing the door. Pull the bill out. If it offers some resistance, chances are the gasket fits properly. If the bill comes right out, or falls out, the gasket is faulty and should be replaced. Test the gasket at several locations around the door.

41. Have you tested the seals on your refrigerator door using a dollar bill?
( ) Yes
( ) No
( ) DK/NS

If Yes to 41,
41a. What condition are they in?
( ) Good Condition
( ) Poor condition

If Poor condition,
41b. Did you replace them?
( ) Yes, I replaced them
( ) No, I have not replaced them
( ) No, I have not replaced them but I plan to

If Yes to 41 (did test the seals),
41c. Did you do this before or after you read about this on the report?
( ) Before
( ) After
( ) DK/NS

If 'After', ask:
41d. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6

( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

42. Did you change any of your other habits as a result of the Energy Saving Tips in the Personalized Energy Report?
( ) Yes
( ) No
( ) DK/NS

If Yes to 42,
42a. What have you done?

Now, let's review some of your overall impressions of the report and the program. Using the 1 to 10 scale, with 1 meaning that you "strongly disagree" and 10 meaning that you "strongly agree", please rate the following statements.

43. The recommendations in the Personalized Energy Report provided new ideas that I was not previously considering.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
43a. How could this be improved?

44. The recommendations in the Personalized Energy Report increased the likelihood that I would take the recommended actions.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8

( ) 9
( ) 10
( ) DK/NS

If 7 or less
44a. How could this be improved?

45. The Personalized Energy Report looked professional.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
45a. How could this be improved?

46. The Personalized Energy Report was trustworthy.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
46a. How could this be improved?

47. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please indicate your overall satisfaction with the program.
( ) 1
( ) 2
( ) 3
( ) 4

( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
47a. How could this be improved?

48. Using the same scale, please indicate your overall satisfaction with Duke Energy.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
48a. How could this be improved?

49. Let's look at the Compact Fluorescent Light bulbs you received. Did you receive six CFLs?
( ) Yes
( ) No
Ask: **How many did you receive?: ___________________**
( ) DK/NS

50. Did the CFLs provided through the Personalized Energy Report arrive promptly?
( ) Yes
( ) No
( ) DK/NS

If No, ask:
50a. What problems did you experience?
( ) They took too long to arrive
( ) They never arrived
( ) Other: ___________________

51. Did you install any of the three 13-watt CFLs provided?

( ) Yes
( ) No
( ) DK/NS

If Yes,
51a. How many did you install?
( ) 1
( ) 2
( ) 3
( ) DK/NS

If No, ask:
51b. Do you plan on using the 13-watt CFLs?
( ) Yes
( ) No
Ask: **Why not?: _________________**
( ) DK/NS or Maybe

Ask the following series of questions as many times as needed, up to three times - once per bulb.

51c. Thinking of the first 13-watt bulb you installed, how many watts was the old bulb that was replaced with the CFL?
( ) <=44
( ) 45-70
( ) 71-99
( ) 100+
( ) DK/NS

51d. On average, approximately how many hours per day is this light used?
( ) <=1
( ) 1 to 2
( ) 3 to 4
( ) 5 to 10
( ) 11 to 12
( ) 13 to 24
( ) DK/NS

51e. Thinking of the second 13-watt bulb you installed, how many watts was the old bulb that was replaced with the CFL?
( ) <=44
( ) 45-70
( ) 71-99
( ) 100+
( ) DK/NS

51f. On average, approximately how many hours per day is this light used?

( ) <=1
( ) 1 to 2
( ) 3 to 4
( ) 5 to 10
( ) 11 to 12
( ) 13 to 24
( ) DK/NS

51g. Thinking of the third 13-watt bulb you installed, how many watts was the old bulb that was replaced with the CFL?
( ) <=44
( ) 45-70
( ) 71-99
( ) 100+
( ) DK/NS

51h. On average, approximately how many hours per day is this light used?
( ) <=1
( ) 1 to 2
( ) 3 to 4
( ) 5 to 10
( ) 11 to 12
( ) 13 to 24
( ) DK/NS

52i. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 13-watt CFLs.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
52j. Why were you less than satisfied with the CFLs?

52. Did you install any of the three 20-watt CFLs provided ?
( ) Yes
( ) No

( ) DK/NS

If Yes,
52a. How many did you install?
( ) 1
( ) 2
( ) 3
( ) DK/NS

If No, ask:
52b. Do you plan on using the 20-watt CFLs?
( ) Yes
( ) No
Ask: **Why not?: ________________**
( ) DK/NS or Maybe

Ask the following series of questions as many times as needed - once per bulb.

52c. Thinking of the first 20-watt bulb you installed, how many watts was the old bulb that was replaced with the CFL?
( ) <=44
( ) 45-70
( ) 71-99
( ) 100+
( ) DK/NS

52d. On average, approximately how many hours per day is this light used?
( ) <=1
( ) 1 to 2
( ) 3 to 4
( ) 5 to 10
( ) 11 to 12
( ) 13 to 24
( ) DK/NS

52e. Thinking of the second 20-watt bulb you installed, how many watts was the old bulb that was replaced with the CFL?
( ) <=44
( ) 45-70
( ) 71-99
( ) 100+
( ) DK/NS

52f. On average, approximately how many hours per day is this light used?
( ) <=1
( ) 1 to 2

( ) 3 to 4
( ) 5 to 10
( ) 11 to 12
( ) 13 to 24
( ) DK/NS

52g. Thinking of the third 20-watt bulb you installed, how many watts was the old bulb that was replaced with the CFL?
( ) <=44
( ) 45-70
( ) 71-99
( ) 100+
( ) DK/NS

52h. On average, approximately how many hours per day is this light used?
( ) <=1
( ) 1 to 2
( ) 3 to 4
( ) 5 to 10
( ) 11 to 12
( ) 13 to 24
( ) DK/NS

52i. On a scale from 1-10, with 1 indicating that you were very dissatisfied, and 10 indicating that you were very satisfied, please rate your satisfaction with the kit's 20-watt CFLs.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

If 7 or less
52j. Why were you less than satisfied with the CFLs?

53. Did you remove any of the CFLs provided through this program?
( ) Yes *ask:* **53a. How many did you remove?:** __________________
( ) No
( ) DK/NS

If yes to 53,
53b. Why did you remove them?
[ ] Not bright enough
[ ] Too bright
[ ] I did not like the light
[ ] Too slow to start
[ ] Mercury concerns
[ ] Burned out
[ ] Not working properly
[ ] Other

54. Did you have any CFLs installed in your home before you received the CFLs from the program?
( ) Yes *ask*: **54a. How many?: __________________**
( ) No
( ) DK/NS

55. Were you planning on buying CFLs for your home before you received the kit from the Personalized Energy Report program?
( ) Yes
( ) No
( ) Maybe
( ) DK
( ) No, already have them installed in all available sockets

If yes,
55a. How many more CFLs did you plan to buy within the next 3 months?
( ) Number: __________________
( ) Had not set a specific number
( ) DK/NS

If no,
55b. Do you think that you would have purchased more CFLs in the next 3 months if you had not received them from Duke Energy?
( ) Yes
( ) No
( ) Maybe
( ) Don't know

If yes to 55b,
55c. How many would you have purchased within 3 months if you had not received Duke's bulbs?
( ) Number: __________________
( ) Had not set a specific number
( ) DK/NS

56. How long do you think it would have been before you would have purchased additional CFLs had Duke not provided these to you?

____

57. Have you purchased any additional CFLs since receiving the CFLs from the Personalized Energy Report?
( ) Yes *ask*: 57a. **How many?:** __________________
( ) No
( ) DK/NS

58. Did you make any other changes to your home, either directly or indirectly, as a result of the Personalized Energy Report?
( ) Yes
( ) No
( ) DK/NS

If yes,
58a. What changes did you make?

____

If yes,
58b. Using a 1-10 scale with 1 meaning not at all influential, and 10 meaning very influential, how influential was the Personalized Energy Report in you taking this action?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

Smart Energy Now
59. Do you work in the I-277 Loop of Uptown Charlotte?
( ) Yes
( ) No

If Yes,
59a. How many days a week to do you typically work Uptown?
( ) 5 days a week
( ) 3-4 days a week
( ) 1-2 days a week
( ) Office is Uptown, but telecommute full-time

( ) Other: ________________

59b. Does anyone else in your household work in the I-277 Loop of Uptown Charlotte?
( ) Yes
( ) No

If Yes,
59c. How many days a week to does that person typically work Uptown?
( ) 5 days a week
( ) 3-4 days a week
( ) 1-2 days a week
( ) Office is Uptown, but telecommute full-time
( ) Other: ________________

60. Have you heard of "Envision Charlotte"?
( ) Yes
( ) No
( ) DK/NS

If Yes,
60a. What do you know about it?

61. Have you heard of "Smart Energy Now"?
( ) Yes
( ) No
( ) DK/NS

If Yes,
61a. What do you know about it?

If Yes to 60 or 61,
62. Have you participated in any of the Envision Charlotte or Smart Energy Now events or programs?
( ) Yes
( ) No
( ) DK/NS

If Yes,
62a. In which events or programs have you participated?

If Yes to 60 or 61,
63. Has your knowledge of or participation in any of the Smart Energy Now or Envision Charlotte events influenced your decision to participate in the Personalized Energy Report program?
( ) Yes
( ) No

( ) DK/NS

If Yes to 60 or 61,
64. Has your knowledge of or participation in any Smart Energy Now or Envision Charlotte event influenced your energy usage at home?
( ) Yes
( ) No
( ) DK/NS

If Yes,
64a. How has your energy use changed at home?

On a scale from 1-10, with 1 indicating that the factor was not at all influential, and 10 indicating that the factor was very influential, please rate the level of influence of the following factors on your decision to participate in the Personalized Energy Report Program.

65. Your involvement in or awareness of Envision Charlotte, the collaborative partnership among major employers, building owners and managers along with municipal and technology leaders. Its purpose is to create the most environmentally sustainable urban core in the nation by connecting numerous environmental programs and initiatives.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

66. Your involvement or awareness of Smart Energy Now, the program that allows you to see the energy usage of the building you work in in near-real time.
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

Specialty Bulbs

I'm now going to ask you about the number of bulbs currently installed in your home that are specialty bulbs such as dimmable bulbs, three-way bulbs, recessed, flood or directional lights, candelabra lights or other non-standard bulbs…

s1. How many Dimmable bulbs do you have in your home?... how many Outdoor flood bulbs... etc...
Dimmable bulbs: ___________________________
Outdoor flood bulbs: ___________________________
Three-way bulbs: ___________________________
Spotlight bulbs: ___________________________
Recessed bulbs: ___________________________
Candelabra bulbs: ___________________________
Other: ___________________________

s2. **For each of these specialty bulbs installed, how many are CFLs?**
Dimmable bulbs: ___________________________
Outdoor flood bulbs: ___________________________
Three-way bulbs: ___________________________
Spotlight bulbs: ___________________________
Recessed bulbs: ___________________________
Candelabra bulbs: ___________________________
Other: ___________________________

s3. On a scale from 1-10, with 1 indicating not at all interested and 10 indicating very interested, please rate your interest in Duke Energy providing a direct mail specialty CFL program that shipped discounted specialty bulbs directly to your home:
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) DK/NS

Please tell me if you would be interested in receiving the following types of CFLs if they were to be offered in the future…

s4. Dimmable CFLs
( ) Yes

If YES, ask: **About how many hours per day would these bulbs be used?:**

____
( ) No
( ) DK/NS

s5. Outdoor flood CFLs
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?:**

____
( ) No
( ) DK/NS

s6. Three-way CFLs
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?:**

____
( ) No
( ) DK/NS

s7. Spotlight CFLs
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?:**

____
( ) No
( ) DK/NS

s8. Candelabra CFLs
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?:**

____
( ) No
( ) DK/NS

(If responder indicated a different specialty bulb)
s9. {Other bulb}
( ) Yes
If YES, ask: **About how many hours per day would these bulbs be used?:**

____
( ) No
( ) DK/NS

Finally, we have some general demographic questions…

d1. In what type of building do you live?
( ) Single-family home, detached construction
( ) Single family home, factory manufactured/modular

( ) Single family, mobile home
( ) Row House
( ) Two or Three family attached residence-traditional structure
( ) Apartment (4 + families)---traditional structure
( ) Condominium---traditional structure
( ) Other: _________________
( ) Refused
( ) DK/NS

d2. What year was your residence built?
( ) 1959 and before
( ) 1960-1979
( ) 1980-1989
( ) 1990-1997
( ) 1998-2000
( ) 2001-2007
( ) 2008-present
( ) DK/NS

d3. How many rooms are in your home (excluding bathrooms, but including finished basements)?
( ) None
( ) 1-3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10 or more
( ) DK/NS

d4. Which of the following best describes your home's heating system?
( ) None
( ) Central forced air furnace
( ) Electric Baseboard
( ) Heat Pump
( ) Geothermal Heat Pump
( ) Other: _________________

d5. How old is your heating system?
( ) 0-4 years
( ) 5-9 years
( ) 10-14 years
( ) 15-19 years
( ) 19 years or older

( ) DK/NS
( ) Do not have

d6. What is the primary fuel used in your heating system?
( ) Electricity
( ) Natural Gas
( ) Oil
( ) Propane
( ) Other: __________________

d7. What is the secondary fuel used in your primary heating system, if applicable?
( ) Electricity
( ) Natural Gas
( ) Oil
( ) Propane
( ) Other: __________________
( ) None

d8. Do you use one or more of the following to cool your home?
(Mark all that apply)
[ ] None, do not cool the home
[ ] Heat pump for cooling
[ ] Central air conditioning
[ ] Through the wall or window air conditioning unit
[ ] Geothermal Heat pump
[ ] Other (please specify?)

d9. How many window-unit or "through the wall" air conditioner(s) do you use?
( ) None
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more

d10. What is the fuel used in your cooling system?
[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other
[ ] None

d11. How old is your cooling system?
( ) 0-4 years
( ) 5-9 years
( ) 10-14 years
( ) 15-19 years
( ) 19 years or older
( ) DK/NS
( ) Do not have

d12. What is the fuel used by your water heater?
(Mark all that apply)
[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other
[ ] No water heater

d13. How old is your water heater?
( ) 0-4 years
( ) 5-9 years
( ) 10-14 years
( ) 15-19 years
( ) More than 19 years
( ) DK/NS

d14. What type of fuel do you use for indoor cooking on the stovetop or range?
(Mark all that apply)
[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other
[ ] No stovetop or range

d15. What type of fuel do you use for indoor cooking in the oven?
(Mark all that apply)
[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other
[ ] No oven

d16. What type of fuel do you use for clothes drying?
(*Mark all that apply*)

[ ] Electricity
[ ] Natural Gas
[ ] Oil
[ ] Propane
[ ] Other
[ ] No clothes dryer

d17. About how many square feet of living space are in your home?
(Do not include garages or other unheated areas)
Note: A 10-foot by 12 foot room is 120 square feet
( ) Less than 500
( ) 500 to 999
( ) 1000 to 1499
( ) 1500 to 1999
( ) 2000 to 2499
( ) 2500 to 2999
( ) 3000 to 3499
( ) 3500 to 3999
( ) 4000 or more
( ) DK/NS

d18. Do you own or rent your home?
( ) Own
( ) Rent

d19. How many levels are in your home (not including your basement)?
( ) One
( ) Two
( ) Three

d20. Does your home have a heated or unheated basement?
( ) Heated
( ) Unheated
( ) No basement

d21. Does your home have an attic?
( ) Yes
( ) No

d22. Are your central air/heat ducts located in the attic?
( ) Yes
( ) No
( ) N/A

d23. Does your house have cold drafts in the winter?
( ) Yes

( ) No

d24. Does your house have sweaty windows in the winter?
( ) Yes
( ) No

d25. Do you notice uneven temperatures between the rooms in your home?
( ) Yes
( ) No

d26. Does your heating system keep your home comfortable in winter?
( ) Yes
( ) No

d27. Does your cooling system keep your home comfortable in summer?
( ) Yes
( ) No

d28. Do you have a programmable thermostat?
( ) Yes
( ) No

d29. What temperature is your thermostat set to on a typical summer weekday afternoon?
( ) Less than 69 degrees
( ) 69-72 degrees
( ) 73-78 degrees
( ) Higher than 78 degrees
( ) Off
( ) DK/NS

d30. What temperature is your thermostat set to on a typical winter weekday afternoon?
( ) Less than 67 degrees
( ) 67-70 degrees
( ) 71-73 degrees
( ) 74-77 degrees
( ) Higher than 78 degrees
( ) Off
( ) DK/NS

d31. Do You Have a Swimming Pool or Spa?
( ) Yes
( ) No

Read all answers until they reply
d32. **Would a two-degree increase in the summer afternoon temperature in your home affect your comfort..**

( ) Not at all
( ) Slightly
( ) Moderately, or
( ) Greatly

d33. How many people live in this home?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more
( ) Prefer not to answer

d34. How many of them are teenagers?
(age 13-19)
If they ask why: Explain that teenagers are generally associated with higher energy use.
( ) 0
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more
( ) Prefer not to answer

d35. How many persons are usually home on a weekday afternoon?
( ) 0
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8 or more
( ) Prefer not to answer

d36. Are you planning on making any large purchases to improve energy efficiency in the next 3 years?
( ) Yes
( ) No

( ) NS/DK

The following questions are for classification purposes only and will not be used for any other purpose than to help Duke Energy continue to improve service.

d37. What is your age group?
( ) 18-34
( ) 35-49
( ) 50-59
( ) 60-64
( ) 65-74
( ) Over 74
( ) Prefer not to answer

d38. Please indicate your annual household income.
( ) Under $15,000
( ) $15,000-$29,999
( ) $30,000-$49,999
( ) $50,000-$74,999
( ) $75,000-$100,000
( ) Over $100,000
( ) Prefer Not to Answer

That completes our survey. As I mentioned at the start, we'd like to send you a check for $20 for your time. Should we send it to [*name*] at [*address*]?
Name: ___________________________
Address: ___________________________
City: ___________________________
State: ___________________________
Zip: ___________________________

Thank you for your time and feedback today!

We have reached the end of the survey. Do you have any comments that you would like for me to pass on to Duke Energy?

Appendix C: Counts of Participant / Non-participants for Billing Analysis

This appendix presents the counts of participants and non-participants in each month. The first row is always the last month before the first participant, such that for Carolina the first participant showed up in April. 2011 with the first row started in March 2011. The last row is the last month of billing data included in the billing analysis, and it may not be the last month of participation cut-off for this analysis. For example the cut-off month for is June 2012 whereas the billing data goes through August 2012 such that the last couple month with non-participant count being zero.

state	yearmonth	Participant_count	Non_participant_count
Carolinas	201103	0	19044
	201104	96	18807
	201105	4588	14408
	201106	15727	3180
	201107	18452	330
	201108	18829	177
	201109	18722	97
	201110	18909	73
	201111	18952	57
	201112	18970	33
	201201	19052	0
	201202	18955	0
	201203	19046	0
	201204	18956	0
	201205	18903	0
	201206	18815	0
	201207	19029	0
	201208	19050	0

Appendix D: Estimated Model

Dependent Variable: ln_kwhd ln_kwhd

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	19142	72487.5306	3.7868	64.85	<.0001
Error	475619	27772.6470	0.0584		
Corrected Total	494761	100260.1775			

R-Square	Coeff Var	Root MSE	ln_kwhd Mean
0.722994	6.026784	0.241646	4.009529

Source	DF	Type I SS	Mean Square	F Value	Pr > F
acct_id	19053	48338.78942	2.53707	43.45	<.0001
yearmonth	27	21377.08555	791.74391	13559.0	<.0001
avg_temp*yearmonth	28	2614.57411	93.37765	1599.13	<.0001
avg_humi*yearmonth	28	126.33898	4.51211	77.27	<.0001
hehc	1	1.00632	1.00632	17.23	<.0001
k12	1	0.41026	0.41026	7.03	0.0080
lowinc	1	1.69237	1.69237	28.98	<.0001
ss	1	26.66969	26.66969	456.73	<.0001
cfl*cfl_tracker	1	0.00193	0.00193	0.03	0.8556
part	1	0.96192	0.96192	16.47	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
yearmonth	27	1663.144832	61.597957	1054.89	<.0001
avg_temp*yearmonth	28	2571.973457	91.856195	1573.08	<.0001
avg_humi*yearmonth	28	126.876863	4.531317	77.60	<.0001
hehc	1	0.957653	0.957653	16.40	<.0001
k12	1	0.411957	0.411957	7.05	0.0079
lowinc	1	1.718666	1.718666	29.43	<.0001
ss	1	26.673598	26.673598	456.80	<.0001
cfl*cfl_tracker	1	0.002050	0.002050	0.04	0.8514
part	1	0.961919	0.961919	16.47	<.0001

Parameter		Estimate	Standard Error	t Value	Pr > |t|
yearmonth	201005	1.053213	0.320518	3.29	0.001
yearmonth	201006	0.266963	0.115046	2.32	0.0203
yearmonth	201007	0.359319	0.131661	2.73	0.0064
yearmonth	201008	0.033891	0.136999	0.25	0.8046
yearmonth	201009	0.14479	0.109389	1.32	0.1856
yearmonth	201010	0.945644	0.102994	9.18	<.0001
yearmonth	201011	4.337209	0.101572	42.7	<.0001
yearmonth	201012	4.765084	0.098734	48.26	<.0001
yearmonth	201101	4.204488	0.105189	39.97	<.0001
yearmonth	201102	4.453764	0.103698	42.95	<.0001
yearmonth	201103	4.4684	0.102807	43.46	<.0001

yearmonth	201104	3.835708	0.105231	36.45	<.0001
yearmonth	201105	2.441957	0.122295	19.97	<.0001
yearmonth	201106	1.527118	0.12924	11.82	<.0001
yearmonth	201107	0.242246	0.128852	1.88	0.0601
yearmonth	201108	0.247979	0.132774	1.87	0.0618
yearmonth	201109	0.045867	0.122989	0.37	0.7092
yearmonth	201110	1.927721	0.103787	18.57	<.0001
yearmonth	201111	4.533093	0.105981	42.77	<.0001
yearmonth	201112	4.858617	0.111498	43.58	<.0001
yearmonth	201201	4.545762	0.106952	42.5	<.0001
yearmonth	201202	4.377533	0.108825	40.23	<.0001
yearmonth	201203	4.280508	0.101696	42.09	<.0001
yearmonth	201204	2.915185	0.111903	26.05	<.0001
yearmonth	201205	2.079346	0.103085	20.17	<.0001
yearmonth	201206	0.694127	0.128857	5.39	<.0001
yearmonth	201207	0.687251	0.114225	6.02	<.0001
avg_temp*yearmonth	201005	0.020909	0.004791	4.36	<.0001
avg_temp*yearmonth	201006	0.032114	0.000727	44.17	<.0001
avg_temp*yearmonth	201007	0.030717	0.001045	29.38	<.0001
avg_temp*yearmonth	201008	0.034292	0.001087	31.54	<.0001
avg_temp*yearmonth	201009	0.031669	0.000682	46.45	<.0001
avg_temp*yearmonth	201010	0.021604	0.000472	45.79	<.0001
avg_temp*yearmonth	201011	-0.02789	0.000524	-53.17	<.0001
avg_temp*yearmonth	201012	-0.03308	0.000367	-90.07	<.0001
avg_temp*yearmonth	201101	-0.02176	0.000982	-22.17	<.0001
avg_temp*yearmonth	201102	-0.02795	0.000623	-44.83	<.0001
avg_temp*yearmonth	201103	-0.02887	0.000613	-47.08	<.0001
avg_temp*yearmonth	201104	-0.01867	0.000537	-34.76	<.0001
avg_temp*yearmonth	201105	-0.00125	0.00116	-1.08	0.2806
avg_temp*yearmonth	201106	0.017792	0.000828	21.48	<.0001
avg_temp*yearmonth	201107	0.028995	0.000913	31.75	<.0001
avg_temp*yearmonth	201108	0.030257	0.000979	30.9	<.0001
avg_temp*yearmonth	201109	0.034257	0.000736	46.57	<.0001
avg_temp*yearmonth	201110	0.007622	0.000557	13.69	<.0001
avg_temp*yearmonth	201111	-0.02989	0.000695	-43	<.0001
avg_temp*yearmonth	201112	-0.03359	0.000914	-36.75	<.0001
avg_temp*yearmonth	201201	-0.02713	0.00098	-27.69	<.0001
avg_temp*yearmonth	201202	-0.02519	0.001055	-23.87	<.0001
avg_temp*yearmonth	201203	-0.02461	0.00037	-66.42	<.0001
avg_temp*yearmonth	201204	-0.00829	0.000874	-9.49	<.0001
avg_temp*yearmonth	201205	0.005951	0.000607	9.8	<.0001

avg_temp*yearmonth	201206	0.024818	0.000942	26.35	<.0001
avg_temp*yearmonth	201207	0.025245	0.000706	35.77	<.0001
avg_temp*yearmonth	201208	0.03114	0.000882	35.31	<.0001
avg_humi*yearmonth	201005	0.00122	0.001057	1.15	0.2484
avg_humi*yearmonth	201006	0.001849	0.000398	4.64	<.0001
avg_humi*yearmonth	201007	0.00279	0.00035	7.98	<.0001
avg_humi*yearmonth	201008	0.002825	0.000352	8.02	<.0001
avg_humi*yearmonth	201009	0.004129	0.000265	15.61	<.0001
avg_humi*yearmonth	201010	0.002645	0.000307	8.63	<.0001
avg_humi*yearmonth	201011	-0.00254	0.000303	-8.36	<.0001
avg_humi*yearmonth	201012	-0.00499	0.000351	-14.2	<.0001
avg_humi*yearmonth	201101	-0.00272	0.000383	-7.12	<.0001
avg_humi*yearmonth	201102	-0.00359	0.000379	-9.46	<.0001
avg_humi*yearmonth	201103	-0.00419	0.000394	-10.66	<.0001
avg_humi*yearmonth	201104	-0.00252	0.000575	-4.38	<.0001
avg_humi*yearmonth	201105	0.001904	0.000502	3.79	0.0001
avg_humi*yearmonth	201106	-0.00063	0.000559	-1.12	0.2633
avg_humi*yearmonth	201107	0.005908	0.000451	13.09	<.0001
avg_humi*yearmonth	201108	0.004573	0.000456	10.04	<.0001
avg_humi*yearmonth	201109	0.002617	0.000509	5.14	<.0001
avg_humi*yearmonth	201110	0.001031	0.000441	2.34	0.0195
avg_humi*yearmonth	201111	-0.00409	0.000468	-8.74	<.0001
avg_humi*yearmonth	201112	-0.00511	0.000446	-11.44	<.0001
avg_humi*yearmonth	201201	-0.00511	0.000445	-11.49	<.0001
avg_humi*yearmonth	201202	-0.00454	0.000481	-9.43	<.0001
avg_humi*yearmonth	201203	-0.00395	0.000538	-7.34	<.0001
avg_humi*yearmonth	201204	0.000853	0.000514	1.66	0.0968
avg_humi*yearmonth	201205	0.000987	0.000408	2.42	0.0155
avg_humi*yearmonth	201206	0.002793	0.000529	5.28	<.0001
avg_humi*yearmonth	201207	0.0037	0.000402	9.2	<.0001
avg_humi*yearmonth	201208	0.006004	0.0005	12.01	<.0001
hehc		-0.02613	0.006453	-4.05	<.0001
k12		-0.03288	0.01238	-2.66	0.0079
lowinc		-0.25875	0.047694	-5.43	<.0001
ss		-0.10211	0.004778	-21.37	<.0001
cfl*cfl_tracker[17]		-1.3E-05	6.9E-05	-0.19	0.8514
part		-0.02184	0.00538	-4.06	<.0001

[17] The variable "cfl*cfl_tracker" is insignificant (t value = -0.19). The model was run using the cfl variable alone, but there was no change in the parameters (impacts before = 2.184%, after = 2.183%). Therefore, the CFL variable is not statistically significant.

Appendix E: Estimated Model – Accounting for MyHER

Number of Observations Read	494762
Number of Observations Used	494762

Dependent Variable: ln_kwhd ln_kwhd

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	19143	72488.0760	3.7867	64.85	<.0001
Error	475618	27772.1015	0.0584		
Corrected Total	494761	100260.1775			

R-Square	Coeff Var	Root MSE	ln_kwhd Mean
0.723000	6.026731	0.241644	4.009529

Source	DF	Type I SS	Mean Square	F Value	Pr > F
acct_id	19053	48338.78942	2.53707	43.45	<.0001
yearmonth	27	21377.08555	791.74391	13559.2	<.0001
avg_temp*yearmonth	28	2614.57411	93.37765	1599.16	<.0001
avg_humi*yearmonth	28	126.33898	4.51211	77.27	<.0001
hehc	1	1.00632	1.00632	17.23	<.0001
k12	1	0.41026	0.41026	7.03	0.0080
lowinc	1	1.69237	1.69237	28.98	<.0001
ss	1	26.66969	26.66969	456.74	<.0001
cfl	1	0.03990	0.03990	0.68	0.4085
MH	1	0.49470	0.49470	8.47	0.0036
part	1	0.97472	0.97472	16.69	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
yearmonth	27	1660.152418	61.487127	1053.01	<.0001
avg_temp*yearmonth	28	2563.695257	91.560545	1568.04	<.0001
avg_humi*yearmonth	28	127.330943	4.547534	77.88	<.0001
hehc	1	0.931654	0.931654	15.96	<.0001
k12	1	0.408051	0.408051	6.99	0.0082
lowinc	1	1.719960	1.719960	29.46	<.0001
ss	1	26.727995	26.727995	457.74	<.0001
cfl	1	0.038181	0.038181	0.65	0.4187
MH	1	0.508553	0.508553	8.71	0.0032
part	1	0.974719	0.974719	16.69	<.0001

Parameter		Estimate		Standard Error	t Value	Pr > |t|
yearmonth	201005	1.099737031	B	0.32089692	3.43	0.0006
yearmonth	201006	0.316856119	B	0.11625620	2.73	0.0064
yearmonth	201007	0.414831927	B	0.13295390	3.12	0.0018
yearmonth	201008	0.090242069	B	0.13828131	0.65	0.5140
yearmonth	201009	0.195472084	B	0.11071633	1.77	0.0775
yearmonth	201010	0.994145112	B	0.10428191	9.53	<.0001
yearmonth	201011	4.385773581	B	0.10288036	42.63	<.0001
yearmonth	201012	4.812551900	B	0.10002158	48.12	<.0001
yearmonth	201101	4.255329465	B	0.10656027	39.93	<.0001
yearmonth	201102	4.502841942	B	0.10500934	42.88	<.0001
yearmonth	201103	4.516791726	B	0.10408574	43.39	<.0001
yearmonth	201104	3.883330151	B	0.10644962	36.48	<.0001
yearmonth	201105	2.491264067	B	0.12340676	20.19	<.0001
yearmonth	201106	1.573948881	B	0.13020482	12.09	<.0001
yearmonth	201107	0.294384034	B	0.13003596	2.26	0.0236
yearmonth	201108	0.299285275	B	0.13392921	2.23	0.0254
yearmonth	201109	0.092492458	B	0.12400481	0.75	0.4557
yearmonth	201110	1.974448793	B	0.10499765	18.80	<.0001
yearmonth	201111	4.582337740	B	0.10728820	42.71	<.0001
yearmonth	201112	4.909363668	B	0.11283288	43.51	<.0001
yearmonth	201201	4.597922752	B	0.10841447	42.41	<.0001
yearmonth	201202	4.429600356	B	0.11027927	40.17	<.0001
yearmonth	201203	4.327736152	B	0.10296108	42.03	<.0001
yearmonth	201204	2.968090752	B	0.11334803	26.19	<.0001
yearmonth	201205	2.126576354	B	0.10434974	20.38	<.0001
yearmonth	201206	0.725912472	B	0.12932115	5.61	<.0001
yearmonth	201207	0.712370377	B	0.11456154	6.22	<.0001
yearmonth	201208	0.000000000	B	.	.	.
avg_temp*yearmonth	201005	0.020894596		0.00479050	4.36	<.0001
avg_temp*yearmonth	201006	0.032081555		0.00072718	44.12	<.0001
avg_temp*yearmonth	201007	0.030620335		0.00104580	29.28	<.0001
avg_temp*yearmonth	201008	0.034185666		0.00108792	31.42	<.0001
avg_temp*yearmonth	201009	0.031620276		0.00068205	46.36	<.0001
avg_temp*yearmonth	201010	0.021577775		0.00047185	45.73	<.0001
avg_temp*yearmonth	201011	-0.027916372		0.00052455	-53.22	<.0001
avg_temp*yearmonth	201012	-0.033096213		0.00036730	-90.11	<.0001
avg_temp*yearmonth	201101	-0.021870259		0.00098225	-22.27	<.0001
avg_temp*yearmonth	201102	-0.027987313		0.00062360	-44.88	<.0001
avg_temp*yearmonth	201103	-0.028915082		0.00061340	-47.14	<.0001
avg_temp*yearmonth	201104	-0.018701601		0.00053714	-34.82	<.0001
avg_temp*yearmonth	201105	-0.001317790		0.00116019	-1.14	0.2560
avg_temp*yearmonth	201106	0.017779082		0.00082828	21.46	<.0001
avg_temp*yearmonth	201107	0.028927079		0.00091343	31.67	<.0001
avg_temp*yearmonth	201108	0.030192121		0.00097951	30.82	<.0001
avg_temp*yearmonth	201109	0.034234701		0.00073572	46.53	<.0001
avg_temp*yearmonth	201110	0.007586339		0.00055714	13.62	<.0001
avg_temp*yearmonth	201111	-0.029943458		0.00069532	-43.06	<.0001
avg_temp*yearmonth	201112	-0.033653536		0.00091414	-36.81	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
avg_temp*yearmonth 201201	-0.027235594	0.00098033	-27.78	<.0001
avg_temp*yearmonth 201202	-0.025302131	0.00105611	-23.96	<.0001
avg_temp*yearmonth 201203	-0.024618458	0.00037048	-66.45	<.0001
avg_temp*yearmonth 201204	-0.008400881	0.00087489	-9.60	<.0001
avg_temp*yearmonth 201205	0.005911332	0.00060742	9.73	<.0001
avg_temp*yearmonth 201206	0.024989160	0.00094356	26.48	<.0001
avg_temp*yearmonth 201207	0.025477864	0.00070979	35.89	<.0001
avg_temp*yearmonth 201208	0.031569190	0.00089383	35.32	<.0001
avg_humi*yearmonth 201005	0.001226009	0.00105684	1.16	0.2460
avg_humi*yearmonth 201006	0.001838992	0.00039830	4.62	<.0001
avg_humi*yearmonth 201007	0.002774695	0.00034995	7.93	<.0001
avg_humi*yearmonth 201008	0.002810267	0.00035225	7.98	<.0001
avg_humi*yearmonth 201009	0.004125637	0.00026452	15.60	<.0001
avg_humi*yearmonth 201010	0.002642463	0.00030659	8.62	<.0001
avg_humi*yearmonth 201011	-0.002541030	0.00030349	-8.37	<.0001
avg_humi*yearmonth 201012	-0.004985849	0.00035109	-14.20	<.0001
avg_humi*yearmonth 201101	-0.002728350	0.00038255	-7.13	<.0001
avg_humi*yearmonth 201102	-0.003601663	0.00037944	-9.49	<.0001
avg_humi*yearmonth 201103	-0.004189317	0.00039365	-10.64	<.0001
avg_humi*yearmonth 201104	-0.002511972	0.00057526	-4.37	<.0001
avg_humi*yearmonth 201105	0.001926460	0.00050217	3.84	0.0001
avg_humi*yearmonth 201106	-0.000614177	0.00055869	-1.10	0.2716
avg_humi*yearmonth 201107	0.005904245	0.00045134	13.08	<.0001
avg_humi*yearmonth 201108	0.004579603	0.00045562	10.05	<.0001
avg_humi*yearmonth 201109	0.002638902	0.00050888	5.19	<.0001
avg_humi*yearmonth 201110	0.001058980	0.00044132	2.40	0.0164
avg_humi*yearmonth 201111	-0.004092195	0.00046824	-8.74	<.0001
avg_humi*yearmonth 201112	-0.005119310	0.00044615	-11.47	<.0001
avg_humi*yearmonth 201201	-0.005130594	0.00044528	-11.52	<.0001
avg_humi*yearmonth 201202	-0.004549104	0.00048149	-9.45	<.0001
avg_humi*yearmonth 201203	-0.003957062	0.00053828	-7.35	<.0001
avg_humi*yearmonth 201204	0.000848550	0.00051361	1.65	0.0985
avg_humi*yearmonth 201205	0.001007279	0.00040772	2.47	0.0135
avg_humi*yearmonth 201206	0.002832398	0.00052883	5.36	<.0001
avg_humi*yearmonth 201207	0.003759054	0.00040274	9.33	<.0001
avg_humi*yearmonth 201208	0.006186340	0.00050398	12.28	<.0001
hehc	-0.025779212	0.00645383	-3.99	<.0001
k12	-0.032727684	0.01238036	-2.64	0.0082
lowinc	-0.258852564	0.04769452	-5.43	<.0001
ss	-0.102217049	0.00477766	-21.39	<.0001
cfl	0.001000912	0.00123779	0.81	0.4187
MH	-0.010298687	0.00348971	-2.95	0.0032
part[18]	-0.021983710	0.00538067	-4.09	<.0001

[18] Per Duke Energy's request, a revised model with MyHER participants explicitly controlled for was developed to avoid double counting savings from MyHER. This revised model yields similar results as the original model with no significant statistical difference.

Appendix F: Impact Algorithms

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW = ISR \times units \times \left[\frac{Watts_{base} - Watts_{ee}}{1000}\right] \times CF \times (1 + HVAC_d)$$

Gross Annual Energy Savings

$$\Delta kWh = ISR \times units \times \left[\frac{(Watts \times HOU)_{base} - (Watts \times HOU)_{ee}}{1000}\right] \times 365 \times (1 + HVAC_c)$$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
units = number of units installed under the program
$Watts_{ee}$ = connected load of energy-efficient unit = 16.35
$Watts_{base}$ = connected (nameplate) load of baseline unit(s) displaced
HOU = Average daily hours of use (based on connected load)
CF = coincidence factor = 0.123
$HVAC_c$ = HVAC system interaction factor for annual electricity consumption = -0.037
$HVAC_d$ = HVAC system interaction factor for demand = 0.168

The coincidence factor for this analysis was taken from Duke Energy's Residential Smart $aver lighting logger study performed in North Carolina with participants from the 2010 CFL campaigns.

$HVAC_c$ - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The weights were determined through appliance saturation data from the Home Profile Database supplied by Duke Energy.

Charlotte, NC

Heating Fuel	Heating System	Cooling System	Weight	HVACc
Other	Any except Heat Pump	Any except Heat Pump	0.0042	0.069
		None	0.0004	0

Any	Heat Pump	Heat Pump	0.2782	-0.1
Gas Propane Oil	Central Furnace	None	0.0067	0
		Room/Window	0.5508	0.069
		Central AC		0.069
Electricity	Electric baseboard/ central furnace	None	0.0030	-0.43
		Room/Window	0.1493	-0.31
		Central AC		-0.31
None	None	Any	0.0074	0
Total Weighted Average			1	-0.037

$HVAC_d$ - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Charlotte, NC

Cooling System	HVACd
None	0
Room/Window	.17
Central AC	.17
Heat Pump	.17

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 18.

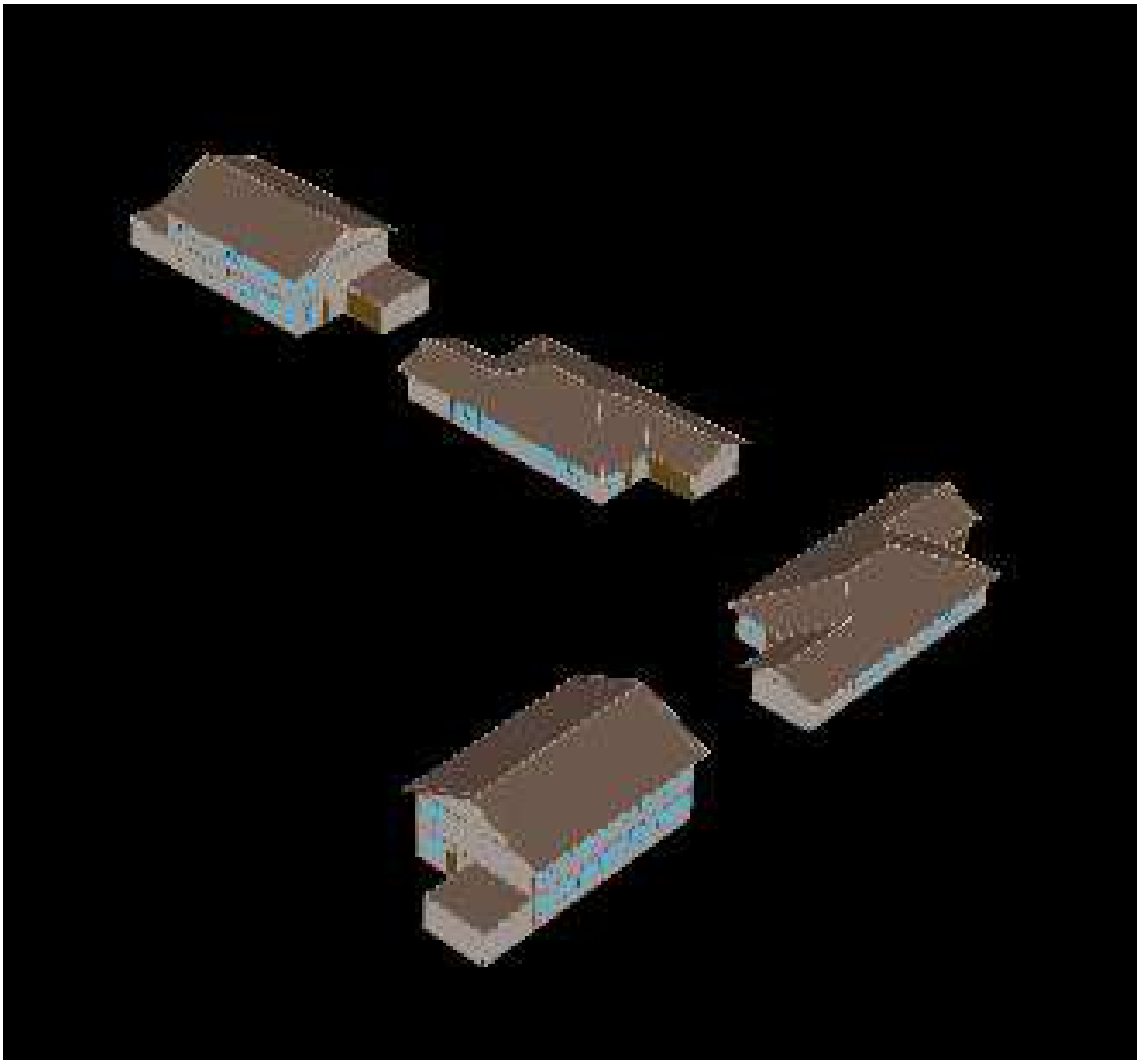


Figure 18. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F

Characteristic	Value
Duct location	Attic (unconditioned space)
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	26%; evenly distributed between supply and return
Cooling season	Charlotte – April 17 to October 6
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix G: Personalized Energy Report Questionnaire

Personalized Energy Report Printed Survey Form

RECEIVE YOUR FREE, PERSONALIZED ENERGY REPORT (PER)™

[redacted]
[redacted] TWIN OAKS DR MOUNT AIRY NC 27030

FOR THE ADDRESS SHOWN ABOVE, PLEASE ANSWER THE FOLLOWING QUESTIONS RELATED TO YOUR HOME AND ENERGY USAGE. FILL IN THE CIRCLES COMPLETELY USING BLUE OR BLACK INK.

PROPERTY DETAILS

1. What type of home best describes your primary residence? *(check only one)*
   - Detached single family
   - Duplex / 2 family
   - Townhouse
   - Apartment / Multi – Family / (3 or more units)
   - Condominium
   - Manufactured home

2. How many levels does your home have, excluding the basement and unfinished attic?
   - 1
   - 2
   - 3

3. In what year was your home built?
   - Before 1959
   - 1960 – 1979
   - 1980 – 1989
   - 1990 – 1997
   - 1998 – 2000
   - 2001 – 2007
   - 2008 +

4. Does your home have an attic?
   - Yes
   - No

5. Does your home have a basement?
   - Yes, heated
   - Yes, unheated
   - No

6. Excluding bathrooms and hallways, how many rooms are in your home? *(Include finished basement)*
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - More than 9

7. How would you describe the size of the rooms in your home?
   - Above average
   - Average
   - Below average

8. Approximate size (heated area) of your home? Your answers to questions 6 & 7 above will allow us to estimate the size of your home in square feet. Or, if you know the square footage of your home, you may choose it here and we will use your input.
   - < 500
   - 500-999
   - 1000-1499
   - 1500-1999
   - 2000-2499
   - 2500-2999
   - 3000-3499
   - 3500-3999
   - 4000 or more
   - Don't know

MAIN HEATING SYSTEM

9. What is the fuel used in your primary heating system?
   - Electric
   - Natural Gas
   - Oil
   - Propane
   - Other (solar, wood, etc)
   - No heat system

10. Which of the following bests describes your home's primary heating system?
    - Electric Baseboard or ceiling cable
    - Forced air furnace
    - Standard heat pump
    - Ground source heat pump
    - Water boiler
    - Steam boiler
    - Wood heating system
    - Heat pump with gas backup
    - Heat pump with propane backup
    - Heat pump with oil backup
    - No heat system

11. How old is your heating system?
    - 0 – 4 years
    - 5 – 9 years
    - 10 – 14 years
    - 15 – 19 years
    - 20 years or greater

COOLING SYSTEM

12. Do you have a central cooling system? (If you use window or room air conditioners, you will note this in question 14)
    - No central cooling system
    - Central air conditioning
    - Heat Pump

13. If you have any cooling system, how old is it?
    - 0 – 4 years
    - 5 – 9 years
    - 10 – 14 years
    - 15 – 19 years
    - 20 years or greater

14. Do you use room or window air conditioners?
    - Yes
    - No

15. How many room or window A/Cs?
    - 1
    - 2
    - 3

16. If you have a central heating and cooling system with air ducts, are any of these ducts located in the attic?
    - Yes
    - No
    - Not applicable

Duke Energy.

17. What is your thermostat setting for a typical heating day and a typical cooling day in the afternoon?

Heating
- < 67 °
- 67 – 70 °F
- 71 – 73 °F
- 74 – 77 °F
- > 77 °F
- Thermostat off/ No thermostat

Cooling
- < 69 °
- 69 – 72 °F
- 73 – 76 °F
- 77 – 78 °F
- > 78 °F
- Thermostat off/ No thermostat

18. Do you have any of the following comfort issues in your home?

a. *Cold drafts in the winter*
- Yes
- No

b. *Sweaty windows in the winter*
- Yes
- No

c. *Cooling system will not keep the home comfortable*
- Yes
- No

d. *Heating system will not keep the home comfortable*
- Yes
- No

e. *Uneven temperatures between rooms*
- Yes
- No

19. How many people live in your home?
- 1
- 2
- 3
- 4
- 5
- 6
- 7 or more

20. Do you own or rent this home?
- Own
- Rent

21. What fuel is used by your water heater?
- Electric
- Natural Gas
- Propane
- Other
- None

22. What is the age of your water heater?
- 0 – 4 years
- 5 – 9 years
- 10 – 14 years
- 15 – 19 years
- 20 years or greater

23. What type of fuel do you use for clothes drying?
- Electric
- Natural Gas
- Other
- None

24. What type of fuel do you use for your cook top?
- Electric
- Natural Gas
- Other
- None

25. What type of fuel do you use for your oven?
- Electric
- Natural Gas
- Other
- None

26. a. Do you have a swimming pool?
- Yes
- No

b. *Do you have a pool heater?*
- Yes
- No

c. *What type of fuel do you use to heat your pool?*
- Electric
- Natural Gas
- Oil
- Propane
- Not applicable

27. a. Do you have a hot tub?
- Yes
- No

b. *What type of fuel do you use to heat your hot tub?*
- Electric
- Natural Gas
- Oil
- Propane

28. Would a two degree increase in your home's indoor temperature during summer weekday afternoons affect your family's comfort?
- Not at all
- A small impact
- A moderate impact
- A large impact

29. Are you planning to make any large purchases to improve the energy efficiency of your home within the next three years?
- Yes
- No
- Not sure

30. How many CFLs* do you have installed in your home?

* 0 6 0 3 0 7 0 *

31. Please print your email address in the boxes below. By providing my email address, I acknowledge that I'm signing up to receive email messages from Duke Energy.

*compact fluorescent light bulbs

Appendix H: Personalized Energy Report Sample

PERSONALIZED ENERGY REPORT (PER)®
August 3, 2012

Duke Energy

Dear Customer:

Thank you for joining thousands of households that have taken steps to save energy and money by requesting a **Personalized Energy Report (PER)®.** This report analyzes your past energy usage and evaluates your answers from the energy survey, to provide:

- A history and seasonal chart of your energy use
- A pie chart estimating how much energy is used
- A comparison of your energy use to similar homes
- Tips that help you save energy and money.

A copy of your report is also available online at www.duke-energy.com when you sign in to Online Services. When you sign in to manage your account, be sure to visit the Home Energy Center, where you will find a wide assortment of energy saving tips, tools and helpful charts.

Sincerely,

K. Griffin

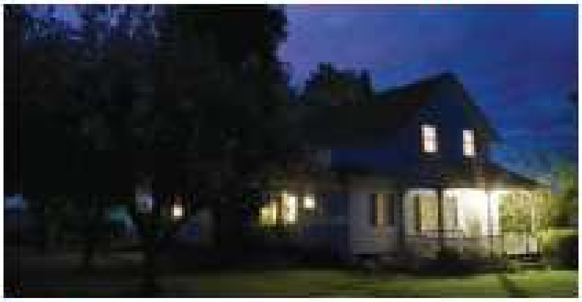
K. Griffin
Personalized Energy Report (PER)® Manager

YOUR PERSONALIZED ENERGY REPORT (PER)®	
Prepared for	Kelly Griffin
Account No.	
Date Prepared	August 3, 2012
Type of Home	SingleFamily
Home Size	2,750
Year Home Built	1980 - 1989
Space Heating Fuel	Gas
Water Heating Fuel	Gas

The Griffin family report

Page 1 of 4

YOUR MONTHLY ELECTRIC USAGE WITH AN APPROXIMATE ELECTRIC CHARGE*



AUGUST 2011 - JULY 2012		
Bill Month	Electricity Usage (kWh)	Approximate Bill*
Aug 11	2,915	$278
Sep 11	1,980	$189
Oct 11	1,307	$125
Nov 11	1,214	$116
Dec 11	1,387	$132
Jan 12	1,528	$146
Feb 12	1,135	$108
Mar 12	1,116	$107
Apr 12	1,195	$114
May 12	1,332	$127
Jun 12	1,791	$171
Jul 12	2,258	$216
Total	19,158	$1,829

*Important. Average energy rates are used in this report. The bill amounts in this table and following charts will not match your actual energy costs. For detailed information on your actual bills, visit "Energy Usage and Cost Details" in your Online Services account at www.duke-energy.com.

A SAMPLE OF YOUR HOME'S MONTH-TO-MONTH ELECTRIC USE*

* Note that your energy use can be impacted by seasonal weather.

KNOW YOUR BILL AMOUNT IN ADVANCE

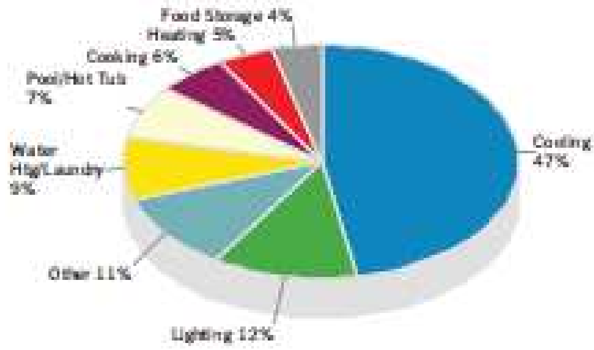
The Equal Payment Plan is a free service that makes managing your budget easier by providing a predictable monthly bill. Equal Payment Plan covers all basic services. Additional services, such as outdoor lighting, are not included in the plan.

Your monthly bill is based on your previous year's electricity usage and is divided into 11 equal payments. It makes planning and budgeting your energy costs more accurate and convenient. All you need is an account with a record of good payment for the past 12 months.

To sign up or learn more, visit **www.duke-energy.com/north-carolina/billing/equal-payment.asp**.

HOW YOUR HOUSEHOLD USES ELECTRICITY

2011-2012 ANNUAL COST BREAKDOWN	
Cooling	$860
Lighting	$215
Other	$199
Water Htg/Laundry	$159
Pool/Hot Tub	$130
Cooking	$104
Heating	$83
Food Storage	$75
Total	**$1,825**



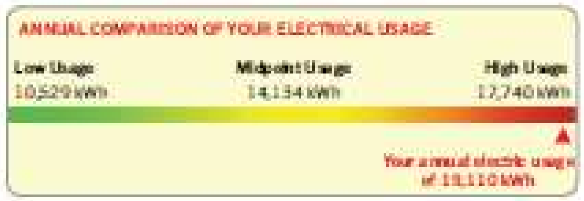
The dollar amounts and percentages in this pie chart are estimates based on inputs you provided on your survey. They are not based on actual measured readings from your home.

YOUR HOME'S ANNUAL ELECTRIC USAGE COMPARISON TO SIMILAR HOMES

The scale to the right shows you how your household's annual electric usage compares with the range of usage by similar households serviced by Duke Energy in North Carolina.

This comparison considers your home's fuel blend, the number of people in your family, and other information you provided in your questionnaire.

Using electricity wisely is good for the environment, saves you money, and may reduce the need to build more power plants in North Carolina. And that's good for everybody.



RECEIVE A REBATE AND REDUCE YOUR ENERGY BILL WITH SMART $AVER®

The Smart $aver® program from Duke Energy rewards North Carolina customers with a rebate of $200 when they replace their current heat pump or air conditioner with a high efficiency system. If this is the year you're buying a new heating or cooling system for your home, you can save hundreds of dollars in annual operating costs by installing a qualified system and experience greater comfort in your home.

QUALIFYING SYSTEMS	CUSTOMER REBATES
Heat Pump (14.00 SEER or greater with a variable speed (ECM) fan)	$200
Air Conditioner (14.00 SEER or greater with a variable speed (ECM) fan)	$200
Geothermal Heat Pump (11.50 EER or greater with a variable speed (ECM) fan)	$200

For more information visit www.duke-energy.com/north-carolina/savings/smartsaver.asp, or call 1-800-785-6209.

ENERGY SAVING TIPS FOR YOUR HOME

HEATING

In the winter, if you manually set your thermostat down to save money while you're gone, when you return, reset your thermostat to the normal temperature setting. Setting the thermostat really high won't help it heat up any faster.

When heating your home, try to minimize the number of times that doors to the outside are opened and closed; cold outside air enters your home each time you open the door.

The use of ceiling fans in the winter is most effective in rooms with very high ceilings, where warm air rises and collects above the living space. Normal rooms of 8 to 10 foot ceilings will see little benefit from fan usage.

If you've turned down your thermostat in the winter to save money, you may be uncomfortable in the evening hours when you are less active. For these short periods, consider using a portable heater to warm the room that you occupy instead of turning up the thermostat.

COOLING

In the summer, if you manually set your thermostat up to save money while you're gone, when you return, reset your thermostat to the normal temperature setting. Setting the thermostat really low won't help it cool down any faster.

In the summer, use the exhaust fans in your kitchen and baths to exhaust hot air and moisture. Both the heat and the humidity is an extra load on your air conditioner.

When air conditioning your home, try to minimize the number of times that doors to the outside are opened and closed; hot and humid outside air enters your home each time you open the door.

When air conditioning, avoid activities that add heat and humidity to your home during the hottest parts of the day. This includes cooking, bathing, clothes drying and dishwashing.

WATER HEATING & LAUNDRY

Don't overload the dryer. Overloading makes the dryer work harder and may cause excessive lint and wrinkling.

Dry loads consecutively to take advantage of heat build-up in your dryer.

Remove clothes as soon as they are dry. This not only saves energy but also helps to prevent wrinkling.

Your dishes should not need rinsing before putting them in the dishwasher, but if you do, use cold water instead of hot.

WEATHERIZATION

Heavy curtains or the use of window quilts will help reduce heat loss at night during the heating season. When the sun is shining, open the covering and allow the sun to help heat the room.

During the heating season, keep window shades open during the day to benefit from the heat of the sun. Close the window shades at night to keep the heat in.

LIGHTING

The money you spend on light bulbs is only 5-10 percent of your total lighting costs. The other 90-95 percent is the cost of electricity. Energy efficient compact fluorescent lights cost more to purchase, but only use about one fourth the energy to supply the same amount of light.

Take advantage of daylight whenever possible and turn off unneeded lighting. Fixtures with photocells and motion detectors are an excellent way to save on your lighting costs.

Use dimmers to control the amount of light you need. Dimming the lights to half the illumination cuts energy consumption roughly in half. (Note: For compact fluorescent lights, use only bulbs that are rated for use with dimmers.)

Look for the ENERGY STAR® label on light bulbs and light fixtures. These models save energy, and money, and help the environment.

MISCELLANEOUS

Check refrigerator door seals by closing the door on a dollar bill. If you can easily pull the dollar out then the seal is not very effective and needs to be replaced.

Keep your refrigerator out of direct sunlight and in as cool a location as possible. A 10 degree increase in the surrounding air temperature can result in 20 percent higher energy consumption.

Appendix I: DSMore Table

Per Measure Impacts Summary for PER

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross* savings (kWh/unit)	EM&V gross* kW (customer peak/unit)	EM&V gross* kW (coincident peak/unit)*	Unit of measure	Combined spillover less freeridership adjustment**	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
PER		Carolinas	521	0.5141	0.0865	home	N/A	521	0.5141	0.0865	no	10
Program wide		**Carolinas**	**521**	**0.5141**	**0.0865**	**home**	**N/A**	**521**	**0.5141**	**0.0865**	**no**	**10**

Notes: 1. Technology names should match the DSMore naming convention.
2. Energy impacts are average per installed unit for each DSMore technology and unit description (measure/ton/sq.ft., etc.)
3. Any analysis using a control group (such as billing analysis with a control group) does not need a freeridership adjustment (it is already in the analysis via the control group adjustment)
4. EM&V load shape: "no" if using standard DSMore load shape for technology units, "yes" if an evaluation-provided load shape should be used for DSMore.
* The evaluation methodology provided net savings only. By design, gross savings are excluded from this methodological approach. The controlled quasi-experimental design approach was selected to increase the reliability of the energy savings estimates. This approach provides net savings as the analytical output.
** There is no Freeridership value provided in this table due to the evaluation methodology employed.

Appendix J: Previous Impact Evaluation Approaches

Previous to 2013, many impact evaluations employed one of four different strategies for estimating impacts. These are:

1. **The Experimental Design Approach** in which customers are randomly sorted into a test and control group. In this design savings are based on the difference between the consumption of these two groups over the same period of time. The mathematics of this approach is called the "difference of differences approach". This approach provides net savings because it segregates the two groups independently as a function of their random assignment. Only the test group receives exposure to the program, while the randomly assigned non-participants are used as a control group. When these two groups are compared, in a difference of differences approach, the findings are net savings because the savings are already adjusted for what would have happened without the program by subtracting out the savings from the control group. In this approach, subtracting or adding the differences in the energy use of the control group adjusts the gross savings (pre vs. post consumption of the test group) to compensate for the change in consumption of the non-program-exposed control group. This savings produced from this approach are net.

2. **The Quasi-Experimental Approach** is similar to the experimental design approach. However, the construction of the control group is not based on random assignment. In this approach the evaluation experts purposefully and systematically selects subjects to use as a control group. However, because this type of analysis uses a non-random approach to represent the control group, the term "control group" is not used because it can be confused with a random assignment approach. In the use of the quasi-experimental design the evaluation experts selects the comparison group so that it is as closely matched to the test group (participants) as possible. The term used to represent the group that is used to adjust savings for what would have occurred is the "*comparison group*". Assignments to the comparison group population are carefully considered by the evaluation expert in order to develop a comparison group that is as identical as possible to the test group, except for the participation in the program. The characteristics of the test group that are used for matching are typically demographic characteristics (age, housing type, location, income, etc.), energy use characteristics (amount of energy they use and when they use it) and in some cases psychographic characteristics (attitudes and behaviors). While the match is not as reliable as a true experimental design the results provided from this difference of differences approach are net savings. That is, the savings are already adjusted for what would have occurred without the program via the use of the matched comparison group and the use of the differences of differences analytical approach.

3. **The Pre versus Post with Net Adjustment Approach** is a simpler approach than the experimental or quasi-experimental approach in that the energy savings are based not on the use of the comparison or control groups, but instead are based on the difference between the pre-program and post-program periods of the test group. This approach is a differences approach in that gross savings are estimated as the difference between the pre

and post program periods. To convert gross savings to net of freerider savings (what would have occurred without the program), the savings that would have been achieved without the program are subtracted from the gross savings. The estimation of the savings that would have occurred without the program is typically calculated via the use of a freeridership battery of questions asked of the participants. These questions essentially get at what actions the participants would have taken without the program. Then the estimates of savings that would have occurred are then subtracted from the gross savings to provide net savings that are adjusted for freeridership.

4. **The Engineering Based with Net Adjustment Approach** is another standard energy savings estimation approach using an engineering estimation approach in which savings are estimated via the use of engineering calculations rather than billing or consumption records. In this approach, the actions taken are identified via interviews, surveys or inspections. Then a trained energy evaluation expert calculates the expected savings under the installation and use conditions of the participant's facilities. These are estimated savings based on known conditions about the energy use of the equipment that was going to be in use without the program and the consumption of the program-induced equipment. In this case the savings are gross and need to be adjusted by what the participant would have done without the program. As in the previous approach, the estimation of the savings that would have occurred without the program is typically calculated via the use of a freeridership battery of questions asked of the participants.

The above 4 approaches have been used as the standard approaches in the field of energy program evaluation for over 30 years. The approaches presented above are presented in descending order of their reliability. The approach with the highest level of reliability is the experimental design approach. The least reliable is the engineering based approach. The experimental design approach, when done well, is typically reliable to a couple of percent. The engineering approach, even when done well, is typically reliable to within 20% to 30%. In order to develop an approach that is more reliable than the pre versus post or the engineering approach, but is not as costly as the experimental or quasi experimental approaches, the field of evaluation developed the controlled fixed effects net billing analysis approach. This approach delivers net energy savings at a level of reliability that is similar to the experimental or quasi-experimental design but does not include the costs to form and use an independent control or comparison group.

5. **The Controlled Fixed Effects Billing Analysis with and without Net Adjustment** approach has been developed to provide savings estimates when a control or comparison group is not available or advisable because of cost considerations. In this approach, the participant's energy use data is used to econometrically model the energy savings for the participant by employing a rolling comparison time period using the time before customers participated in a program as the comparison period, forming a proxy comparison group. Because customers come into a program at a specific time, the time before that enrollment is grouped with other pre-program periods of all participants. Because the customer's pre-program period is used to control for normal energy changes over time at the population level, it is more reliable than the use of a comparison group. That is, the participants are exactly matched to the comparison group because they are the

same individuals. There is no selection bias because there is no selection into a control or comparison group. This strengthens the study. Because only the pre-program energy use is used as the proxy comparison group, there is no program influence on that period of time that is used for the savings estimation. Because people come into the program at different periods of time, essentially providing a full analytical period (timeline) of non-participating energy consumption, the entire pre-program period can be used as the comparison group over the pre and post analytical program period. This analytical approach can also control for the effects of participating in other energy efficiency programs so that the savings achieved via multiple program participation is only counted once and credited to only one program. In cases in which there are multiple program participants, the savings associated with participants who have participated in multiple programs is subtracted from the savings identified within the billing analysis approach by subtracting out the typical savings associated with the typical installation in proportion of their occurrence in the participating population.

This approach has gained considerable use within the evaluation community and has been adopted as standard practice by several of the leading evaluation firms in the United States. The approach has also been peer reviewed within the evaluation community and accepted as one of the more reliable evaluation approaches that is not as reliable as the experimental design approach, but is probably more reliable than the quasi-experimental design because it reduces the bias associated with comparison group selection. When this approach has been used in the past, typically net savings were estimated by conducting a freeridership questionnaire and then subtracting out the savings associated with freeridership. This is the approach that was used in the Duke Energy Home Energy House Call 2011 impact evaluation reports. However, recent developments in the field of evaluation has indicated that when a program is assessing standard market consumable measures that are inexpensive and have low purchase barriers, there is no need to adjust for freeriders because their market practices are already in the pre-program billing data. These measures that are typically readily available in the market and typically cost well under $5 each do not rise to the level that they pose a significant financial or technical barrier once an adoption decision has been made. As a result there is no need to adjust for freeriders when a program focuses on low-cost and readily available measures. Thus the field of evaluation is now moving away from adjusting for freeriders for minor low-cost, readily available measures (CFLs, pipe wrap, aerators, shower heads, etc.) when a billing analysis approach is used that employs a rolling pre-program period as the comparison group. However, when the program offers measures that have significant adoption barriers, such as a high cost or technical uncertainty (air-conditioners, major Energy Star appliances, motors, chillers, pumps compressors, etc.), then this approach must also include a freerider analysis to estimate net effect. Because major measures are not a standard market consumable product, the savings from these measures would not typically be net savings from the use of a rolling comparison period consisting of the pre-program period for all enrolling participants.

Final Report

Process and Impact Evaluation of the Non-Residential Smart $aver® Prescriptive Program in the Carolina System: Lighting and Occupancy Sensors

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

April 5, 2013

Submitted by

Nick Hall, Brian Evans,
and Dave Ladd

TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

Subcontractors:
Pete Jacobs
BuildingMetrics, Inc.

Carol Yin
Yinsight, Inc.

Stuart Waterbury and John Bates
Architectural Energy Corporation

TECMARKET Works

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Significant Impact Evaluation Findings for Linear Fluorescent Measures

- Energy and coincident peak demand savings realization rates for kWh and coincident peak kW for linear fluorescent lighting were 1.73 (energy) and 1.36 (demand) respectively, indicating the program planning estimates were conservative estimates of linear fluorescent lighting savings.
- Measurement and verification (M&V) activities conducted for this study produced an estimate of 6,384 lighting equivalent full load hours (EFLH), compared to a program planning estimate of 3,680 EFLH.
- M&V activities estimated a coincidence factor (CF) of 0.76, compared to a program planning estimate of 0.9.
- Although there were some small differences between the number of fixtures recorded in the program tracking database versus the number of fixtures in the field, the overall installation verification rate was 1.00.
- Program planning and M&V estimates of baseline fixture wattage were within 2%. M&V estimates of efficient fixture watts were an average of about 7% lower than program planning estimates, indicating conservative values of fixture watts were used during program design.

Significant Impact Evaluation Findings for Occupancy Sensor Measures

- Energy and coincident peak demand savings realization rates for kWh and kW for occupancy sensor measures were 1.19 and 0.75 respectively, indicating the program planning estimates were conservative estimates of occupancy sensor kWh savings, but overestimated occupancy sensor coincident peak kW savings.
- M&V activities conducted for this study produced an estimate of 5,665 lighting equivalent full load hours (EFLH) before the installation of occupancy sensors, compared to a program planning estimate of 3,680 EFLH.
- M&V activities produced an estimate of connected lighting kW per occupancy sensor that was 31% lower than the program assumption. Many of the occupancy sensors in the study were controlling a single fixture, which contributed to the reduced connected watts per sensor.
- M&V activities estimated an average kWh savings of 45% of the uncontrolled consumption and an average kW savings of 37% of the uncontrolled demand, compared to the program estimate of 30% for both kWh and kW. Although the kW savings as a percentage of the baseline estimated from M&V was higher, the connected load per

sensor was less, thus the overall demand savings per sensor from M&V was less than the program estimate.

A summary of the impact findings is presented in the standardized Duke Energy Program Impact Metrics Tables below.

Table ES-1. Program Impact Metrics Summary for North and South Carolina

Metric	Result
Number of Program Participants January 2009 through February 29, 2012	2261 projects
Gross Coincident Peak kW per unit	kW/unit
3 Lamp T5HO replacing T12	0.027
HPT8 4ft 2 lamp, T12 to HPT8	0.027
HPT8 4ft 4 lamp, T12 to HPT8	0.057
Low Watt T8 lamps, 4ft	0.005
LW HPT8 4ft 2 lamp, replace T8	0.016
LW HPT8 4ft 3 lamp, replace T8	0.021
LW HPT8 4ft 4 lamp, replace T8	0.031
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	0.022
T8 2ft 1 lamp	0.009
T8 2ft 2 lamp	0.021
T8 4ft 2 lamp	0.017
T8 4ft 3 lamp	0.037
T8 4ft 4 lamp	0.039
T8 8ft 1 lamp	0.021
T8 8ft 2 lamp	0.013
Occupancy Sensors under 500 W	0.082
Occupancy Sensors over 500 W	0.197
Gross kWh per unit	kWh/unit
3 Lamp T5HO replacing T12	140.5
HPT8 4ft 2 lamp, T12 to HPT8	142.3
HPT8 4ft 4 lamp, T12 to HPT8	294.3
Low Watt T8 lamps, 4ft	25.5
LW HPT8 4ft 2 lamp, replace T8	83.5
LW HPT8 4ft 3 lamp, replace T8	108.3
LW HPT8 4ft 4 lamp, replace T8	159.6
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	116.5
T8 2ft 1 lamp	44.7
T8 2ft 2 lamp	108.5
T8 4ft 2 lamp	89.4
T8 4ft 3 lamp	191.5
T8 4ft 4 lamp	204.3
T8 8ft 1 lamp	108.5
T8 8ft 2 lamp	70.2
Occupancy Sensors under 500 W	512.6
Occupancy Sensors over 500 W	1275.6
Gross therms per unit	N/A
Freeridership rate	41.0%
Spillover rate	46.5%
Self Selection and False Response rate	0.0%
Total Discounting to be applied to Gross values	105.5%
Net Coincident Peak kW per unit	kW/unit

Metric	Result
3 Lamp T5HO replacing T12	0.028
HPT8 4ft 2 lamp, T12 to HPT8	0.029
HPT8 4ft 4 lamp, T12 to HPT8	0.060
Low Watt T8 lamps, 4ft	0.005
LW HPT8 4ft 2 lamp, replace T8	0.017
LW HPT8 4ft 3 lamp, replace T8	0.022
LW HPT8 4ft 4 lamp, replace T8	0.032
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	0.023
T8 2ft 1 lamp	0.009
T8 2ft 2 lamp	0.022
T8 4ft 2 lamp	0.018
T8 4ft 3 lamp	0.039
T8 4ft 4 lamp	0.041
T8 8ft 1 lamp	0.022
T8 8ft 2 lamp	0.014
Occupancy Sensors under 500 W	0.087
Occupancy Sensors over 500 W	0.208
Net kWh per unit	kWh/unit
3 Lamp T5HO replacing T12	148.2
HPT8 4ft 2 lamp, T12 to HPT8	150.1
HPT8 4ft 4 lamp, T12 to HPT8	310.5
Low Watt T8 lamps, 4ft	26.9
LW HPT8 4ft 2 lamp, replace T8	88.1
LW HPT8 4ft 3 lamp, replace T8	114.2
LW HPT8 4ft 4 lamp, replace T8	168.4
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	122.9
T8 2ft 1 lamp	47.2
T8 2ft 2 lamp	114.5
T8 4ft 2 lamp	94.3
T8 4ft 3 lamp	202.1
T8 4ft 4 lamp	215.5
T8 8ft 1 lamp	114.5
T8 8ft 2 lamp	74.1
Occupancy Sensors under 500 W	540.8
Occupancy Sensors over 500 W	1345.8
Net therms per unit	N/A
Measure Life	10yr (linear fluorescent) 8yr (occupancy sensor)

Net to Gross

The net to gross analysis is based on participant self-reports and complies with standard evaluation practices and protocols, including the California Evaluation Protocols (TecMarket Works, April 2006). The net to gross analysis produced a net to gross ratio of 1.055 at the program level. That is, the program saved 5.5% greater savings than the measures installed via the program incentive because the program induced participants to take additional energy efficiency actions beyond those incented by the program. This analysis is consistent with other similar programs in which the participant spillover rate (46.5%) is slightly greater than the rate of freeridership (43.8% for linear fluorescents and 39.7% for occupancy sensors).

Recommendations

Based on the results of the impact evaluation, the TecMarket Works team has the following recommendations:

1. Conservative estimates of lighting EFLH should be updated with M&V results.
2. The weighted average self-reported operating hours were 5,412 EFLH, which represents a better estimate of lighting EFLH than the standard estimate of 3,680 EFLH. Consider including the self-reported operating hours in the ex-ante estimates of measure savings.
3. The measured coincidence factor of 0.76 was lower than the program planning estimate of 0.90. Consider revising the coincidence factor assumption to 0.76 for future program planning activities.
4. The Carolina program estimates do not include HVAC interactive effects. Consider including HVAC interactive effects in the measure savings calculations. The HVAC interactive effects calculated in this evaluation increased kWh savings by 4.2% and increased demand savings by 20%.

Significant Process Evaluation Findings

Key Findings from the Management Interviews

- All interviewees agree that Smart $aver Prescriptive program forms an important cornerstone of Duke Energy's offerings for their business customers.
- Interviewees agree that the trade ally network continues to be the most effective way for customers to learn about the program.
- There seems to be widespread agreement among the interviewees that the Smart $aver website is being successfully used as the key repository of information about Smart $aver, as well as the source for the latest information on any program or measure changes.
- Duke Energy staff are in agreement that WECC's application processing and fulfillment services, while excellent in the past, has suffered a decrease in performance that has not yet been resolved.
- WECC has not been able to successfully communicate to the Duke Energy program managers their approach to implementing the trade ally network.

Key Findings from the Participant Surveys

- The most common type of participation in the prescriptive Smart $aver program involved retrofit installations of T8 fluorescent lighting (66 out of 84 participants in the survey, or 78.6%). Most of the other measures were occupancy sensor installations (14 out of 84 participants, or 16.7%)

- The median rebate amount received by survey participants for fluorescent lighting installations was $279, and the median amount for occupancy sensor installations was $490.

- The most frequent channels for learning about Smart $aver were through trade allies (32.1% or 27 out of 84), the information provided by the Smart $aver program (15.5% or 13 out of 84) and from Duke Energy representatives directly (14.3% or 12 out of 84).

- Most participants got their rebate applications from the Duke Energy website (52.4% or 44 out of 84), with trade allies being the other main source for applications (31.0% or 26 out of 84).

- Nearly one out of five (18.6% or 13 out of 70) Smart $aver participants who installed fluorescent lighting reported problems receiving their rebates, while none of those who installed occupancy sensors reported problems (0.0% or 0 out of 14).

- The most common reason for purchasing the energy efficient equipment was to reduce energy costs, mentioned by 59.5% (50 out of 84), while the incentive rebate itself was a distant second, mentioned by 28.6% (24 out of 84).

- Nearly every participant in this survey who installed fluorescent lighting was replacing an existing unit (98.6% or 69 out of 70), while this was the case with only half (50.0% or 7 out of 14) or the occupancy sensor installations. For at least 28.6% (4 out of 14) of the occupancy sensor installations, it was the first equipment of its type installed by the organization. Among those that replaced existing equipment, about half (48.7% or 37 out of 76) described the equipment that was replaced as being in “good” working order.

- Only a third of participants (33.3% or 28 out of 84) say that without Smart $aver, they would have purchased exactly the same equipment at exactly the same time, while 27.4% (23 out of 84) say that without Smart $aver they would have continued to use their existing equipment.

- Overall satisfaction with the Smart $aver program was high: 89.3% (75 out of 84) rated their satisfaction an “8” or higher on a 10-point scale. The specific aspect of the program that they were most satisfied with was the information explaining the program (84.5% or 71 out of 84 rated this aspect an “8” or higher), and the aspect they were least satisfied with was the amount of the rebate offered (only 66.7% or 56 out of 84 rated this aspect an “8” or higher).

- When asked what they liked least about participating in Smart $aver, the most common complaints had to do with paperwork and difficulties with application forms, mentioned by 26.2% (22 out of 84).

- When asked what they’d recommend to improve the Smart $aver program, the most common response was that more types of equipment should be included in the program, mentioned by 21.4% (18 out of 84).

Recommendations

1) When Duke Energy is faced with a difference in opinion over more than one outreach approach, Duke Energy should develop analysis plans for testing the comparative effectiveness of the different approaches. This may require that each approach be tested in a different region, or that Duke Energy defines, a priori, what should be the baseline performance against which a new outreach approach should be tested. Developing an analysis plan prior to gathering research will help define what kinds of data should be gathered in order to make a sound program-wide decision.
2) Duke Energy should consider formally structuring a market intelligence effort that leverages existing outreach efforts to the trade allies. The benefit of a structured information gathering effort will allow Duke Energy to have quantitative data on past trade ally behavior that can be used to prioritize future trade ally outreach strategies.

Introduction and Purpose of Study

Overview and Objective

This document presents the process and impact evaluation report for Duke Energy's Non-Residential Smart Program as it was administered in the Carolina System. The evaluation was conducted by TecMarket Works, and subcontractors BuildingMetrics, Inc., Architectural Energy Corporation, Yinsight, Inc, and Matthew Joyce.

The objective of the process evaluation is to document program operations and identify if there are any areas of improvement for future program implementation.

The focus of the impact evaluation is on linear fluorescent lighting fixtures and occupancy sensors. A previous report examined high-bay lighting fixtures, which were and still are the dominant measure adopted by program participants. As the program has matured, linear fluorescent lighting and occupancy sensors savings have increased as a percentage of total program savings. This report was prepared in response to emergence of these two measure types as significant measures in the overall program portfolio.

Summary of the Evaluation Data

The findings presented in this report were analyzed using survey data from participants and stakeholders in the Smart $aver program as presented in Table 1 below.

Table 1. Evaluation Date Ranges

Evaluation Component	Start Date of EMV Participation	End Date of EMV Participation[1]	Dates of Analysis[2]
Participant Surveys	January 2009	February 2012	April 16, 2012 – May 8, 2012
Trade Ally Surveys	January 2009	February 2012	July 2012
Program Manager and Vendor Interviews	January 2009	February 2012	Apr 16, 2012 – Oct 15 2012
Engineering Estimates	January 2009	February 2012	10/19/12 – 12/13/12
Short Term M&V of Selected Fixtures	January 2009	February 2012	8/23/12 – 9/21/12

[1] Cut-off date for when customer became a participant in Smart $aver, and last date of pre consumption data before post EE measure install data can be used in the EMV analysis.
[2] Start date is the date that data collection began, and the end date is the last day of data collection.

Description of Program

The Smart $aver Prescriptive program is designed to motivate Duke Energy's commercial and industrial customers to install high efficiency equipment that they otherwise might not have chosen, by offering rebates up to 50% of the project cost on selected equipment. The Smart $aver Prescriptive program is offered in conjunction with a Custom program, which will be evaluated in a separate study. The measures offered through the prescriptive program have pre-calculated ex ante energy savings, while the measures eligible for the custom program requires project-specific energy savings calculations to be submitted with each application. The combination of both programs allows Duke Energy customers a flexible range of options to meet their individual needs for energy efficient equipment.

The Smart $aver program achieves their objectives by stimulating the market through "trade allies", the distributors and contractors offering high efficiency equipment. This marketing approach through nurturing a network of trade allies has been found successful in past evaluations. The Smart $aver program has been run by one program manager in the past, who has since moved on. In June and September of 2010, Duke Energy brought on two new program managers so that the Smart $aver prescriptive program had one program manager for the Carolinas and another for the Midwest states.

Methodology

Overview of the Evaluation Approach

The process evaluation had three components: management interviews, trade ally interviews, and participant surveys. The impact evaluation employed a tracking system review, onsite surveys and short term Measurement and Verification (M&V) of selected lighting fixtures and occupancy sensors using portable data loggers.

Study Methodology

Management Interviews

Management interviews were conducted with program implementation staff and management in order to capture their insights about the programs operations and challenges. We interviewed:

- Three Duke Energy Managers and two Duke Energy Smart $aver program managers
- Two Duke Energy account managers
- Three WECC program staff and one WECC trade ally representative
- Two project managers from CustomerLink
- One technical consultant

Trade Ally Interviews

Ten Non-Residential Smart $aver trade allies were interviewed in June of 2012. All of the interviews were conducted with a sales manager within the firm or an equivalent representative. Each of the respondents indicated that they were the individual within their company who had the most experience and was the most acquainted with the program. The interview protocol used during these interviews can be found in Appendix D: Trade Ally Interview Instrument.

The interviews were written to cover various aspects of the program, such as program operations, aspects of trade allies' involvement, incentive levels applied, covered technologies, and program effects from the trade allies' perspectives.

Participant Surveys

The sample list provided by Duke Energy consisted of 1,011 organizations in North Carolina and 11 organizations in South Carolina. Out of a total of 1,022 organizations across the Carolina Systems, 257 (25.1% of 1,022) were called and of these, 84 (32.7% of 257) completed the survey. The response rate for this study is 32.7 percent of those contacted, representing 8.2% of the 1,022 population. Of these, 81 surveys (96.4% of 84) with usable responses were completed for organizations in North Carolina and 3 surveys (3.6% of 84) were completed for organizations in South Carolina.

Engineering Estimates

The evaluation team conducted field M&V on a sample of linear fluorescent lighting and occupancy sensor participants to estimate savings for this measure. The field M&V consisted of a site visit, verification of the quantity and type of incented lighting fixtures, verification of fixture wattage assumptions against manufacturer's catalog data, interviews with customers to identify the type and quantity of the replaced fixtures, and short-term monitoring of lighting system operation using light loggers to measure operating hours. The field M&V activities were conducted by TecMarket Works' sub-contractors and the results were forwarded to Architectural Energy Corporation for analysis and to BuildingMetrics for confirmation. The field M&V activities were compliant with the International Performance Measurement and Verification Protocols (IPMVP) Option A – Partially measured, retrofit isolation protocol.

Lighting program participation records covering the period from January 2009 through the end of February 2012 were obtained from Duke Energy. The data, delivered as an Excel spreadsheet flat file, contained customer name and address, installing vendor contact information, measure descriptions, unit energy savings estimates, number of measures installed, lighting operating hours, installed fixture watts, rebate amounts, and so on. These data were examined to identify which of the measures promoted by the program were adopted by program participants and in what numbers, how the energy savings in the tracking system compared to the program savings estimates, and the availability of any customer description data that could be used in the analysis.

Data collection methods, sample sizes, and sampling methodology

Management Interviews

Management interviews were conducted with program implementation staff and management in order to capture their insights about the programs operations and challenges. We interviewed:

- Three Duke Energy Managers and two Duke Energy Smart $aver program managers
- Two Duke Energy account managers
- Three WECC program staff and one WECC trade ally representative
- Two project managers from CustomerLink
- One technical consultant

Trade Ally Interviews

Ten Non-Residential Smart $aver trade allies were interviewed in June of 2012 from a random selection of 132 trade allies with contact information.

Participant Surveys

The sample list provided by Duke Energy consisted of 1011 organizations in North Carolina and 11 organizations in South Carolina. Out of a total of 1022 organizations across the Carolina System, 257 (25.1% of 1022) were called and of these, 84 (32.7% of 257) completed the survey for a total response rate of 8.2% (84 out of 1022). Of these, 81 surveys (96.4% of 84) with usable responses were completed for organizations in North Carolina and 3 surveys (3.6% of 84) were completed for organizations in South Carolina. Most respondents' organizations received incentives for purchasing Fluorescent Lighting (83.3% or 70 out of 84), while the rest received incentives for purchasing Occupancy Sensors (16.7% or 14 out of 84). Because organizations could receive multiple rebates, these 84 organizations accounted for a total of 193 Smart $aver-rebated equipment installations.

Engineering Estimates

The sampling plan incorporates a stratified random sample approach, where the projects are stratified according to technology type (linear fluorescent and occupancy sensors), and sampled randomly within each stratum. A sample of 25 projects, representing 38 individual measures, was used in the study.

Number of completes and sample disposition for each data collection effort

Trade Ally Interviews

From the list of 132 records, 10 trade allies were contacted for interviews in June of 2012.

Participant Surveys

The sample list provided by Duke Energy consisted of 1011 organizations in North Carolina and 11 organizations in South Carolina. Out of a total of 1022 organizations across the Carolina System, 257 (25.1% of 1022) were called and of these, 84 (32.7% of 257) completed the survey for a total response rate of 8.2% (84 out of 1022). Of these, 81 surveys (96.4% of 84) with usable responses were completed for organizations in North Carolina and 3 surveys (3.6% of 84) were completed for organizations in South Carolina. Most respondents' organizations received incentives for purchasing Fluorescent Lighting (83.3% or 70 out of 84), while the rest received incentives for purchasing Occupancy Sensors (16.7% or 14 out of 84). Because organizations could receive multiple rebates, these 84 organizations accounted for a total of 193 Smart $aver-rebated equipment installations.

Engineering Estimates

At the conclusion of the evaluation, last minute customer refusals eliminated two of the sites from the sample. One of the occupancy sensor sites was not successfully monitored and thus eliminated from the sample. The achieved sample is shown in the table below.

Table 2. Status of 2009-2012 Linear Fluorescent and Occupancy Sensor Sample

Group	Sample Size	Completed	Notes
Linear Fluorescent	15	14	Customer refusal. 1 site dropped.
Occupancy Sensor	10	8	Customer refusal, loggers did not record any data. 2 sites dropped.

More information can be found in the section "Sample Design" on page 17.

Expected and achieved precision

Participant Surveys

The survey sample methodology had an expected precision of 90% +/- 10.0% and an achieved precision of 90% +/-8.6%.

Engineering Estimates

A sample meeting +/- 10% relative precision at 90% confidence was selected. A coefficient of variation of 0.3 was assumed for lighting measure population.

Impact Analysis

The impact evaluation employed a tracking system review, an engineering review of the lighting measure savings calculations, and field measurement and verification (M&V) of selected lighting measures.

Tracking Data Analysis

The tracking system review revealed that a few measures were responsible for the majority of the savings. Tracking data for the Carolina System obtained from Duke Energy from January 2009 through February 2012 show the following breakdown of energy savings by measure:

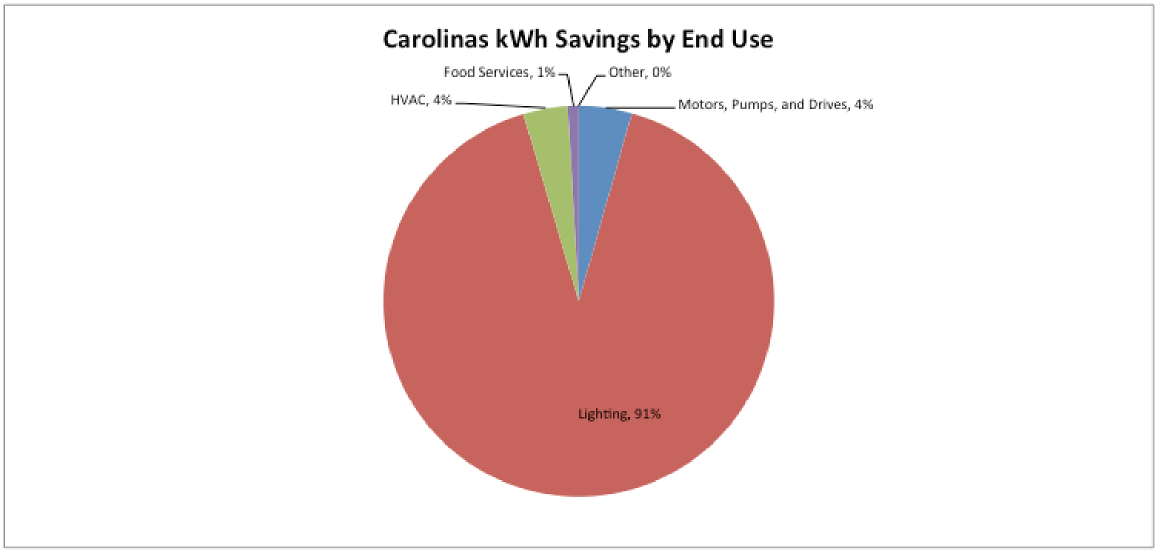


Figure 1. Measure Contribution to Carolina System C&I Program Savings

Note lighting measures made up 91% of the total reported savings. Lighting was dominated by high-bay applications, making up 64% of the total lighting savings.

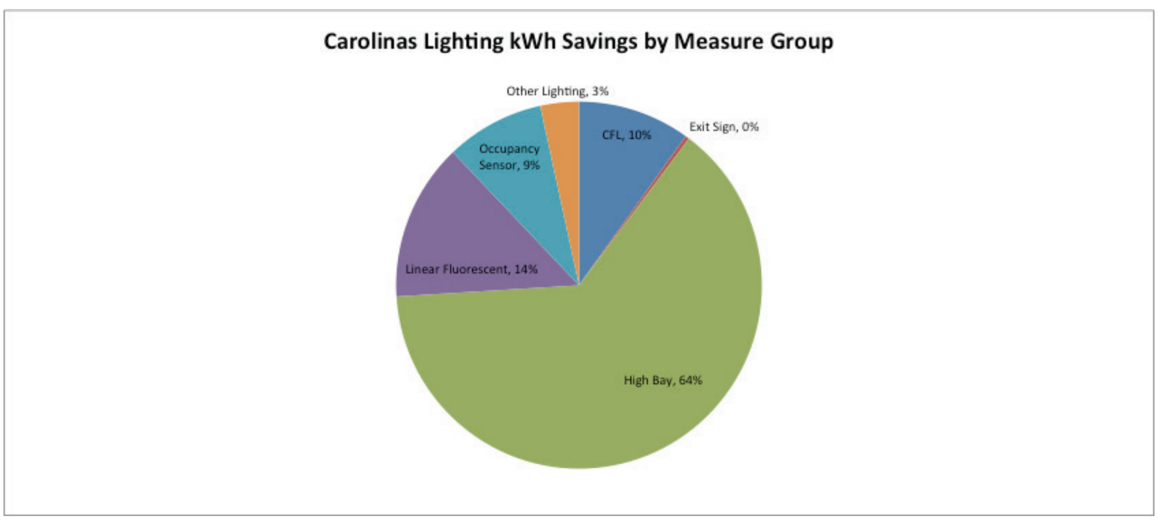


Figure 2. Lighting Measure Savings Distribution

The Smart $aver non-residential prescriptive program evaluation report dated June 16, 2011 focused on the high bay applications. For this study, we focused on linear fluorescent lighting and occupancy sensors.

The evaluation team conducted field M&V on a sample of linear fluorescent lighting and occupancy sensor participants to estimate savings for this measure. The field M&V consisted of a site visit, verification of the quantity and type of incented lighting fixtures, verification of fixture wattage assumptions against manufacturer's catalog data, interviews with customers to identify the type and quantity of the replaced fixtures, and short-term monitoring of lighting system operation using light loggers to measure operating hours. The field M&V activities were conducted by TecMarket Works' sub-contractors and the results were forwarded to Architectural Energy Corporation for analysis and to BuildingMetrics for confirmation. The field M&V activities were compliant with the International Performance Measurement and Verification Protocols (IPMVP) Option A – Partially measured, retrofit isolation protocol.

Lighting program participation records covering the period from January 2009 through the end of February 2012 were obtained from Duke Energy. The data, delivered as an Excel spreadsheet flat file, contained customer name and address, installing vendor contact information, measure descriptions, unit energy savings estimates, number of measures installed, lighting operating hours, installed fixture watts, rebate amounts, and so on. These data were examined to identify which of the measures promoted by the program were adopted by program participants and in what numbers, how the energy savings in the tracking system compared to the program savings estimates, and the availability of any customer description data that could be used in the analysis.

Customers indicated the annual operating hours of their lighting systems on the incentive applications. These self-reported lighting system hours of operation are entered into the program tracking database. A tabulation of the average self-reported operating hours by building type are shown in Table 3.

Table 3. Self-Reported Lighting Operating Hours by Building Type

Building Description	Operating hour report frequency by building type	Average self-reported operating hours from program application
Big Box Retail	89	5,206
Education	782	2,788
Grocery	231	7,680
Healthcare	197	6,424
Industrial	613	6,177
Lodging	138	3,072
Office	536	3,545
Other	302	5,060
Public Assembly	60	2,799
Public Order/Safety	38	3,246
Restaurant	67	3,335
Small Box Retail	577	4,994
Warehouse	263	5,022
All Buildings	3,893	5,177

The distribution of the self-reported operating hours by building type and fixture type is shown in Table 4:

Table 4. Self-Reported Lighting Operating Hours by Building and Fixture Type

Building Type	CFL	Linear fluorescent	High Bay
Big Box Retail	2,808	4,960	5,400
Education	2,327	3,123	2,386
Grocery	3,285	4,138	7,011
Healthcare	6,743	5,965	8,034
Industrial	4,535	4,795	6,306
Lodging	3,090	3,026	
Office	3,329	3,490	5,516
Other	5,250	4,662	5,219
Public Assembly	2,265	3,033	2,756
Public Order/Safety	3,053	3,903	2,615
Restaurant	2,921	3,901	
Small Box Retail	3,936	4,635	5,134
Warehouse	3,660	5,687	5,022
All Buildings	4,166	4,134	5,531

Sample Design

The sampling plan incorporates a stratified random sample approach, where the projects are stratified according to technology type (linear fluorescent and occupancy sensors), and sampled randomly within each stratum. The total sample size is calculated from the following equation[3]:

[3] Bonneville Power Administration, *Sampling Reference Guide. Research Supporting an Update of BPA's Measurement and Verification Protocols*, August, 2010.

$$n = \frac{\left(\sum_k \left(kWh_k \times cv_k\right)\right)^2}{\left(\frac{P \times kWh}{Z}\right)^2 + \sum_k \frac{\left(kWh_k \times cv_k\right)^2}{N_k}}$$

where:

n = total sample size required
kWh_k = estimated savings from group k
cv_k = assumed coefficient of variation for group k
P = desired precision
KWh = total kWh savings
Z = z statistic (1.645 at 90% confidence)
N_k = population size of group k

Samples are allocated to each group based on the following equation:

$$n_k = n \times \frac{kWh_k \times cv_k}{\sum_k \left(kWh_k \times cv_k\right)}$$

A sample meeting +/- 10% relative precision at 90% confidence was selected. A coefficient of variation of 0.3 was assumed for lighting measure population. The Carolina participation at the time of sample selection, and the resulting sample sizes are summarized in Table 5.

Table 5. Sample Selection for Carolina Linear Fluorescent and Occupancy Sensor

Group	kWh	cv	Total Projects	Sample Size
Linear Fluorescent	35,284,878	0.3	1,482	15
Occupancy Sensor	21,491,704	0.3	779	10
Total			2,261	25

A sample of 25 projects, representing 38 individual measures, was used in the study. The allocation of the projects across linear fluorescent and occupancy sensor measures is shown in the Table 5 above. Sites were randomly selected within each group. Each sampled site was recruited for the M&V study by TecMarket Works contractors. Backup sites were used when it was not possible to successfully recruit customers in the primary sample.

At the conclusion of the evaluation, last minute customer refusals eliminated two of the sites from the sample. One of the occupancy sensor sites was not successfully monitored and thus eliminated from the sample. The achieved sample is shown in the table below.

Table 6. Status of 2009-2012 Linear Fluorescent and Occupancy Sensor Sample

Group	Sample Size	Completed	Notes
Linear Fluorescent	15	14	Customer refusal. 1 site dropped.
Occupancy Sensor	10	8	Customer refusal, loggers did not record any data. 2 sites dropped.

A summary of the characteristics of the 14 customers that participated for the linear fluorescent M&V study is shown in Table 7.

Table 7. Linear Fluorescent Lighting M&V Study Participants

Site	Building Type	Total fixtures rebated	Installed Fixture(s)	Baseline Fixture(s)
LF-1	Grocery	83	T-8 8ft 1 lamp	T-12 8ft 1 lamp
LF-2	Office	2	T8 4ft 2lamp 28W	T8 4ft 2 lamp 32W
LF-3	Office	322	T-8 4ft 2 lamp	T-12 4ft 2 lamp
		266	T-8 4ft 3 lamp	T-12 4ft 3 lamp
		592	T-8 4ft 4 lamp	T-12 4ft 4 lamp
LF-4	Other (Rec Center)	12	T-8 4ft 2 lamp	T-12 4ft 2 lamp
		30	T-8 4ft 4 lamp	T-12 4ft 4 lamp
LF-5	Other (communications)	503	T-8 4ft 2 lamp 28W	T-12 4ft 2 lamp
		137	T-8 2ft 2 lamp	T-12 2ft 2 lamp
LF-6	Small Box Retail	124	T8 4ft 2 lamp 28W	T8 4ft 2 lamp 32W
		56	T8 4ft 3 lamp 28W	T8 4ft 3 lamp 32W
LF-7	Office	120	T-8 4ft 4 lamp	T-12 4ft 4 lamp
		318	T-8 4ft 2 lamp	T-12 4ft 2 lamp
LF-8	Industrial	86	T-8 2ft 2 lamp	T-12 2ft 2 lamp
		42	HP T-8 4ft 2 lamp	T-12 8ft 1 lamp
		2432	HP T-8 4ft 2 lamp	T-12 4ft 2 lamp
LF-9	Education (K-12)	15	T-8 4ft 4 lamp	T-12 4ft 4 lamp
LF-10	Industrial	16	T-8 4ft 4 lamp	T-12 4ft 4 lamp
		120	T-8 4ft 3 lamp	T-12 4ft 3 lamp
LF-11	Education (K-12)	1415	T-8 4ft 4 lamp	T-12 4ft 4 lamp
		636	T-8 4ft 2 lamp	T-12 4ft 2 lamp
		2	T-8 2ft 2 lamp	T-12 2ft 2 lamp
		4	T-8 2ft 1 lamp	T-12 2ft 1 lamp
		418	HP LW T-8 4ft 4 lamp	T-8 4ft 4 lamp
		416	HP LW T-8 4ft 3 lamp	T-8 4ft 3 lamp
		142	HP LW T-8 4ft 2 lamp	T-8 4ft 2 lamp
LF-12	Grocery	151	T-8 8ft 2 lamp	T-12 8ft 2 lamp
		40	HP T-8 4ft 4 lamp	T-12 4ft 4 lamp
LF-13	Religious Worship	71	HO T5 3 lamp	500W Halogen
LF-14	Small Box Retail	792	T8 4ft 28W	T8 4ft 32W

The characteristics of the eight sites that participated in the occupancy sensor study are shown in and Table 8.

Table 8. Occupancy Sensor M&V Study Participants

Site	Business Type	Number of Occupancy Sensors Rebated	Occupancy sensor type
OS-1	Industrial	3	Occupancy Sensors under 500 W
OS-2	Industrial	71	Occupancy Sensors under 500 W
OS-3	Industrial	17 27	Occupancy Sensors under 500 W Occupancy Sensors over 500 W
OS-4	Education (College and University)	89	Occupancy Sensors over 500 W
OS-5	Warehouse	461	Occupancy Sensors under 500 W
OS-6	Warehouse	177	Occupancy Sensors under 500 W
OS-7	Office	144	Occupancy Sensors under 500 W
OS-8	Education (College and University)	24	Occupancy Sensors under 500 W

Gross Savings Analysis

Paper file applications and supporting documentation were obtained for each site. The data in the application files were reviewed and compared to the program tracking database and onsite survey observations. Discrepancies were noted and corrected for the impact evaluation. These discrepancies are reported in Table 9.

Table 9. Tracking System and Paper File Discrepancies

Measure	Site	Discrepancy
Linear Fluorescent	2	Lamp watts not fixture watts used. A fixture watts value that includes the observed ballast factor was used, normalized per lamp replaced.
	5	Site confirmed low-wattage (28W) 4 ft T8 fixtures; tracking system assumed standard 32 watt T8s.
	6	Fixture counts off: 117 2 lamp fixtures counted; 124 expected. 53 3 lamp fixtures counted; 56 expected.
	11	Low wattage (25W) T8 fixtures observed; tracking system assumed standard wattage T8 fixtures.
	13	Baseline fixture used a 500 W halogen light source; program assumed T-12 fixture baseline.
	14	Rebate to upgrade highbay fixtures from 32W to 28W lamps. Program calcs used lamp watts; A fixture watts value that includes the observed ballast factor was used, normalized per lamp replaced.

Occupancy Sensor	2	Highbay fixture integrated occupancy sensors rebated.
	6	Highbay fixture integrated occupancy sensors rebated.

Fixture watts reported in the manufacturer's catalogs (where available) were averaged and compared to the standard assumptions used in program design for several popular fixture types. This comparison is shown in Figure 3.

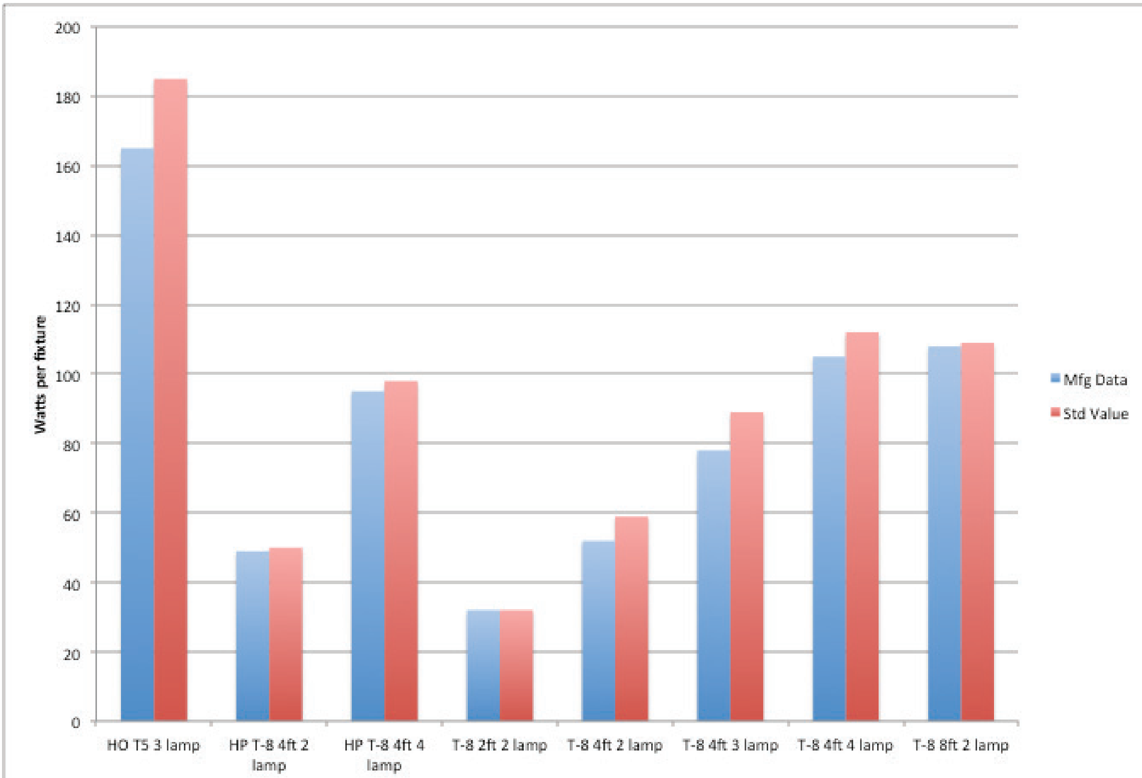


Figure 3. Comparison of Installed Fixture Watts from Manufacturers vs. Standard Assumptions

These data are also shown in Table 10.

Table 10. Comparison of Manufacturer's Fixture Watts with Standard Program Assumptions for Linear Fluorescent Fixtures

Fixture	n	Program Assumption	Mfg Cutsheets
HO T5 3 lamp	1	185	165
HP T-8 4ft 2 lamp	1	50	49
HP T-8 4ft 4 lamp	1	98	95
T-8 2ft 2 lamp	1	32	32
T-8 4ft 2 lamp	3	59	52
T-8 4ft 3 lamp	2	89	78
T-8 4ft 4 lamp	3	112	105
T-8 8ft 2 lamp	1	109	108

In all cases, the program standard assumption exceeds the manufacturers' cut sheet values, indicating conservative values were used in developing the program estimates of fixture savings.

The fixture quantities installed at the sampled sites along with the number of light loggers deployed are shown in Table 11 and
Table 12. Light loggers were deployed to monitor the on/off behavior of the lighting systems based on the circuiting and switching of the lighting systems. At some sites, recording current loggers were installed to measure time series current on selected lighting circuits.

Table 11. Logger Installations at Linear Fluorescent M&V Study Sites

Site	Business Type	Total fixtures rebated	Loggers installed
LF-1	Grocery	83	6
LF-2	Office	2	2
LF-3	Office	1180	33
LF-4	Other (Rec Center)	42	11
LF-5	Other (communications)	640	6
LF-6	Small Box Retail	180	9
LF-7	Office	438	15
LF-8	Industrial	2560	4 circuits
LF-9	Education (K-12)	15	5
LF-10	Industrial	136	11
LF-11	Education (K-12)	3033	29
LF-12	Grocery	191	10
LF-13	Religious Worship	71	4 circuits
LF-14	Small Box Retail	792	12 circuits

Table 12. Logger Installations at Occupancy Sensor M&V Study Sites

Site	Business Type	Total Occupancy Sensors rebated	Loggers installed
OS-1	Industrial	3	3
OS-2	Industrial	71	16
OS-3	Industrial	44	18
OS-4	Education (College and University)	89	21
OS-5	Warehouse	461	8 circuits
OS-6	Warehouse	177	13
OS-7	Office	144	15
OS-8	Education (College and University)	24	4

The light logger data were downloaded by the TecMarket Works contractors. These data were processed by engineers from Architectural Energy Corporation and reviewed by BuildingMetrics and TecMarket Works. The results are summarized in Table 13 and Table 14. Average weekday and weekend load shapes for each site from the logger study are also shown in Appendix A: Load Shapes.

Table 13. Lighting Logger Study Results

Site	Business Type	Application self reported annual operating hours	Logger study annual operating hours	Ratio logged / self report	Coincident demand factor[4]
LF-1	Grocery	3,536	5,077	1.44	1.0
LF-2	Office	2,340	2,591	1.11	0.95
LF-3	Office	2,657	5,429	2.04	0.90
LF-4	Other (Rec Center)	2,920	2,977	1.02	0.77
LF-5	Other (communications)	3,120	6,642	2.13	0.97
LF-6	Small Box Retail	4,600	5,277	1.15	1.0
LF-7	Office	2,340	2,591	1.11	0.64
LF-8	Industrial	8,760	8,676	0.99	1.0
LF-9	Education (K-12)	2,000	1,486	0.74	0.03
LF-10	Industrial	6,240	3,561	0.57	0.96
LF-11	Education (K-12)	2,500	2,051	0.82	0.63
LF-12	Grocery	3,744	6,578	1.76	1.0
LF-13	Religious Worship	1,820	379	0.21	0.07
LF-14	Small Box Retail	4,420	6,199	1.40	0.97
	Wt. Average[5]	**5,583**	**6,384**	1.14	**0.76**

Table 14. Occupancy Sensor Logger Study Results

Site	Business Type	Connected kW	EFLH		DF[6]	
			Pre	Post	Pre	Post
OS-1	Industrial	0.57	3,942	2,126	1.00	0.61
OS-2	Industrial	16.61	6,103	1,107	1.00	0.33
OS-3	Industrial	16.43	4,979	3,359	0.91	0.72
OS-4	Education (College and University)	47.20	4,510	2,882	1.00	0.69
OS-5	Warehouse	99.27	6,558	3,723	1.00	0.67
OS-6	Warehouse	51.02	4,621	3,265	1.00	0.78
OS-7	Office	16.99	2,273	1,125	0.75	0.52
OS-8	Education (College and University)	20.18	4,029	2,627	1.00	0.46
	Wt. Average		5,655	3,029	0.98	0.65

[4] Coincidence factor is defined as the fraction of the total connected load operating at the coincident peak hour, which is defined as the hour between 3pm and 4pm on the hottest summer workday.
[5] Individual site operating hours were weighted by kWh savings per site to obtain kWh savings weighted average operating hours. Individual site coincidence factors were weighted by kW savings per site to obtain a kW savings weighted coincidence factor.
[6] The diversity factor is defined as the fraction of the total connected load operating at any particular hour. The diversity factor at the coincident peak hour is defined as the fraction of the total connected load operating during the hour between 3pm and 4pm on the hottest summer workday.

On average, the light logger study predicted about 14% more operating hours for linear fluorescent measures than the customer self-reported values, and 1.7 times more operating hours than the 3680 EFLH assumption used in the program design estimates. The light logger study for occupancy sensors predicted about 1.5 times more uncontrolled operating hours than the 3680 EFLH assumption used in the program design estimates.

For linear fluorescent measures, the light logger results were combined with the verified fixture counts and verified installed fixture watts to estimate the actual energy and peak demand savings, using the equations shown below.

$$kWh_{savings} = (Watts_{base} - Watts_{ee}) / 1000 \text{ x } EFLH_{post} \text{ x } (1+WHF_e)$$

$$kW_{savings} = (Watts_{base} - Watts_{ee}) / 1000 \text{ x } CF \text{ x } (1+WHF_d)$$

where:

$Watts_{base}$ = baseline fixture watts
$Watts_{ee}$ = efficient fixture watts
$EFLH_{post}$ = equivalent full-load lighting operating hours after retrofit
CF = coincidence factor
= fraction of total connected load operating at the utility coincident peak hour
= defined as hour ending at 4pm
WHF_e = waste heat factor for energy
WHF_d = waste heat factor for demand

For occupancy sensor measures, the light logger results were combined with the verified fixture counts and verified installed fixture watts to estimate the actual energy and peak demand savings, using the equations shown below.

$$kWh_{savings} = Watts_{controlled} \text{ x } (EFLH_{pre} - EFLH_{post}) / 1000 \text{ x } (1+WHF_e)$$

$$kW_{savings} = Watts_{controlled} / 1000 \text{ x } (DF_{pre} - DF_{post}) \text{ x } (1+WHF_d)$$

where:

$Watts_{controlled}$ = controlled fixture watts
$EFLH_{pre}$ = equivalent full-load lighting operating hours without occupancy sensor
$EFLH_{post}$ = equivalent full-load lighting operating hours with occupancy sensor
DF_{pre} = diversity factor without occupancy sensor
= fraction of total connected load operating without occupancy sensor controls
DF_{post} = diversity factor with occupancy sensor
= fraction of total connected load operating once occupancy sensor controls have been installed

Waste heat factors were calculated using building energy simulation models derived from the commercial building prototypes used in the California Database for Energy Efficiency Resources (DEER) study[7], with adjustments made for local building practices and climate. The commercial prototypes were using long-term average weather data for Charlotte, Asheville and Greenville. The results of the interactive effects simulations are shown in Appendix B: Results of HVAC Interactive Effects Simulations.

Based on the observed building and HVAC system type, the interactive effects multipliers used for each of the sites in the study are shown below:

Site	Business Type	HVAC System Type	WHF_e	WHF_d
LF-1	Grocery	AC with econ gas heat	0.162	0.448
LF-2	Office	Heat pump no econ	-0.122	0.137
LF-3	Office	AC no econ elec heat	-0.04	0.151
LF-4	Other (Rec Center)	AC with econ gas heat	0.071	0.279
LF-5	Other (communications)	AC no econ elec heat	-0.04	0.151
LF-6	Small Box Retail	Heat pump no econ	0.073	0.257
LF-7	Office	AC no econ gas heat	0.115	0.149
LF-8	Industrial	AC with econ gas heat	0.095	0.203
LF-9	Education (K-12)	AC with econ gas heat	0.143	0.265
LF-10	Industrial	Heat pump no econ	-0.031	0.184
LF-11	Education (K-12)	AC with econ gas heat	0.117	0.279
LF-12	Grocery	AC no econ elec heat	-0.28	0.595
LF-13	Religious Worship	AC no econ gas heat	0.197	0.211
LF-14	Small Box Retail	Heat pump no econ	0.073	0.257
OS-1	Industrial	AC no econ gas heat	0.115	0.149
OS-2	Industrial	Heat pump no econ	-0.003	0.205
OS-3	Industrial	AC econ gas heat	0.17	0.149
OS-4	Education (College and University)	AC econ gas heat	0.143	0.265
OS-5	Warehouse	No AC gas heat	0	0
OS-6	Warehouse	No AC gas heat	0	0
OS-7	Office	AC no econ gas heat	0.103	0.136
OS-8	Education (College and University)	AC econ gas heat	0.158	0.136
	Wt. Average		0.042	0.220

Gross Impact Results

These results of the energy and demand savings calculations are shown in Table 15 and Table 16. These results were compared to the tracked savings based on the fixture counts and standard per fixture kW and kWh savings estimates from program design work papers. The ratio of the

[7] Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer.

evaluated savings to the program planning estimated savings is expressed as a realization rate (RR) for kWh, non-coincident peak (NCP) kW, and coincident peak (CP) kW.

Table 15. Results of Linear Fluorescent Lighting M&V Study

Site	Building Type	kWh Savings			NCP kW Savings			CP kW Savings		
		M&V	Program Planning	RR	M&V	Program Planning	RR	M&V	Program Planning	RR
LF-1	Grocery	8,324	5,192	1.60	2.04	1.41	1.45	2.04	1.27	1.61
LF-2	Office	50	59	0.85	0.03	0.02	1.56	0.02	0.01	1.65
LF-3	Office	280,230	115,670	2.42	61.90	31.43	1.97	55.70	28.29	1.97
LF-4	Other (Rec Center)	3,596	4,152	0.87	1.44	1.13	1.28	1.11	1.02	1.09
LF-5	Other (commun-ications)	101,147	34,485	2.93	18.26	9.37	1.95	17.71	8.43	2.10
LF-6	Small Box Retail	13,019	6,124	2.13	2.89	1.66	1.74	2.89	1.50	1.93
LF-7	Office	20,956	30,515	0.69	8.33	8.29	1.00	5.33	7.46	0.71
LF-8	Industrial	561,387	207,643	2.70	71.09	56.42	1.26	71.09	50.78	1.40
LF-9	Education	815	1,766	0.46	0.61	0.48	1.26	0.02	0.43	0.04
LF-10	Industrial	14,189	15,132	0.94	4.87	4.11	1.18	4.67	3.70	1.26
LF-11	Education	185,298	270,877	0.68	103.40	73.61	1.40	65.17	66.25	0.98
LF-12	Grocery	20,010	12,899	1.55	6.74	3.51	1.92	6.74	3.15	2.14
LF-13	Religious Worship	10,790	5,748	1.88	28.80	1.56	18.44	2.02	1.41	1.43
LF-14	Small Box Retail	31,608	11,658	2.71	5.97	3.17	1.88	5.79	2.85	2.03
	Total	**1,251,419**	**721,919**	**1.73**	**316.36**	**196.17**	**1.61**	**240.31**	**176.56**	**1.36**

Table 16. Results of NC and SC Occupancy Sensor M&V Study

Site	Building Type	kWh Savings			NCP kW Savings			CP kW Savings		
		M&V	Program Planning	RR	M&V	Program Planning	RR	M&V	Program Planning	RR
OS-1	Industrial	1,158	1,290	0.90	0.19	0.37	0.52	0.26	0.33	0.79
OS-2	Industrial	82,754	30,530	2.71	13.07	8.68	1.51	13.34	7.81	1.71
OS-3	Industrial	31,139	36,200	0.86	2.78	9.97	0.28	3.63	8.97	0.40
OS-4	Education (College and University)	87,830	95,230	0.92	6.78	26.01	0.26	18.76	23.41	0.80

OS-5	Warehouse	281,427	198,230	1.42	17.76	56.34	0.32	32.49	50.71	0.64
OS-6	Warehouse	69,206	76,110	0.91	9.14	21.63	0.42	11.34	19.47	0.58
OS-7	Office	21,531	61,920	0.35	4.46	17.60	0.25	4.46	15.84	0.28
OS-8	Education (College and University)	32,766	10,320	3.17	2.18	2.93	0.74	12.35	2.64	4.68
	Total	**607,811**	**509,830**	**1.19**	**56.35**	**143.53**	**0.39**	**96.62**	**129.18**	**0.75**

A comparison of the assumptions used in the calculations for linear fluorescent measures is shown in Table 17. Total installed measure count, baseline fixture watts, and installed fixture watts assumptions from the program tracking database or program design work papers were compared to verified values from the M&V study. Although there were some small differences between the number of fixtures recorded in the program tracking database versus the number of fixtures in the field, the overall installation verification rate was very close to 1. Program planning and M&V estimates of baseline fixture wattage were within 2%, due largely to a discrepancy in the baseline fixture type at site LF-13. M&V estimates of efficient fixture watts were an average of about 8% lower than program planning estimates, due to a combination of a tracking system error at site L-11 and the use of conservative values of fixture watts during program design.

A comparison of the assumptions used in the calculations for occupancy sensor measures is shown in Table 18. Total installed measure count, sensor connected load, energy savings and demand savings factor assumptions from the program tracking database or program design work papers were compared to verified values from the M&V study. The number of occupancy sensors verified in the field matched the tracking data exactly. Verified connected load was on average about 31% lower than program design assumptions. Energy savings (a percentage of the uncontrolled energy consumption) was 45%, or about 1.5 times larger than the program design assumption of 30%. Coincident demand savings (as a percentage of connected kW) was 37%, or about 1.2 times larger than the program design assumption of 30%.

Table 17. Comparison of Linear Fluorescent Measure Savings Assumptions

Site	Building Type	Duke Name	Quantity			Baseline Fixture Watts			Efficient Fixture Watts		
			M&V	Tracking	Ratio	M&V	Program	Ratio	M&V	Program	Ratio
LF-1	Grocery	T8 8ft 1 lamp	83	83	1.00	75.0	75.0	1.00	58.0	58.0	1.00
LF-2	Office	Low Watt T8 lamps, 4ft	4	4	1.00	29.0	32.0	0.91	23.5	28.0	0.84
LF-3	Office	T8 4ft 2 lamp	322	322	1.00	72.0	72.0	1.00	48.0	58.0	0.83
		T8 4ft 3 lamp	266	266	1.00	115.0	115.0	1.00	71.0	85.0	0.84
		T8 4ft 4 lamp	592	592	1.00	144.0	144.0	1.00	86.0	112.0	0.77
LF-4	Other (Rec Center)	T8 4ft 2 lamp	12	12	1.00	72.0	72.0	1.00	58.0	58.0	1.00
		T8 4ft 4 lamp	30	30	1.00	144.0	144.0	1.00	112.0	112.0	1.00
LF-5	Other (commun-ications)	T8 2ft 2 lamp	137	137	1.00	56.0	50.0	1.12	32.0	33.0	0.97
		T8 4ft 2 lamp	503	503	1.00	72.0	72.0	1.00	47.0	58.0	0.81
LF-6	Small Box Retail	Low Watt T8 lamps, 4ft	393	416	0.94	29.3	32.0	0.91	23.4	28.0	0.84
LF-7	Office	T8 4ft 2 lamp	318	318	1.00	72.0	72.0	1.00	59.0	58.0	1.02
		T8 4ft 4 lamp	120	120	1.00	144.0	144.0	1.00	118.0	112.0	1.05
LF-8	Industrial	T8 2ft 2 lamp	86	86	1.00	56.0	50.0	1.12	32.0	33.0	0.97
		T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	42	42	1.00	75.0	75.0	1.00	49.0	57.0	0.86
		HPT8 4ft 2 lamp, T12 to HPT8	2432	2432	1.00	72.0	72.0	1.00	49.0	49.7	0.99
LF-9	Education	T8 4ft 4 lamp	15	15	1.00	144.0	144.0	1.00	112.0	112.0	1.00
LF-10	Industrial	T8 4ft 4 lamp	16	16	1.00	144.0	144.0	1.00	112.0	112.0	1.00
		T8 4ft 3 lamp	120	120	1.00	115.0	115.0	1.00	85.0	85.0	1.00
LF-11	Education	LW HPT8 4ft 2 lamp, replace T8	142	142	1.00	59.0	58.0	1.02	41.0	44.9	0.91
		LW HPT8 4ft 3 lamp, replace T8	416	416	1.00	89.0	85.0	1.05	61.3	68.0	0.90
		LW HPT8 4ft 4 lamp, replace T8	418	418	1.00	112.0	112.0	1.00	80.5	87.0	0.93
		T8 2ft 1 lamp	4	4	1.00	28.0	25.0	1.12	18.0	18.0	1.00
		T8 2ft 2 lamp	2	2	1.00	56.0	50.0	1.12	32.0	33.0	0.97
		T8 4ft 2 lamp	636	636	1.00	72.0	72.0	1.00	59.0	58.0	1.02
		T8 4ft 4 lamp	1415	1415	1.00	144.0	144.0	1.00	112.0	112.0	1.00
LF-12	Grocery	T8 8ft 2 lamp	151	151	1.00	123.0	123.0	1.00	108.0	112.0	0.96
		HPT8 4ft 4 lamp, T12 to HPT8	40	40	1.00	144.0	144.0	1.00	95.0	97.9	0.97
LF-13	Religious Worship	3 Lamp T5HO replacing T12	71	71	1.00	500.0	207.0	2.42	165.0	185.0	0.89
LF-14	Small Box Retail	Low Watt T8 lamps, 4ft	792	792	1.00	36.7	32.0	1.15	30.7	28.0	1.10
	Wt Average				1.00			1.02			0.92

Table 18. Comparison of Occupancy Sensor Measure Savings Assumptions

Site	Building Type	Duke Name	Quantity			Connected Load			Energy Savings Factor			Demand Savings Factor		
			M&V	Tracking	Ratio	M&V	Program	Ratio	M&V	Program	Ratio	M&V	Program	Ratio
OS-1	Industrial	Occupancy Sensors under 500 W	3	3	1.0	0.19	0.39	0.49	0.46	0.3	1.54	0.39	0.30	1.32
OS-2	Industrial	Occupancy Sensors under 500 W	71	71	1.0	0.23	0.39	0.60	0.82	0.3	2.73	0.67	0.30	2.22
OS-3	Industrial	Occupancy Sensors over 500 W	27	27	1.0									
		Occupancy Sensors under 500 W	17	17	1.0	0.37	0.75	0.50	0.33	0.3	1.08	0.19	0.30	0.64
OS-4	Education (College and University)	Occupancy Sensors over 500 W	89	89	1.0	0.53	0.98	0.54	0.36	0.3	1.20	0.31	0.30	1.05
OS-5	Warehouse	Occupancy Sensors under 500 W	461	461	1.0	0.22	0.39	0.55	0.43	0.3	1.44	0.33	0.30	1.09
OS-6	Warehouse	Occupancy Sensors under 500 W	177	177	1.0	0.29	0.39	0.74	0.29	0.3	0.98	0.22	0.30	0.74
OS-7	Office	Occupancy Sensors under 500 W	144	144	1.0	0.12	0.39	0.30	0.51	0.3	1.68	0.23	0.30	0.77
OS-8	Education (College and University)	Occupancy Sensors under 500 W	24	24	1.0	0.84	0.39	2.16	0.35	0.3	1.16	0.54	0.30	1.80
		Weighted Average			1.0			0.69	0.45	0.3	1.52	0.37	0.30	1.24

The estimated achieved sampling precision in the realization rates is shown in Table 19. Due to customer refusals which reduced the sample size, and higher than expected variability in the savings from the M&V activity relative to the program planning values, the achieved relative precision was higher than the targeted value. However, the impact of higher relative precision on the overall program is minimal given that linear fluorescent and occupancy sensor measures represent only 13% and 8% of the total program savings respectively.

Table 19. Realization Rate Achieved Sampling Precision

Project Type	Population Size	Sample Size	Actual Sample cv	Relative Precision
Linear Fluorescent	1482	14	0.57	+/- 25%
Occupancy Sensor	779	8	0.46	+/- 27%
Total	2261	22		+/- 18.5%

Net to Gross Analysis

Freeridership

TecMarket Works utilized two sets of multiple questions from the participant survey to estimate freeridership.

For the first set of calculations, the primary "gateway" question asks when they might have replaced their units without the Smart $aver program, and the second question asks those who say they would have delayed their purchase to estimate how long they would have delayed the purchase.

The gateway question asked survey respondents what their behavior would have been if the Smart $aver rebate program had not been available. The four categories of responses were:

a.) bought the same unit at the same time
b.) bought the same unit at a later time
c.) bought a used unit at the same time
d.) continued to use the currently installed unit and not purchase a new or used unit

The breakdown of responses to the gateway question can be seen in Table 20. Participants who indicated that they would have bought the same unit at the same time were assigned 100% freeridership. Participants answering that they would have continued using the currently installed unit were assigned 0% freeridership.

Freeridership for participants who indicated that they would have bought their units at a later time was determined by when they said they would have purchased the units in the absence of the program. Each response to this question was converted to a freerider percentage as presented in Table 20 separately for Linear Fluorescent Lighting (FL) and Occupancy Sensors (OS).

The equivalent freerider rate (the number of units that count toward freeridership) in the case of customers who indicated they would have purchased the unit at a later time, is the product of the freerider percentage multiplied by the number of respondents/units (each respondent was surveyed about one recently installed unit).

Table 20. Program Freeridership for Standard Participants

Gateway Question Response	Linear Fluorescent Lighting Count (freeriders)	Occupancy Sensor Count (freeriders)
Same unit at same time (100% freerider)	23 (23)	5 (5)
Same unit within 6 months (75% freerider)	0 (0)	0 (0)
Same unit 6-12 months later (50% freerider)	3 (1.5)	1 (0.5)
Same unit 12-24 months later (25% freerider)	7 (1.75)	4 (1.0)
Same unit more than 24 months	9 (0)	1 (0)

later (0% freerider)		
Same unit, don't know when (mean % freerider of the five rows above = 62.5% for Fluorescent Lighting, 59.1% for Occupancy Sensors)	8 (5.0)	0 (0)
Purchased a used unit	0 (0)	0 (0)
Continued using old unit (0% freerider)	20 (0)	3 (0)
TOTAL COUNT	**70**	**14**
Freeriders	**31.25**	**6.5**
Freerider %	**44.6%**	**46.4%**

The second set of calculations is based on questions which ask what participants would have done without the Smart $aver incentive, and without the Smart $aver program information and technical assistance.

The three categories of responses to these questions were:

a.) bought unit with at least the same efficiency level
b.) bought a unit with a different efficiency level
c.) not sure what organization would have done

The breakdown of responses to these questions can be seen in Table 21 and Table 22. Participants who indicated that they would have bought the same efficiency level without the incentive or program information were assigned the average freeridership calculated for participants who said they would purchase the same unit in Table 20: 62.5% for Fluorescent Lighting (FL) and 59.1% for Occupancy Sensors (OS). Participants answering that they would have selected a different efficiency level were assigned 0% freeridership.

Table 21. Program Freeridership Based on Financial Incentive by Rebated Measure

Response for "without financial incentive"	Linear Fluorescent Lighting Count (freeriders)	Occupancy Sensor Count (freeriders)
Would have selected same efficiency level without financial incentive (freerider percent based on planned time of purchase: 62.5% FL, 59.1% OS)	44 (27.50)	6 (3.55)
Would have made a different choice without financial incentive (freerider 0%)	14 (0)	6 (0)
Not sure what company would have done without financial incentive (mean % freerider from the two columns above: 47.4% FL, 29.6% OS)	12 (5.69)	2 (0.59)
TOTAL COUNT	**70**	**14**
Freeriders	**33.19**	**4.14**

Freerider %	**47.4%**	**29.6%**

Table 22. Program Freeridership Based on Information and Assistance by Rebated Measure

Response for "without program information and technical assistance"	Linear Fluorescent Lighting Count (freeriders)	Occupancy Sensor Count (freeriders)
Would have selected same efficiency level without program information/technical assistance (freerider percent based on planned time of purchase: 62.5% FL, 59.1% OS)	42 (26.25)	8 (4.73)
Would have made a different choice without program information/technical assistance (freerider 0%)	18 (0)	4 (0)
Not sure what company would have done without program information/technical assistance (mean % freerider from the two columns above: 43.8% FL, 39.4% OS)	10 (4.38)	2 (0.79)
TOTAL COUNT	**70**	**14**
Freeriders	**30.63**	**5.52**
Freerider %	**43.8%**	**39.4%**

Since the program included both an incentive payment and technical assistance/program information, the final freeridership estimate is the lower of the two figures presented for each measure in Table 21 and Table 22. Thus, freeridership for the Smart $aver program in the Carolinas is estimated at 43.8% for Fluorescent Lighting and 29.6% for Occupancy Sensors.

Validity and Reliability of the Freerider Estimation Approach

The field of freeridership assessment as specified in the California Evaluation Protocols basic estimation approach requires the construction of questions that allow the evaluation contractor to estimate the level of freeridership. The basic approach used in this evaluation is based on the results of a set of freerider questions incorporated into participant survey instruments that meets the reliability standards for freerider questions. The approach used in this assessment examines the various ways in which the program impacts the customer's acquisition and use of equipment incented as part of the Non-Residential Smart $aver Prescriptive program, and allocates a freeridership factor for each of the types of responses contained in the survey questions. The allocation approach assigns high freeridership values to participants who would have acquired the same equipment on their own, and that factor is influenced by their stated intentions regarding the timing and efficiency level of this acquisition. The scoring approach is proportional to the degree to which the participant would have acquired and used equivalent equipment on their own.

Spillover

In order to estimate the spillover savings attributed to the program several questions were added to the participant questionnaire. These questions were asked to determine the extent to which the program's information and incentives caused additional non-incented spillover actions to be taken by the participants. A total of 84 survey participants answered the net to gross question battery.

Survey participants were asked if they had taken any actions above and beyond those rebated by the program at their company or at any other locations. If the respondent indicated that they had not purchased or installed any other type of high efficiency equipment or made energy efficiency improvements since their participation in the program, the spillover level was set to zero and no spillover credit was provided. Respondents that had taken additional measures were asked about the type of equipment and where it was installed. However, no spillover was provided to those respondents that took additional actions unless they also indicated that their experience with the program caused, to some degree, the action to be taken by rating the influence of their experience with the program on their decision to do so on a scale from one to ten with ten being the most influential. This rating is referred to as the participant's attribution score.

If a participant indicated that the program was influential in their purchase and use decision, then their spillover savings was adjusted by the fractional amount of the strength of their attribution score. That is, if the respondent indicated an attribution score of seven out of ten, then their spillover savings were multiplied by 0.7 to estimate their spillover contribution to the program net to gross ratio.

Table 23. Spillover Measures and Attribution

Measure	Quantity	Attribution Score	EUL	kWh Savings	Spillover kWh Savings
2.5 Ton HVAC	1	10	15	130	130
3 Ton Gaspack Unit	1	10	15	156	156
3 Ton HVAC Package Units	4	10	15	624	624
3-5 ton HVAC units	6	10	15	1,248	1,248
4 Ton HVAC	2	10	15	416	416
Air compressor w/ VFD	1	6	15	18,800	11,280
Chillers 450 ton	2	10	20	206,100	206,100
Computer-controlled thermostats	5	10	11	7,995	7,995
Electronic ballasts and high-efficiency light fixtures--2x4 fluorescent	30	7	12	885	620
Emergency Lighting and Exit Lighting replaced with energy-saving and LED fixtures	60	6	16	13,740	8,244
Faucet aerators & fixtures	3	4	5	74	29
HVAC controls, building automation controls	1	8	15	260,050	208,040
LED exit lights	40	7	16	9,160	6,412
Lighting Occupancy	8	7	10	3,923	2,746

Sensor <500 W					
Lighting T8 w/ Electronic Ballast 2ft 2 lamp	139	7	12	15,165	10,615
Lighting Occupancy Sensor <500 W	14	7	10	6,866	4,806
Motion sensors	24	4	10	11,770	4,708
Occupancy sensors	500	10	10	245,200	245,200
Occupancy sensors	100	7	10	49,040	34,328
Occupancy Sensors	20	8	10	9,808	7,846
Occupancy sensors and timers	6	10	10	2,942	2,942
Occupancy Sensors--lightbox sensors, Leviton	12	7	10	5,885	4,119
Refrigerators	3	8	12	2,370	1,896
T8 4ft 2 lamp	500	7	12	14,750	10,325
T8 w/ Electronic Ballast 4ft 2 lamp	60	7	12	1,770	1,239
TOTAL/AVERAGE		**7.88**	**14.1**	**888,866**	**782,065**

Table 23 shows each measure taken by the 84 survey participants for which enough information was provided to calculate energy savings. Spillover energy savings were estimated from the customer description of the measure taken and ex-ante savings estimates from Duke Energy work papers for that measure. The spillover savings were not subject to ex-post evaluation. Actions taken by respondents that provided insufficient data to estimate impact received zero spillover credit. Actions that were determined, or believed, to be implemented outside of Duke Energy territory also received zero spillover credit. Furthermore, spillover was limited to measures that are eligible to receive a rebate through the program. Although the spillover savings were not subject to ex-post evaluation, the approach taken is believed to provide the spillover estimates that are significantly below the actual achieved spillover savings.

Figure 4 graphically shows the estimated spillover impacts over the lifetime of the spillover measures. The first, and largest, drop-off occurs at ten years when the occupancy sensors reach the end of their EULs. The final major drop occurs after 15 years when the HVAC measures expire. From 17 to 20 years, the only remaining measure is chillers.

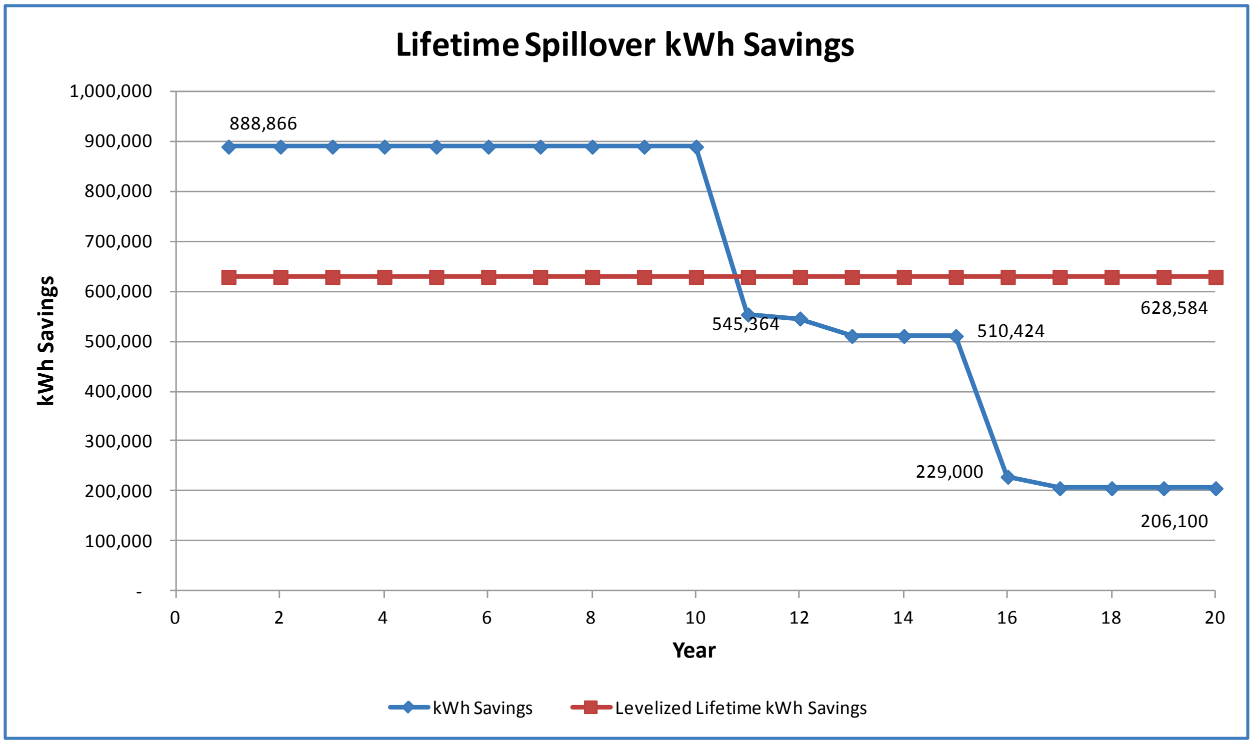


Figure 4. Lifetime Spillover kWh Savings

Table 24 shows the spillover percentage for the program of 46.5%.

Table 24. Spillover Percentage

Survey Respondent kWh Savings Excluding Spillover	Survey Respondent Spillover kWh savings	Spillover Percentage
1,680,461	782,065	46.5%

While TecMarket Works notes that the spillover savings documented in this report are lower than actually achieved, it should be understood that the assignment of spillover is, to a limited degree, subjective in that its accuracy depends on the ability of the attribution score to accurately estimate the degree of causation as well as the recall ability of the participant. However, the overall average causation score for the assessed spillover cause is high. That is, on average the attribution score provided by participants is 8.04 on a 10 point scale. This score represents that this program has significant influence on participants' actions well beyond those measures incented by the program.

Program Net to Gross Adjustment

To estimate the overall program-level net to gross adjustment, it is necessary to first determine the weighted average program freeridership. Linear fluorescents accounted for 80% and occupancy sensors accounted for 20% of the total kWh savings achieved by survey participants. The average program wide net to gross ratio for this program is 1.055. It should be noted that this net to gross ratio only includes adjustments for free ridership and short term participant spillover. Estimates for short and long term non-participant spillover and short and long term market effects are not included in this study and would be savings in addition to that documented in this report. While a short term participant net-to- gross ration of 1.055 indicates the program saved more energy that what is reflected in the gross energy projected savings estimates, this savings level is only part of the savings that are achieved by energy efficiency programs. Additional evaluation efforts are needed to document short and long term non-participant spillover and short and long term market effects.

Freeridership scores presented in this report are weighted by their measure's contribution to overall kWh savings and calculated as follows:

Program Freeridership = (80% * Linear Fluorescent FR) + (20% * Occupancy Sensor FR)
= (80% * 43.8%) + (20% * 29.6%)
= 41.0%

The net to gross ratio is then calculated as follows:

NTGR = 1 + (spillover – freeridership)
= 1+ (0.465 - 0.410)
= 1.055

Total Gross and Net Impacts

The total first year gross and net savings are tabulated for each of the measures studied in the evaluation[8]. These estimates were calculated by applying the gross realization rates for kWh, NCP kW and CP kW to the program planning estimates for each measure. The evaluated first year gross and net impacts are summarized in Table 25.

Table 25. First Year Gross And Net Savings by Measure

Metric	Result
Gross Coincident Peak kW per unit	kW/unit-yr
3 Lamp T5HO replacing T12	0.027
HPT8 4ft 2 lamp, T12 to HPT8	0.027
HPT8 4ft 4 lamp, T12 to HPT8	0.057
Low Watt T8 lamps, 4ft	0.005
LW HPT8 4ft 2 lamp, replace T8	0.016
LW HPT8 4ft 3 lamp, replace T8	0.021
LW HPT8 4ft 4 lamp, replace T8	0.031
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	0.022
T8 2ft 1 lamp	0.009
T8 2ft 2 lamp	0.021
T8 4ft 2 lamp	0.017
T8 4ft 3 lamp	0.037
T8 4ft 4 lamp	0.039
T8 8ft 1 lamp	0.021
T8 8ft 2 lamp	0.013
Occupancy Sensors under 500 W	0.082
Occupancy Sensors over 500 W	0.197

[8] Note, the gross savings realization rates developed by this evaluation can be applied to other similar linear fluorescent and occupancy sensor measures not specifically studied in this evaluation.

Metric	Result
Gross kWh per unit	kWh/unit-yr
3 Lamp T5HO replacing T12	140.5
HPT8 4ft 2 lamp, T12 to HPT8	142.3
HPT8 4ft 4 lamp, T12 to HPT8	294.3
Low Watt T8 lamps, 4ft	25.5
LW HPT8 4ft 2 lamp, replace T8	83.5
LW HPT8 4ft 3 lamp, replace T8	108.3
LW HPT8 4ft 4 lamp, replace T8	159.6
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	116.5
T8 2ft 1 lamp	44.7
T8 2ft 2 lamp	108.5
T8 4ft 2 lamp	89.4
T8 4ft 3 lamp	191.5
T8 4ft 4 lamp	204.3
T8 8ft 1 lamp	108.5
T8 8ft 2 lamp	70.2
Occupancy Sensors under 500 W	512.6
Occupancy Sensors over 500 W	1275.6
Gross therms per unit	N/A
Freeridership rate	41.0%
Spillover rate	46.5%
Self Selection and False Response rate	0%
Total Discounting to be applied to Gross values	105.5%
Net Coincident Peak kW per unit	kW/unit-yr
3 Lamp T5HO replacing T12	0.028
HPT8 4ft 2 lamp, T12 to HPT8	0.029
HPT8 4ft 4 lamp, T12 to HPT8	0.060
Low Watt T8 lamps, 4ft	0.005
LW HPT8 4ft 2 lamp, replace T8	0.017
LW HPT8 4ft 3 lamp, replace T8	0.022
LW HPT8 4ft 4 lamp, replace T8	0.032
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	0.023
T8 2ft 1 lamp	0.009
T8 2ft 2 lamp	0.022
T8 4ft 2 lamp	0.018
T8 4ft 3 lamp	0.039
T8 4ft 4 lamp	0.041
T8 8ft 1 lamp	0.022
T8 8ft 2 lamp	0.014
Occupancy Sensors under 500 W	0.087
Occupancy Sensors over 500 W	0.208
Net kWh per unit	kWh/unit-yr
3 Lamp T5HO replacing T12	148.2
HPT8 4ft 2 lamp, T12 to HPT8	150.1
HPT8 4ft 4 lamp, T12 to HPT8	310.5
Low Watt T8 lamps, 4ft	26.9
LW HPT8 4ft 2 lamp, replace T8	88.1
LW HPT8 4ft 3 lamp, replace T8	114.2
LW HPT8 4ft 4 lamp, replace T8	168.4
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	122.9
T8 2ft 1 lamp	47.2

Metric	Result
T8 2ft 2 lamp	114.5
T8 4ft 2 lamp	94.3
T8 4ft 3 lamp	202.1
T8 4ft 4 lamp	215.5
T8 8ft 1 lamp	114.5
T8 8ft 2 lamp	74.1
Occupancy Sensors under 500 W	540.8
Occupancy Sensors over 500 W	1345.8
Net therms per unit	N/A

Lifecycle savings were estimated by applying the following effective useful life (EUL) assumptions[9] to each measure.

Table 26. Effective Useful Life for Lighting Measures

Measure	EUL (years)
Linear Fluorescent	10
Occupancy Sensor	8

Applying the EUL estimates listed above to each measure, the lifecycle gross and net kWh savings are shown in Table 27.

[9] EUL data taken from Duke Workpapers prepared by Franklin Energy Systems.

Table 27. Gross and Net Lifecycle Savings

Metric	Result
Gross Lifecycle kWh per unit	kWh/unit
3 Lamp T5HO replacing T12	1,405
HPT8 4ft 2 lamp, T12 to HPT8	1,423
HPT8 4ft 4 lamp, T12 to HPT8	2,943
Low Watt T8 lamps, 4ft	255
LW HPT8 4ft 2 lamp, replace T8	835
LW HPT8 4ft 3 lamp, replace T8	1,083
LW HPT8 4ft 4 lamp, replace T8	1,596
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	1,165
T8 2ft 1 lamp	447
T8 2ft 2 lamp	1,085
T8 4ft 2 lamp	894
T8 4ft 3 lamp	1,915
T8 4ft 4 lamp	2,043
T8 8ft 1 lamp	1,085
T8 8ft 2 lamp	702
Occupancy Sensors under 500 W	4,101
Occupancy Sensors over 500 W	10,205
Net Lifecycle kWh per unit	kWh/unit
3 Lamp T5HO replacing T12	1,482
HPT8 4ft 2 lamp, T12 to HPT8	1,501
HPT8 4ft 4 lamp, T12 to HPT8	3,105
Low Watt T8 lamps, 4ft	269
LW HPT8 4ft 2 lamp, replace T8	881
LW HPT8 4ft 3 lamp, replace T8	1,142
LW HPT8 4ft 4 lamp, replace T8	1,684
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp	1,229
T8 2ft 1 lamp	472
T8 2ft 2 lamp	1,145
T8 4ft 2 lamp	943
T8 4ft 3 lamp	2,021
T8 4ft 4 lamp	2,155
T8 8ft 1 lamp	1,145
T8 8ft 2 lamp	741
Occupancy Sensors under 500 W	4,327
Occupancy Sensors over 500 W	10,766

Management Interviews

Program Background & Objective

The Smart $aver Prescriptive program is designed to motivate Duke Energy's commercial and industrial customers to install high efficiency equipment that they otherwise might not have chosen, by offering rebates up to 50% of the project cost on selected equipment. The Smart $aver Prescriptive program is offered in conjunction with a Custom program, which will be evaluated in a separate study. The measures offered through the prescriptive program have pre-calculated energy savings, while the measures eligible for the custom program requires project-specific energy savings calculations to be submitted with each application. The combination of both programs allows Duke Energy customers a flexible range of options to meet their individual needs for energy efficient equipment.

The Smart $aver program achieves its objectives by stimulating the market through "trade allies", the distributors and contractors offering high efficiency equipment. This marketing approach through nurturing a network of trade allies has been found successful in past evaluations. The Smart $aver program has been run by one program manager in the past, who has since moved on. In June and September of 2010, Duke Energy brought on two new program managers so that the Smart $aver prescriptive program had one program manager for the Carolinas and another for the Midwest states.

Duke Energy began offering the Smart $aver program in 2009, when state regulators approved Duke Energy's Save-A-Watt initiative. A Duke Energy program manager reports that there have been minimal changes to the program, with the major change being an increase in the number of chiller measures. One factor in a commercial customer's participation in Save-A-Watt programs in general is the cost recovery rider that is charged to participating customers[10]. Duke Energy's large business account managers actively work with these large customers to help them understand their potential for energy and demand savings and associated incentives through Duke Energy's Save-A-Watt program. The Duke Energy program manager also reports that he and the Carolinas regulatory agencies have been making efforts to work more closely, and to communicate in a timely manner around any questions that arise on either side.

Program Operations

Duke Energy implements the Smart $aver program through a third party vendor, the Wisconsin Energy Conservation Corporation (WECC). WECC has a number of responsibilities, including managing a network of trade allies (including vendors, distributors and manufacturers), processing the applications, processing the incentives, and conducting site inspections on a sample of the installations to verify that the equipment received for the incentive was actually installed. WECC reports that their compensation structure has changed as of April 2011 with the

[10] Commercial customers meeting certain criteria (i.e. certain rates in South Carolina, and certain rates and usage levels in North Carolina) may choose to opt out of the Save-A-Watt programs and not pay the rider if they are implementing energy efficiency measures on their own.

start of their new contract with Duke Energy: WECC now has a kWh goal for both the Smart $aver Prescriptive and Custom programs for each state in Duke Energy's service territory. One WECC interviewee remarks, "*This compensation structure provides us with incentives to meet and exceed impact goals and encourages us to go after bigger [higher savings] projects*."

Duke Energy also uses a vendor, CustomerLink, for their Smart $aver call center, and a technical consulting team led by Morgan Marketing Partners for assistance in their annual technical review of the program's measures. Each of these vendors will be discussed below.

Trade Ally Network

The Smart $aver program is primarily marketed through a network of trade allies, including vendors, distributors, and contractors. This network is managed by WECC, and allows Duke Energy to position the Smart $aver option to customers who may be faced with urgent or early replacement equipment replacement needs, and/or who may not have assigned account representatives at Duke Energy.

A WECC interviewee reports that while application and rebate processing are similar for each state in Duke Energy's territory, the specific outreach differs because each region has its own unique customer base and climate. The outreach efforts also leverages campaigns independently initiated by the trade allies. A WECC interviewee reports, "*Right now Trane has a promotion on high efficiency cooling, so we try to piggy back on the manufacturer's promotion so allies and customers are hearing it from all sides*."

WECC reaches out to trade allies through direct contact, interviews, seminars, phone call and email about program requirements and the benefits of promoting efficiency for both the trade ally's business and their customers. These efforts include making presentations at meetings held by manufacturers for their contractors and attending trade conferences.

WECC identifies contractors and distributors that sell equipment/products in each technology market including, for example, lighting, chillers, pumps, drives, and compressed air technologies. Once identified, WECC encourages the trade ally to become a registered Duke trade ally, which includes listing a registered trade ally on the Duke web site. For their outreach efforts, WECC organizes the trade allies by technology offered and according to company size and participation in the program. WECC then initiates a structured calling effort with those targeted trade allies to make sure they are informed about the program and its benefits.

Account Managers

Duke Energy has an account management team with approximately 60-70 representatives assigned to the large commercial customers across the five states. These account managers are in regular communication with the large customers about their needs and actively recruit them to participate in the Smart $aver Prescriptive program, as well as the other energy efficiency and demand response programs under Save-A-Watt. As an account manager explains, "*A lot of it is individual work with the customer, building relationships*." One Duke Energy manager expressed his belief that the large customers who have opted out may be doing so without full consideration of the financial benefits.

The account managers report that they have the pleasure of personally delivering incentive checks to the customers, and that they have used this opportunity to suggest that the incentive check might be used as seed money for the next energy efficiency retrofit. TecMarket Works notes that this is a commendable approach, and helps to instill a mindset that more opportunities for savings are out there. When asked, an account manager reports that Duke Energy has not formally tracked whether these incentive checks have been used as seed money for subsequent retrofits.

Duke Energy may want to conduct a one-time survey of their past Smart $aver participants to see if any have used their Smart $aver incentives as seed money for their next energy efficiency retrofit project or check participation records to determine if customers are re-enrolling for other technologies after they receive their incentive payment. Due to the state of the economy, there may not be very many customers that can afford to do this, at this time; on the other hand, customers may be looking for ways in which they can reduce their utility bills to deal with the current economic pressures. However, Duke Energy can consider constructing case studies specifically about those customers who do use incentives as seed money, or at least obtain testimonials from those customers to share with others.

One account manager reports that they are always on the lookout for case studies about their customers: "*If any of us have a really good story to tell, we are always encouraged to bring that up and suggest that as a potential case study*." He also reports that the account managers may receive requests for case studies around certain technologies, with a recent request coming from a manufacturing segment manager. In addition to the account managers, these Duke Energy segment managers work with the Smart $aver program to help reach customers in their respective segments. These segments include manufacturers, data centers, hospitals, government, commercial real estate, water/waste-water, education (K-12 as well as colleges and universities) and national accounts.

Each account manager has both personal kWh goals and team kWh goals. "*If we all make our goal we'll make the team goal*." Both account managers interviewed mentioned that these were aggressive "stretch" goals that have doubled since the previous year (across all their states), and that they were on track with the current participation rates.

One account manager suggests that to improve program operations, they might be allowed to access the database showing the status of their customers' Prescriptive applications. The account manager explains that sometimes his customers will tell him they checked one box on the application but not another, and he would like to double check both their applications and the files they've submitted, as well as access past participation data for customers so he can provide examples of what projects have occurred in the past. Currently, the account manager says he has to "pester" the program manager for this information. Further inquiry with the Duke Energy program managers revealed that Duke Energy's Business Service Center team provides support to the account managers, and it is they who have direct access to WECC's reporting portal and information on application status.

Small Business Team

Duke Energy has designed a Small Business Strategy Team of four staff members to reach out to their small to medium business customers in all five states. For these unassigned customers, the small business team conducts webinars and holds regional meetings where customers are invited to learn about Duke Energy's nonresidential programs. They leverage other Duke Energy outbound telephone and mail campaigns, and are using social media to reach their audience. While the Smart $aver prescriptive program has been benefitting the large business customers, Duke Energy recognizes that it has not been fully utilized by small and medium businesses. A Duke program manager reports that they are "*heading in a new direction, there's a focus on small and medium business customers now…so that they have a similar type of experience that large customers get, regarding energy efficiency*". The small and medium business market is considered to include all business customers who have less than $250,000 in annual revenue. The team lead reports that they target businesses according to a number of characteristics. These may include billing data, their business revenue, and other information from Duke Energy's Market Analytics group and the Customer Data group. The team will call the business, try to identify who the decision maker is, and talk to the decision-maker about the Smart $aver's prescriptive incentives. This outreach occurs year round, and the level of effort in each state depends on the availability of Smart $aver funds.

The Small Business Strategy Team sets internal objectives for their outreach efforts, in terms of both participation "lift" and kWh impacts. The team lead reports that they currently have a 5% lift above prior participation rates. The team also ran a successful pilot where they provided the customer with leads to trade allies who in the past have been frequent participants.

Website

The Duke Energy website serves as the primary means of disseminating updated information about the program to both the customers and the trade allies. The website includes lists of qualifying measures, their associated incentives, and updated applications that need to be filled out.

In addition to the current list of measures, the website includes video demos on how to fill out the application and an example of a completed application. Prominently featured on every page is a link to contact information should the applicant have either technical or application-related questions.

A couple of Duke Energy staff acknowledged that information about the Smart $aver program was hard to navigate to; no others had any complaints or suggestions for improving the content of the web site.

Call Center

Duke Energy contracts with a third party call center, CustomerLink, to answer questions from trade allies and customers. CustomerLink reports that they will lead the customer to the website and online application and show them what kinds of incentives they would receive for the measures they are considering. CustomerLink tracks and reports on these calls in two different ways. They track calls at the phone switch level, reporting how many calls were offered for the program, how many seconds it took to answer the call, how long the average call lasted, and other service level statistics. They also track and report on the content of the calls including, for example, whether the caller was a customer or new trade ally, whether they were calling to obtain an application, to check an application status, or if they had a technical versus an application-related question. This information is posted to Duke Energy's data system on a daily basis. According to one CustomerLink project manager, approximately 60% of the calls are from Duke Energy customers and 40% are from vendors. For the vendors, CustomerLink maintains a trade ally participation list that is listed on the Duke Energy Smart $aver website. When vendors call, CustomerLink uses that opportunity to promote the participation list as a benefit of becoming a registered trade ally with Duke Energy.

Applications and Rebates

Completed applications can be mailed, faxed, or emailed to Duke Energy. Duke Energy also provides an application that can be filled out online, and then printed out for submission. Duke Energy has also been considering the feasibility of accepting applications directly from an online form. Many applicants have requested this feature in the past. One program manager reports that some of the hurdles to offering online submission include IT cost constraints and data security concerns. Although Duke Energy has begun accepting emailed applications, the issue of customer data security has already arisen with email. To resolve this, Duke Energy has established a secure email connection with WECC so that emailed applications can be transmitted securely to WECC for processing. Duke Energy reports that they are continuing to work on the hurdles and that "*an online application is completely possible*" in the future.

WECC responsibilities also include assisting trade allies with filling out the application, identifying incomplete or missing information, and in general, "*to overcome any barriers to participation by the trade allies*." WECC makes a special effort to assist trade allies who have submitted incomplete applications, noting that these efforts are most valuable because often the incomplete applications are only lacking a specification sheet or an invoice. A WECC program manager reports that "*Historically, the trade ally service representatives would follow up on the incomplete applications in an effort to convert them into completed applications, but earlier this spring WECC initiated a new process that begins with WECC fulfillment staff making the initial follow up call, unless the WECC Trade Ally Representative opts to personally follow up*."

WECC receives the applications and reviews each one to make sure all program requirements are met. Duke Energy requires WECC to enter the application in their database within 3 days of receipt, with a data-entry accuracy level of 100%, along with a classification of whether the application is complete, incomplete, or rejected. To achieve the 100% accuracy service level, WECC reports they have a dedicated staff member who double-checks the paper applications with a printout of the day's entries. For complete applications, WECC will send out a rebate check within 8 business days. WECC also sends out letters for rejected applications.

A WECC program manager reports that they upload paid applications to the Duke hub bi-weekly. WECC then e-mails Duke Energy program managers, Duke Energy account managers, and WECC trade ally service representatives a listing of all applications that have been completed, marked incomplete or rejected from the previous day. "*This ensures that not only is everyone aware of the measures processed but also that the customer and the trade allies receive the help they need to complete their current application and to acquire a deeper knowledge for future opportunities*." Duke Energy calculates program impacts based on participation entered by WECC and the deemed savings developed by Duke Energy for those measures.

In the past evaluation of the Smart $aver program, TecMarket Works found that WECC's fulfillment service levels at 100% accuracy constituted best in class. For this evaluation period, however, the Duke Energy program managers have reported that WECC's fulfillment team had suffered a recent drop in performance for several months, from June through September. The errors ranged from processing an application twice, to incorrectly denying the eligibility of some measures. According to a Duke Energy program manager, WECC had attributed the drop in performance to staffing changes, but still were unable to resolve the issues and return to their former service levels.

Site Verifications

WECC conducts field verifications on at least 5% of the applications from each state to verify that the equipment listed on the application matches what is installed at the customer's premise. The sample is roughly stratified by technology, incentive amount, region, and tries to cover a diverse group of trade allies, including customers who self-install.

A Duke Energy program manager reports that it is rare for verifications to fail. In the few cases that do fail verifications, customers have been responsive and corrected their application for the correct measures. In some cases, the customers are appreciative of the verification results because they had been overcharged by the vendor for uninstalled measures. The program manager says that when warranted, Duke Energy may ask WECC to conduct a pre-inspection, but those cases are rare.

Communication and Coordination

Duke Energy reports that they hold two different biweekly meetings with their vendors WECC and Customer Link. One set of meetings addresses trade ally outreach. At these meetings, all team members have an opportunity to discuss changes or other hot topics. This is also an opportunity that WECC takes to bring issues to Duke Energy, keeping them apprised of what their trade ally representatives hear from the trade allies. At the other set of meetings, Duke Energy discusses fulfillment issues with WECC management, and WECC provides Duke Energy with weekly score cards that provide a report of performance versus goals. In some meetings, Customer Link's call center manager identifies information that they need from the fulfillment team, and the Duke Energy Program manager acknowledges the usefulness of the meetings in establishing a channel for regular communications. In addition to these biweekly meetings, formal quarterly review meetings are also conducted where all program metrics and performance aspects are discussed.

A WECC staff member reports that many members of the WECC implementation team are in contact with the Smart $aver program managers on a daily basis, producing reports that Duke Energy requests, responding to questions and ensuring that the program is operating smoothly. As the WECC interviewee reports, his role is "*making sure that the client gets what they want*".

Program Achievements

At the time of these interviews, Duke Energy reports that the prescriptive Smart $aver program is ahead of their goals to date, and was ahead of their goals in 2011 as well. The Duke Energy program manager reports that the Smart $aver program staff have continued to improve their coordination with Duke Energy's large customer account managers, made possible by having a dedicated program manager for the Smart $aver prescriptive program in the Carolinas and another for the Midwest states.

A Duke Energy program manager reports that they have improved their methods of targeting small, medium, and unassigned customers, and have been developing outreach that presents energy savings "*in a humorous way, not with engineering terms*." As part of these efforts, Duke Energy developed videos about energy savings opportunities that are now on Duke Energy's website, including one video on ninja-proof occupancy sensors that has recently won an advertising award[11].

Duke Energy has continued to be a contributor to their peers in energy efficiency, by sharing their lessons learned and their expertise. They have participated in DOE projects and in the nation-wide Consortium for Energy Efficiency, an organization of energy efficiency program administrators from utilities and federal agencies. The program manager also reports that he is in the process of creating a resource group that will include public and municipal utilities, energy cooperatives, and other energy efficiency program administrators that may be interested in sharing resources and technical information on measures.

Program Planning

Annual Review

Duke Energy conducts an annual review of the Smart $aver Prescriptive measures. At this time, updates to baselines are made, obsolete measures are removed, and new measures are proposed for the program. Duke Energy engages a consulting company, Morgan Marketing Partners (MMP) along with their subcontractor Franklin Energy, to assist with the technical review. This

[11] This video can be viewed at: http://www.duke-energy.com/ohio-business/smart-saver/customer/lighting-incentives.asp

technical review team conducts engineering analysis and building simulation modeling that is used in determining which measures would be cost effective, a role they have played since the days before the Save-A-Watt initiative was developed. They also provide inputs needed for the DSMore analysis and provides suggested guidelines/language to use for the measure rebate applications.

MMP reports that the team's general process involves reviewing measures that are being used by other energy efficiency programs in the country, identified through market potential studies. MMP selects those technologies for which there is a good understanding of their applications and available data on their savings. For weather sensitive measures, energy savings are calculated across 11 different building types and by weather zone using the DOE2 model. For non-weather sensitive measures, engineering analysis is completed using the best available information. MMP conducts multiple runs of their model for each building type to obtain an energy savings estimate that can be generalized across the mix of buildings that are expected to participate. MMP reports that the technical review team prefers to be conservative with their estimates: "*If we have good documentation that we believe has better numbers, we recommend that instead*." When asked why MMP recommends more conservative estimates, the interviewee explained that there are enough variables in the estimates that "*the conservative number is defensible in any filings*". This helps to ensure that Duke Energy would not overstate goals, so that Duke Energy "*is not at risk for not accomplishing goals*". MMP reports that they are often asked to include "emerging technologies" in their technology updates, and that MMP will do so when there is a body of data for that technology's performance across a number of similar applications.

Both the two new Duke Energy program managers and MMP acknowledge that the recent annual review was not easy, with tight timelines leading to a number of errors in the report, which were then corrected over a number of months with much discussion before the annual review was shared with state regulators. MMP reports that the technical review team has already identified some "lessons learned" to make the process easier in the future, including more regular communications with the Duke Energy program managers to better understand and identify upcoming needs earlier. The review process also allowed the technical review team to better understand the new program managers' expectations for the report content and the full scope of work that they would like the technical review team to take on.

Duke Energy occasionally brings in engineering consultants to supplement existing efforts. A Duke Energy manager reports that these may include targeted analyses to allow Duke Energy to obtain a different and more detailed perspective on possible measures for certain technology areas such as lighting and HVAC. The Duke Energy manager also believes this will help make the programs more effective by allowing the Smart $aver program to consider different tiers of incentives based upon the different efficiency levels of a particular technology or upon the different operating parameters that are reported by the customers. In the previous evaluation of Smart $aver, TecMarket Works made a recommendation for a similar course of action, and supports this current exploration of different incentive levels for different levels of efficiency.

In addition to technical reviews, Duke Energy also considers measures that are submitted through the Smart $aver Custom program: if measures are being submitted through the Custom program with increasing frequency, Duke Energy will consider the cost effectiveness of including it in the Prescriptive program.

In the Carolinas, the North Carolina regulatory agency must approve of the measures that can be included in the program's offerings. In April of 2011, Duke Energy shared with the Public Staff their proposal to increase Duke's flexibility to make changes to the program's offerings without going through regulatory approval. This will enable the Smart $aver program to respond more flexibly to market needs and changes in efficiency standards. The formal request for this additional flexibility was made in the first quarter of 2012, and at the time of these interviews in April of 2012, this request was still being reviewed by stakeholders and interveners.

Outreach strategy

Duke Energy has contracted with WECC to design the outreach plan for the trade ally network.

A Duke Energy manager reports that the Smart $aver program managers at Duke Energy have shared with WECC several approaches that they believe would help them guide Smart $aver marketing and outreach efforts:

- Identify what the high-participation trade allies do differently from low-participation trade allies.
- Tailor individual outreach plans for the needs of individual market segments in each state or region.
- Target upstream market actors such as distributors and manufacturers and those trade allies that are most active in the market place.

TecMarket Works notes that the previous Smart $aver evaluation study report contained a recommendation to "*specifically focus on barriers for a particular key market segment*." We agree that Duke Energy's approach to focus on individual market segments in each region is an improvement upon the original recommendation.

Both Duke Energy Smart $aver program managers report that they had asked WECC management to define their outreach approach, repeatedly, but they did not receive a description of a viable strategy. When the evaluation team followed up with WECC to find out what outreach approach was used, a WECC manager reported that their proposed approach was to first classify trade allies into groups of a) those who used the program regularly, b) those who use the program occasionally, and c) those who use the program infrequently. Then, the outreach efforts would be directed to those who most need additional support, namely the trade allies who use the program occasionally or infrequently. WECC reports they completed the ranking at the beginning of 2012, and while they have increased outreach efforts to the occasional and infrequent participants, they have continued to reach out to the frequent participants as well. WECC also reports that they do not target trade allies by the different technologies, but may do so in the future. Currently, at the time of the interview in August 2012, a WECC staff member reports that they are targeting trade allies "*according to their contribution to the program*" resulting in more outreach to lighting trade allies, then HVAC, then motors and then food services. WECC has not formally evaluated this approach, but reports that they plan to conduct an evaluation at the end of the third quarter.

While this seems to be a reasonable approach, it is unclear why WECC did not successfully communicate to Duke Energy that WECC was using an approach different from what Duke Energy program managers have suggested. Nor is it clear why, if this approach was in use since the beginning of 2012, why Duke Energy had not learned of this approach at the time of the evaluation interviews in mid-2012. There is clearly a barrier that has been impeding communication and perhaps collaboration. While it is not within the scope of this evaluation to address specific communication issues, the evaluation team identifies this as a problem in the program's implementation. Furthermore, the evaluation team points out that it is a fundamental responsibility of the implementer of any program to clearly communicate their methods and approaches to all stakeholders. In this case, this responsibility lies with WECC, as the implementer of the trade ally network, to have successfully communicated their outreach approach to Duke Energy, their primary stakeholder.

Moving forward, TecMarket Works offers several thoughts to consider. First, there is an opportunity that may be lost if any outreach efforts are not also used to gather data on the trade allies. This data can be used to support Duke Energy's approach of identifying key drivers of those trade allies who are frequent participants. Second, targeting trade allies on the basis of their contribution to the program may yield the unintentional result of getting "more of the same", that is, a continued dominance of lighting over other measures. If one were to use WECC's reasoning that less-frequent participants may derive more benefit from outreach efforts, it should follow that WECC should also be targeting trade allies in those technology areas that are less frequently utilized by customers. This is not necessarily what TecMarket Works recommends but we want to point out that in this case as well, there is an opportunity to gather data on the drivers for the trade allies in different technology markets. No matter what the approach, if an outreach effort were to also be used to gather information about the trade allies' characteristics in a structured way, Duke Energy would gain useful information for future outreach efforts.

RECOMMENDATION: If Duke Energy is faced with a difference in opinion over more than one outreach approach, Duke Energy should develop analysis plans for testing the comparative effectiveness of the different approaches. This may require that each approach be tested in a different region, or that Duke Energy defines, a priori, what should be the baseline performance against which a new outreach approach should be tested. Developing an analysis plan prior to gathering research will help define what kinds of data should be gathered in order to make a sound conclusion.

RECOMMENDATION: Duke Energy should consider formally structuring a market intelligence effort that leverages existing outreach efforts to the trade allies. The benefit of a structured information gathering effort will allow Duke Energy to have quantitative data on past trade ally behavior that can be used to prioritize future trade ally outreach strategies. Special attention will need to be focused on keeping such a system efficient and streamlined so that it does not overly impact the program's cost effectiveness.

We acknowledge that much of this intelligence already resides within the Smart $aver program managers, account managers, and trade ally representatives, gathered from their own experiences and expertise as well as shared anecdotes and any previous quantitative market characterizations.

A "structured market intelligence effort" could mean anything from asking a market intelligence expert to design an information gathering plan and to implement a knowledge management system for sharing that information, to simply asking trade ally representatives to ask all trade allies they talk to within a certain period (say, a week) three or four questions about key issues such as their most useful tactic for selling energy efficiency, their key drivers for participating, etc., and summarizing that information[12]. Duke Energy already regularly conducts focus groups with trade allies (discussed below), separate from an outreach effort.

Program Improvements Under Consideration

Existing program improvement efforts

Early replacement incentives: In order to help identify ways in which the Smart $aver program might be improved, Duke Energy program staff periodically conduct focus groups with trade allies. Focus groups were conducted with trade allies in the HVAC and lighting markets in the winter of 2011. Duke Energy was able to identify very different needs from each of these groups. The lighting trade allies "*really own the application process*" and the application process seems to be "*almost automatic*", reports a Duke Energy program manager. The lighting incentive offered by the Smart $aver program also seemed sufficient to drive early replacement decisions. However, the HVAC trade allies shared that the Smart $aver incentive was too small to drive early replacements of existing HVAC equipment. Duke Energy is using this feedback to consider whether potential savings from early replacement of HVAC equipment might justify higher incentives.

Incentives for trade allies

The issue of incentives to the trade allies is an issue that periodically arises, reports a Duke Energy program manager. While there has been much discussion of this option, overall the Smart $aver program is meeting its objectives. However, there seem to be differences in whether incentives may be needed, depending on the technology market. Based upon findings from focus groups, Duke Energy has learned from the lighting trade allies that they would just pass any trade ally incentive on to the customer; that the additional trade ally incentive would not change the lighting trade allies' behavior or recommendations. The program manager reports that feedback from the HVAC trade allies was different: these trade allies report that they would be more interested in the Smart $aver program if Duke Energy paid them a fee. TecMarket Works suggests that this reinforces other feedback Duke Energy has received, that the existing HVAC incentives might be too low for early replacements. It is also not always clear whether a trade ally incentive would truly be more effective than an increased customer incentive for targeted markets. While a higher customer incentive may reduce freeridership because it allows more customers to participate who could not have participated with the original incentive, a trade ally incentive may increase freeridership by increasing trade ally's efforts to "push" the program and search harder to find those who had already decided to take action, without affecting the underlying market demand or "pull".

[12] This information can also be obtained through a standard telephone survey, but implementing an in-house market intelligence effort has different pros and cons.

If Duke Energy changes the program incentives during a down economy in order to move the market, this change should be accompanied by a clear explanation of the underlying economic reasons, so that Duke Energy may manage expectations about whether the incentive is permanent. Managing these expectations may help prevent customers from delaying projects until the next round of expected bonus incentives. In these conditions it will be important to set any such system up so that there are appropriate sunset conditions that act to trigger such applications of variable incentive structures. Likewise, attention will need to be place on keeping the programs cost effective.

Program Needs

One Duke Energy manager reports that there is a need for tools that can help customers evaluate different energy efficiency project alternatives and submit applications online. Duke Energy is currently putting together tools that will help evaluate different project alternatives. These spreadsheets can take a list of measures, allow the input of a customer's marginal rate for energy costs, and generate savings impacts in terms of the lifecycle costs to the customer. "*It's complicated stuff, but it's those spreadsheets that will become line tools*." Furthermore, this manager believes that such a tool would be particularly important because customers and even some account managers have difficulty understanding lifecycle costs: "*they are guilty of focusing on "here's the incentive, here's the capital costs" but they don't bring into account lifecycle costs*."

If Duke Energy has not yet done so, Duke Energy may wish to consider whether it would be useful to allow for two baselines for calculating the lifecycle costs in their spreadsheets. The vendor could identify the instances in which the baseline for comparison will be the current standard (or code) for the measure, and instances in which the existing equipment will be used as the baseline. Calculations using the current standard for energy efficiency may be easier to automate. However, customers who are uncertain about the full benefits of energy efficiency equipment may develop a better appreciation when considering the lifecycle costs that are calculated from the baseline of their existing equipment.

Other recommendations

In the previous Smart $aver Prescriptive evaluation report, the evaluation team made a number of recommendations. Reported below are ones that the evaluation team feels remain relevant for the current program.

#4) Duke Energy should explore the feasibility of developing a coordinated marketing campaign for one market segment, implementing it as a pilot, and evaluating its effectiveness. A small pilot would allow Duke Energy to assess whether targeting marketing to one segment would be a more effective approach for future program efforts.

#8) Explore whether it is feasible to create marketing and outreach campaigns that focus on lifecycle costs. This may allow customers to look beyond consideration about a measure's capital cost and its incentive, and understand the energy savings that would be delivered over the measure's effective useful life.

#11) (If not already being done through the Small Business Strategy Team that has been formed) Duke Energy should consider the feasibility of designing, implementing, and evaluating a pilot program to help <500 kW customers to prioritize energy efficient projects. This may allow more Duke Energy customers to achieve greater savings by providing them with a more complete picture of their energy efficiency options.

#12) Duke Energy should consider the potential benefits of increased market segment penetration if marketing were structured to specifically focus on barriers for a particular key market segment. Duke Energy may want to do this by identifying one high priority market and conducting a characterization study about that market. Duke Energy might then identify that market's specific barriers to participation and develop a logic model that specifies a strategic approach toward overcoming those barriers. Duke Energy can then evaluate the effectiveness of the approach at the end of the program cycle. This would allow Duke Energy to see if they would be able to successfully drive greater activity in a particular segment if there arose a need for doing so in the future.

Program challenges

The biggest program challenges faced by the Smart $aver Prescriptive program are ones being faced by most other energy efficiency programs across the country: Poor economic climate and a need for new measures to replace ones that have transitioned to code or have been made standard.

Duke Energy periodically reviews the incentives being offered to see if they are enough to drive customer participation. The Duke Energy program manager reports that they have gotten consistent feedback from customers that the incentives for HVAC measures are not high enough to cover the incremental cost between the high efficiency qualifying measure and the lower efficiency measure. One Duke Energy manager explains the balance they are trying to achieve with incentives:

"*This is not our money, we give it out but it's the ratepayers who fund it. It is really incumbent upon us to be good stewards of our customers' money. This means we want to try to keep costs as low as possible, we want to make incentive payments just as much as needed to move the market. We're trying to spend the money as wisely as possible*."

Another challenge that the Smart $aver program faces is the lack of flexibility to change the measure mix to meet changing standards and market conditions without first undergoing regulatory review and approval. A Duke Energy program manager reports that this has prevented the Smart $aver program in the Carolinas from removing NEEMA premium motors and T12 fixtures even though both these technologies have become the standard efficiency level. "*Until we have the ability to do that, the program won't be as successful as it could be*," says the program manager.

Trade Ally Interviews

The ten Smart $aver trade allies from the Carolinas system were interviewed in April 2012. All of the interviews were conducted with a sales manager within the firm or an equivalent representative. Each of the respondents indicated that they are the individual within their company who has the most experience and is the most acquainted with the program. The interview protocol used during these interviews can be found in Appendix D: Trade Ally Interview Instrument.

The interviews were written to cover various aspects of the program, such as program operations, aspects of trade allies' involvement, incentive levels applied, covered technologies, and program effects from the trade allies' perspectives. The results of the process interviews are reported by the response categories presented below.

Program Materials

We asked the trade allies if they had enough program materials such as brochures, applications, and program documentation to effectively sell the program to their customers. All ten trade allies indicated that they had enough program forms and applications for their use.

One trade ally specifically mentioned that she would like Duke Energy to target advertising at maintenance, budget and controls personnel at commercial customers that are potential Smart $aver participants.

Problems That Have Come Up

All trade allies interviewed said that their experiences with the program were currently free of any major problems and that they were pleased with the program. One trade ally did report that there initially had been some "*kinks*" in the application process but they had been worked out through communication with Duke Energy.

When we asked about customer complaints from the trade allies' perspective; in response to our question, trade allies reported that there have been very few customer complaints. In fact, trade allies could recall no specific customer complaints.

Wait Time for Incentive

The length of time that passes from when the application forms are submitted, to the arrival of the rebate check are described as very reasonable by all ten trade allies. The stated average length of time to wait for a rebate check varied very little from 2 to 3 weeks.

What About Smart $aver Works Well

Each interviewed trade ally was asked what they think works well about the program. This question was then followed with a question about what changes should be made to the progam. The trade allies responded to the question of what works well about the program with a variety of responses. Seven out of ten trade allies mentioned ease of use and ease of forms as an aspect of Smart $aver that works well. Further, one trade ally noted that the ease of forms allowed them to offer to fill out the forms for their customers and provide this service at no additional charge to their customers. Complex forms or rebate process would require them to recover some of that cost via their pricing arrangements.

Four trade allies also mentioned that they are pleased with the current online/electronic versions of the forms.

Two trade allies mentioned the quick turnaround of the application process. Specific responses include:

- "It's straightforward."
- "Duke Energy does a great job of turning around the applications and rebate checks."
- "The whole program has been very positive and very well received by our clients. It gets lighting projects onto the front burner."

What Should Change About Smart $aver

The responses to the question of what should be changed varied among the trade allies, with some vendors providing multiple responses.

One of the common responses received is that trade allies would like to see a more streamlined and simplified rebate system that is based solely on watts reduced rather than differing incentives for specific technology retrofits. Trade allies feel that a rebate system based on the number of watts reduced would allow them to more easily estimate the customers' incentive amount and would allow for increased energy savings through de-lamping strategies.

Three trade allies mentioned that they would prefer a watts-reduced based system and one of these trade allies also would like to see pre-approval of incentive amounts in order to guarantee those incentives to customers.

Three other suggestions from trade allies related to the application and rebate administration process:

- One trade ally mentioned that he recently serviced one account with similar concurrent projects at multiple addresses. He sent in all the applications from the single account together and he received a separate check for each address. He would prefer to receive one check per account with an itemized description for multiple addresses.
- One trade ally asked for the application to be offered as an executable PDF file in addition to the current electronic forms in Word and PDF.
- One trade ally requested that paperwork mistakes be reported back to him in less than a week, and that customers not be copied on emails regarding application typos or small mistakes.

Communications with Duke Energy Staff

All of the trade allies interviewed said that communication with Duke Energy staff was fine, though limited.

Customer Awareness of Smart $aver

Trade allies were asked how they made customers aware of the Smart $aver program and then to describe the customers' initial reaction to the program.

All of the trade allies said they tell their customers about the program during normal sales communications and present it as a way to achieve a faster return on investment for the incented high efficiency technology. All trade allies said that customers respond positively or very positively to the idea of the incentive and the savings, though some are skeptical at first.

Customer awareness of the Smart $aver incentive varied. Two trade allies reported that the majority of their Smart $aver lighting customer leads were received directly from Duke Energy's vendor portal. One trade ally estimated that 60 percent of customers were already aware of the Smart $aver program before contacting the trade ally. All three of these trade allies also felt that awareness of the program had increased in the last year and that Duke Energy general advertising of the program had led to this increase.

One trade ally stated: "People are asking for high efficiency more and are aware of the incentives more."

Seven trade allies were unsure of the amount of customers who were already aware of the Smart $aver program before contacting the trade ally.

Market Transformation

Trade allies were asked what the incentive level would have to be for more than 80 percent of the market to elect to upgrade to the energy efficient model. Four trade allies felt that the current level of incentives would be sufficient to reach this goal for equipment replacement. One trade ally also felt that higher incentives would be more likely to encourage early replacement of existing standard efficiency lighting than make an appreciable difference in a customer's current choice between standard and high efficiency measures.

Why Trade Allies Participate

Why trade allies participate varies from the basics (increased sales/profit) to the altruistic (doing the right thing for their customers).

- "The return on investment is in line so that this has become the low-hanging fruit."
- "It's great. It's a win-win."
- "I'm passionate about saving energy. If it's not energy efficient, we don't do it."

Program Technologies and Incentives

We also talked to the trade allies about the technologies offered in the program, and the incentives that are provided. The technologies currently covered are supported by everyone we spoke with.

Technologies and Equipment Covered

All ten trade allies interviewed thought that no technologies currently covered by the program should be removed.

Incentive Levels

Nine trade allies interviewed indicated that they were satisfied with the current incentive levels. One trade ally asked for higher incentives but declined to give an amount.

Other Technologies That Should Be Included

Trade allies were asked to mention technologies that they thought should be considered for the program. The only technology mentioned was LED lighting with eight trade allies indicating that they would like to see rebates for LED measures.

How the Program Changes Business

Overall, the trade allies report that the program has changed their business by increasing their sales, increasing the size of their customer base, and providing high levels of customer satisfaction. The comments received from the interviewed contractors include:

- "It has worked well. We have sold more retrofits in last two months than last two years."
- "Business has increased so much, both among existing and new customers."
- "Callbacks have increased. Partial retrofits have become full plan conversions."

Suggestions for Streamlining Participation Process

The only suggestion offered by the trade allies was to streamline the process came from trade allies who suggested that the program utilize a watts reduced-based incentive structure. One trade ally also mentioned a need for more training and interaction between Duke Energy and the trade allies.

Program's Influence on Business Practices

We asked the trade allies about the benefits of their participation in the program to them and to their customers, and how the program has altered their business by changing what equipment they offer.

All trade allies interviewed see the program as a way to encourage customers to upgrade their lighting equipment to a higher efficiency level. In addition, these trade allies noted that the current rebates do provide an incentive for their customers to buy the more efficient product.

Several trade allies have made significant changes to their marketing or stocking strategies since beginning their participation in the Smart $aver program.

- Two trade allies report that 90% of their stock is now high efficiency.

- One trade ally reports that 80% of their stock is high efficiency compared to 30% five years ago.

- One trade ally reports that 100% of stock is high efficiency compared to just 5% two years ago.

We asked the trade allies if their business would change if the Smart $aver® program were no longer offered. We posed the question: *"If the program were to be discontinued, what would happen to the volume of sales of the high efficiency models?"* All ten trade allies indicated that sales would decline despite a large remaining market for lighting retrofits. This response indicates that these allies think that a substantial part of their company's total sales are program induced, suggesting low freeridership levels. Specific responses include:

- "We would have a 75% drop in high efficiency retrofit sales without the program.

- "Ninety-percent of these programs would not happen."

- "Only 25% of county buildings currently have high efficiency fixtures."

- "We estimate that 55% of our customer base has not switched out."

None of the trade allies said they would change their high efficiency model pricing structure if the program were no longer available, suggesting that the program has not had an impact on product pricing. This also indicates that the customers are getting the full advantage of the rebates because the allies are not up-pricing.

Taken together, these influences on business practices suggest that the Smart $aver program is a major driver of current high efficiency lighting installations as well as a strong influencer of the overall awareness and availability of high efficiency lighting measures.

Participant Surveys

This survey focused on customers whose organizations, according to program tracking records, received a rebate from Duke Energy for the purchase of new Linear Fluorescent Lighting or light-controlling Occupancy Sensors.

Non-Residential Smart $aver Equipment Installations

The customer data provided by Duke Energy specified the equipment installation which resulted in a Smart $aver rebate for respondents, which is characterized in Table 28. Half of the respondents who received rebates for Fluorescent Lighting installed T8 4-foot 2 lamps (50.0% or 35 out of 70), and most of the rest installed T8 4-foot 4 lamps (27.1% or 19 out of 70). Only 5.7% (4 out of 70) of Fluorescent Lighting rebate recipients installed T5 lamps, the remainder (94.3% or 66 out of 70) installed some type of T8 lamp. Among Occupancy Sensor installations, 78.6% (11 out of 14) received rebates for systems under 500 watts, while the others (21.4% or 3 out of 14) were for systems over 500 watts.

Table 28. Equipment installation which received a Smart $aver rebate

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
T8 4ft 1 lamp	1.4%	NA	1.2%
T8 4ft 2 lamp	50.0%	NA	41.7%
T8 4ft 3 lamp	5.7%	NA	4.8%
T8 4ft 4 lamp	27.1%	NA	22.6%
T8 2ft or 8ft 2 lamp	4.3%	NA	3.6%
T8 lamp (unspecified)	5.7%	NA	4.8%
T5 4 lamp	5.7%	NA	4.8%
Occupancy sensor under 500W	NA	78.6%	13.1%
Occupancy sensor over 500W	NA	21.4%	3.6%

Table 29 indicates that the average amount of rebates received for Fluorescent Lighting ($622) and Occupancy Sensor installations ($603) were comparable. However, the range of rebate amounts was greater for Fluorescent Lighting installations (minimum $4, maximum $5,625) than Occupancy Sensors (minimum $40, maximum $1,800). Also, the median rebate was higher for Occupancy Sensor installations ($490) than for Fluorescent Lighting ($279).

Table 29. Amount of Smart $aver incentive rebate

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
$60 or less	25.7%	21.4%	25.0%
$61 to $300	25.7%	21.4%	25.0%

$301 to $999	27.1%	28.6%	27.4%
$1000 or more	21.4%	28.6%	22.6%
Minimum rebate	$4.00	$40.00	$4.00
Maximum rebate	$5625.00	$1800.00	$5625.00
Median rebate	$279.00	$490.00	$305.50
Average rebate	$622.42	$603.26	$619.23

The total hours of operation of the rebated Smart $aver equipment is shown in Table 30 (scaled as average hours per day over an entire year). Half (50.0% or 7 out of 14) of Occupancy Sensor installations are operating the equivalent of more than 8 hours per day all year long, compared to only 25.7% (18 out of 70) of Fluorescent Lighting installations operating that many hours per year. However, the hours of operation were not known for 35.7% (30 out of 84) of installations surveyed.

Table 30. Operation hours of Smart $aver installation

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Average of 16+ hours/day over entire year	4.3%	21.4%	7.1%
Average of 10-16 hours/day over entire year	10.0%	7.1%	9.5%
Average of 8-10 hours/day over entire year	11.4%	21.4%	13.1%
Average of 6-8 hours/day over entire year	20.0%	21.4%	20.2%
Average of less than 6 hours/day over entire year	15.7%	7.1%	14.3%
Not specified	38.6%	21.4%	35.7%

Participation in the Non-Residential Smart $aver Program

As seen in Table 31, most respondents in this survey represented organizations in North Carolina (96.4% or 81 out of 84), with the remainder being in South Carolina (3.6% or 3 out of 84). There was a significant difference in distribution of incentives received across states, with 14.3% (2 out of 14) of Occupancy Sensor rebate recipients being in South Carolina, compared to only 1.4% (1 out of 70) of Fluorescent Lighting rebate recipients.

Table 31. Distribution of incentives across states

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84

North Carolina	98.6%	85.7%	96.4%
South Carolina	1.4%	14.3%	3.6%

Table 32 shows that all respondents were aware that their companies participated in the Smart $aver program (aided awareness 100% or 84 out of 84), and all respondent (100% or 84 out of 84) confirmed that the items they received rebates that matched the information on the list supplied by Duke Energy, which was used to recruit respondents for this survey.

Table 32. Awareness of the non-residential Smart $aver program

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Unaided awareness	97.1%	100%	97.6%
Aided awareness	100%	100%	100%
Confirmed rebated item matched recruiting list	100%	100%	100%

The most commonly mentioned sources of awareness of the Non-Residential Smart $aver program are trade allies (32.1% or 27 out of 84), the information provided with the program (15.5% or 13 out of 84), contact with Duke Energy employees (14.3% or 12 out of 84), and the Internet (9.5% or 8 out of 84). Few respondents (7.1% or 6 out of 84) did not know how their company became aware of Smart $aver.

Table 33. Sources of awareness of non-residential Smart $aver program

Percentage mentioning factor	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Recommendation of trade allies	34.3%	21.4%	32.1%
The information provided by the Program	14.3%	21.4%	15.5%
From a Duke Energy employee / account manager / marketing rep	12.9%	21.4%	14.3%
Duke Energy website / email / web research	10.0%	7.1%	9.5%
Recommendation of third party consultant	5.7%	7.1%	6.0%
Past experience with this program	4.3%	7.1%	4.8%
Recommendation of a friend or associate	4.3%	0.0%	3.6%
Advertisement in newspaper	2.9%	0.0%	2.4%
From another employee or branch of my company	0.0%	14.3%	2.4%
Energy audit (not from Duke Energy or not specified)	1.4%	7.1%	2.4%

We are a third party company that processes rebates for other companies	2.9%	0.0%	2.4%
The program technical assistance	1.4%	0.0%	1.2%
Radio advertisement	1.4%	0.0%	1.2%
Landlord / property manager	1.4%	0.0%	1.2%
State Energy Office	1.4%	0.0%	1.2%
Because of past experience with or recommendation from "Smart Energy Now" (or "Envision Charlotte")	1.4%	0.0%	1.2%
Because of past experience with other Duke Energy programs	1.4%	0.0%	1.2%
Wanted to reduce energy costs	1.4%	0.0%	1.2%
Because of past experience with or recommendation from "Non-Residential Energy Assessment"	0.0%	0.0%	0.0%
Recommendation from other utility program	0.0%	0.0%	0.0%
Don't know	5.7%	14.3%	7.1%

Multiple responses were accepted for this question, so columns total to more than 100%.

As seen in Table 34, the most important sources of awareness of the program were trade allies (29.8% or 25 out of 84) and the information provided with the Smart $aver program (15.5% or 13 out of 84). There were some significant differences by the type of rebate received: respondents whose companies received Occupancy Sensor rebates were more likely to say their most important source of awareness of the Smart $aver program came from someone else at their company (14.3% or 2 out of 14, compared to 0.0% or 0 out of 70 who received Fluorescent Lighting rebates), or from Duke Energy employees (21.4% or 3 out of 14, versus 12.9% or 9 out of 70 for Fluorescent Lighting rebates). Trade allies were more likely to be the most important source of awareness for Fluorescent Lighting rebate recipients (32.9% or 23 out of 70, compared to 14.3% or 2 out of 14 Occupancy Sensor rebate recipients).

Table 34. Most important sources of awareness of non-residential Smart $aver program

Percentage mentioning factor as ranked #1 in importance (including "tied for #1")	**Linear Fluorescent Lighting N=70**	**Occupancy Sensors N=14**	**Total N=84**
Recommendation of trade allies	32.9%	14.3%	29.8%
The information provided by the Program	14.3%	21.4%	15.5%
From a Duke Energy employee / account manager / marketing rep	12.9%	21.4%	14.3%
Duke Energy website / email / web research	10.0%	7.1%	9.5%
Recommendation of third party	5.7%	7.1%	6.0%

consultant			
Past experience with this program	4.3%	0.0%	3.6%
Recommendation of a friend or associate	2.9%	0.0%	2.4%
From another employee or branch of my company	0.0%	14.3%	2.4%
Energy audit (not from Duke Energy or not specified)	1.4%	7.1%	2.4%
We are a third party company that processes rebates for other companies	2.9%	0.0%	2.4%
The program technical assistance	1.4%	0.0%	1.2%
Radio advertisement	1.4%	0.0%	1.2%
Advertisement in newspaper	1.4%	0.0%	1.2%
Landlord / property manager	1.4%	0.0%	1.2%
State Energy Office	1.4%	0.0%	1.2%
Because of past experience with or recommendation from "Smart Energy Now" (or "Envision Charlotte")	1.4%	0.0%	1.2%
Because of past experience with other Duke Energy programs	1.4%	0.0%	1.2%
Wanted to reduce energy costs	1.4%	0.0%	1.2%
Because of past experience with or recommendation from "Non-Residential Energy Assessment"	0.0%	0.0%	0.0%
Recommendation from other utility program	0.0%	0.0%	0.0%
Don't know	5.7%	14.3%	7.1%

Multiple responses were accepted for this question, so columns total to more than 100%.

Applying for Rebates through the Smart $aver Program

Table 35 indicates that most Fluorescent Lighting rebate recipients got the application online (55.7% or 39 out of 70), though nearly a third (30.0% or 21 out of 70) got the application from a trade ally. For Occupancy Sensor rebate recipients, these two sources were mentioned equally often (both by 35.7% or 5 out of 14). Some Occupancy Sensor rebate recipients got the application directly from their utility company (14.3% or 2 out of 14), while none (0.0% or 0 out of 70) of the Fluorescent Lighting rebate recipients did.

Table 35. Source of rebate application

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Website / online	55.7%	35.7%	52.4%

Trade allies	30.0%	35.7%	31.0%
Consultant or third party company	5.7%	7.1%	6.0%
Program staff	4.3%	0.0%	3.6%
Utility / Duke Energy	0.0%	14.3%	2.4%
Don't know	4.3%	7.1%	4.8%

Most of the respondents in this survey (71.4% or 10 out of 14 Occupancy Sensor rebates, and 52.9% or 37 out of 70 Fluorescent Lighting rebates) filled out the rebate application themselves, as seen in Table 36. Fluorescent Lighting rebate recipients were more likely to get assistance from trade allies (30.0% or 21 out of 70), compared to those who received rebates for Occupancy Sensors (14.3% or 2 out of 14).

Table 36. Who filled out rebate application for your company?

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
I did (respondent)	52.9%	71.4%	56.0%
Trade allies	30.0%	14.3%	27.4%
Someone else from respondent's company	20.0%	14.3%	19.0%
Consultant / third party company	1.4%	0.0%	1.2%
Don't know	0.0%	0.0%	0.0%

Multiple responses were accepted for this question, so columns total to more than 100%.

The Fluorescent Lighting rebate application was not easy to understand for 13.5% (5 out of 37) of respondents who filled out the forms themselves, but none (0.0% or 0 out of 10) of the Occupancy Sensor rebate recipients who did their own paperwork reported that the application was not easy to understand. Overall, 68.1% (32 out of 47) of respondents reported no problems understanding the forms.

Table 37. Understandability of the application

Base: respondents who filled the forms out themselves	Linear Fluorescent Lighting N=37	Occupancy Sensors N=10	Total N=47
Application was easy to understand	64.9%	80.0%	68.1%
"Some of it" was easy to understand	21.6%	20.0%	21.3%
The application was not easy to understand	13.5%	0.0%	10.6%

The 15 respondents (31.9% of 47) who thought the applications were not easy to understand were asked what was difficult about the forms. Their responses are listed below.

5 out of 15 (33.3%) respondents mentioned issues with technical details:

- *"I think the form would be difficult to fill out for someone who didn't know a lot of technical details about lighting."*
- *"It was mostly easy to understand. The application doesn't reflect some of the code requirements we have to meet with certain fixtures. A Duke representative helped us reconcile those issues after I had submitted the form several times."*
- *"It was OK, but each section did require fastidious attention to detail."*
- *"Some of the technical terms needed definitions."*
- *"There was a lot of information on the form that does not apply to our project, so it took time to find the information on the form that was relevant."*

4 out of 15 (26.7%) respondents mentioned issues with filing paperwork:

- *"It was difficult to figure out the wattage of the light fixture and the difference between wattages. We had a lot of stores in the program, and it was repetitive. I could not fill out one form that covered everything. I disliked having to fill out one form per each store."*
- *"I had to resubmit parts of the rebate form. Yes, it was resolved satisfactorily."*
- *"It wasn't too hard, but did require a lot of exact cross-referencing of Purchase Orders, Equipment numbers, etc."*
- *"When you have many types of fixtures involved, and the vendor's invoice is formatted differently than Duke's form, you have to do a lot of legwork and back-tracking."*

3 out of 15 (20.0%) respondents mentioned issues determining what qualified for the program:

- *"It was difficult determining which items qualified for the program."*
- *"It was difficult to understand the different types of rebates for the different lights. They all qualified for different rebates. Also, I was replacing a lot of 4-lamp fixtures with 2-lamp fixtures, so it was not clear which lamps qualified for which incentives."*
- *"There was confusion over the proper identification of both the old and new measures, and it wasn't clear as to which items qualified for the program."*

3 out of 15 (20.0%) respondents mentioned having to get assistance from a trade ally:

- *"Some of the options needed some clarification from our electrician."*
- *"I filled out most of it, with help from a vendor on some of the more technical questions."*
- *"The forms were filled in partially by myself and partially an electrician."*

As Table 38 indicates, most (60.7% or 51 out of 84) respondents submitted the application for Smart $aver themselves, and in another 20.2% (17 out of 84) cases someone else from their company did the paperwork. Another 19.0% (16 out of 84) of participants had trade allies submit applications for them.

Table 38. Who submitted the application to Duke Energy?

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
I did (respondent)	60.0%	64.3%	60.7%
Someone else from respondent's company	20.0%	21.4%	20.2%
Trade allies	20.0%	14.3%	19.0%
Consultant / third party company	1.4%	0.0%	1.2%
Don't know	0.0%	0.0%	0.0%

Multiple responses were accepted for this question, so columns total to more than 100%.

According to Table 39, nearly one in five respondents in this survey who had Fluorescent Lighting installed (18.6% or 13 out of 70) had problems receiving their Smart $aver rebate, while none of the respondents who installed Occupancy Sensors (0.0% or 0 out of 14) had problems receiving their rebates.

Table 39. Problems receiving Smart $aver rebates

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Had problems receiving Smart $aver rebate	18.6%	0.0%	15.5%
Did not have problems receiving Smart $aver rebate	78.6%	100.0%	82.1%
Don't know	2.9%	0.0%	2.4%

Thirteen respondents (15.5% of 84) reported problems receiving their Smart $aver rebates (all of these were for Fluorescent Lighting installations). Their descriptions of these problems and whether or not they were resolved are listed below.

9 out of 13 (69.2%) respondents who had problems receiving their rebates reported that these problems were resolved to their satisfaction:

- *"Duke sent back our application. They were confused as to what we had purchased. I explained that we had bought entirely new light fixtures, not just switching out some parts. That seemed to clear it up, and after that it was resolved to my satisfaction."*
- *"We needed to submit additional information on the rebate form. Yes, it was resolved to our satisfaction."*
- *"I had initially filled out the form incorrectly, which created a delay. It was resolved to my satisfaction. Duke was very helpful in getting this resolved."*
- *"I had to clarify some of my information to get the rebates. But once I clarified the information, I did not have any trouble receiving my rebates."*

- *"I needed an item clarified on the form. Yes, it was resolved satisfactorily."*
- *"One section of the form required additional information. Yes, it was resolved satisfactorily."*
- *"The form had to be resubmitted. Yes, it was resolved satisfactorily."*
- *"This was only because I made some errors filling out the paperwork. Once I fixed those, I did not have any problems getting the money."*
- *"We had a miscalculation on one of our forms that delayed things a little bit, but once we corrected it, the rebate was returned pretty quickly."*

However, 4 out of 13 (30.8%) respondents who had problems receiving their rebates reported mixed, inconclusive or unsatisfactory results:

- *"We had to resubmit rebate forms due to questions over some of our equipment choices."*
- *"I'm still waiting on 2 incentives, which seem to revolve in a circular discussion between us and Duke. No, it has not been resolved to my satisfaction."*
- *"I don't recall receiving 1 out of the 3 rebates we were expecting. I'm uncertain as to its current status."*
- *"We made a very large order, and asked Duke to let us do the rebates one building at a time. There was a lot of confusion as to how many fixtures we installed in each building. Duke questioned us several times about our applications. One form, we had to submit four different times before receiving the rebate. It was resolved in the end, but after taking myself and my office staff several hours to get it resolved."*

Reasons for Participating in Non-Residential Smart $aver

Table 32 shows that the most frequently mentioned reason for businesses participating in Non-Residential Smart $aver was to reduce energy costs, mentioned by 3 out of 5 respondents (59.5% or 50 out of 84). The rebate incentive itself was mentioned by more than a quarter of respondents (28.6% or 24 out of 84), while the recommendation of a trade ally was mentioned by 11.9% (10 out of 84), and old equipment working poorly was mentioned by 10.7% (9 out of 84). Among respondents whose organizations installed Fluorescent Lighting, some additional factors included T12 lighting being phased out (mentioned by 21.4% or 15 out of 70) and wanting better lighting (mentioned by 12.9% or 9 out of 70). Every respondent in this survey could give a reason for installing their rebated units ("don't know" 0.0% or 0 out of 84).

Table 40. Reasons for purchasing new energy-saving unit

Percentage mentioning factor	**Linear Fluorescent Lighting N=70**	**Occupancy Sensors N=14**	**Total N=84**
Wanted to reduce energy costs	60.0%	57.1%	59.5%
The program incentive	28.6%	28.6%	28.6%
Old lighting (T12) being phased out	21.4%	0.0%	17.9%
Recommendation of trade ally	12.9%	7.1%	11.9%
Old equipment working poorly	10.0%	14.3%	10.7%

Wanted better lighting	12.9%	0.0%	10.7%
Company is trying to "go green" / environmental concerns	5.7%	14.3%	7.1%
Companywide policy / initiative / participation of other branches	4.3%	14.3%	6.0%
State grant / energy promotion	7.1%	0.0%	6.0%
Drawbacks of old equipment (heat, maintenance costs, unavailability of replacements)	7.1%	0.0%	6.0%
ARRA energy grant / federal stimulus	4.3%	7.1%	4.8%
Tax incentive	2.9%	7.1%	3.6%
Recommendation of someone else	1.4%	7.1%	2.4%
Part of remodeling / improving building	2.9%	0.0%	2.4%
Old equipment didn't work	1.4%	0.0%	1.2%
The program technical assistance	0.0%	7.1%	1.2%
The information provided by the Program	1.4%	0.0%	1.2%
Past experience with this program	0.0%	7.1%	1.2%
EPA guidelines	1.4%	0.0%	1.2%
Insurance reason	0.0%	7.1%	1.2%
Property owner's recommendation	0.0%	7.1%	1.2%
Local govt. recommendation	1.4%	0.0%	1.2%
Save money / fiscal responsibility	1.4%	0.0%	1.2%
Worker safety / productivity	1.4%	0.0%	1.2%
Radio advertisement	1.4%	0.0%	1.2%
Advertisement in newspaper	0.0%	0.0%	0.0%
Don't know	0.0%	0.0%	0.0%

Multiple responses were accepted for this question, so columns total to more than 100%.

Table 41 shows only the "most important" reasons for participating in Non-Residential Smart $aver, and nearly half (47.6% or 40 out of 84) mentioned wanting to reduce energy costs as the most important reason, with another 22.6% (19 out of 84) mentioning the rebate incentive itself as the most important reason.

Table 41. Most important reasons for purchasing new energy-saving unit

Percentage mentioning factor as ranked #1 in importance (including "tied for #1")	**Linear Fluorescent Lighting N=70**	**Occupancy Sensors N=14**	**Total N=84**
Wanted to reduce energy costs	50.0%	35.7%	47.6%
The program incentive	24.3%	14.3%	22.6%
Old lighting (T12) being phased out	21.4%	0.0%	17.9%
Wanted better lighting	11.4%	0.0%	9.5%

Recommendation of trade ally	7.1%	7.1%	7.1%
Old equipment working poorly	5.7%	14.3%	7.1%
Company is trying to "go green" / environmental concerns	4.3%	14.3%	6.0%
Companywide policy / initiative / participation of other branches	4.3%	14.3%	6.0%
ARRA energy grant / federal stimulus	4.3%	7.1%	4.8%
State grant / energy promotion	5.7%	0.0%	4.8%
Drawbacks of old equipment (heat, maintenance costs, unavailability of replacements)	4.3%	0.0%	3.6%
Part of remodeling / improving building	2.9%	0.0%	2.4%
Tax incentive	1.4%	0.0%	1.2%
Recommendation of someone else	0.0%	7.1%	1.2%
Past experience with this program	0.0%	7.1%	1.2%
EPA guidelines	1.4%	0.0%	1.2%
Insurance reason	0.0%	7.1%	1.2%
Property owner's recommendation	0.0%	7.1%	1.2%
Local govt. recommendation	1.4%	0.0%	1.2%
Save money / fiscal responsibility	1.4%	0.0%	1.2%
Radio advertisement	1.4%	0.0%	1.2%
Worker safety / productivity	0.0%	0.0%	0.0%
Advertisement in newspaper	0.0%	0.0%	0.0%
Don't know	0.0%	0.0%	0.0%

Multiple responses were accepted for this question, so columns total to more than 100%.

Table 42 shows that almost every Fluorescent Lighting rebate recipient was replacing an existing system (98.6% or 69 out of 70), whereas half of Occupancy Sensor installations did not replace existing systems (50.0% or 7 out of 14). Furthermore, none (0.0% or 0 out of 70) of the Fluorescent Lighting installations were the first time that type of unit had been installed at the respondent's company, whereas for at least 28.6% (4 out of 14) Occupancy Sensor installations it was the first such unit installed at that company (another 14.3% or 2 out of 14 were not sure if it was the first installation or not).

Table 42. Replacing existing units and first-time installations

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Newly installed unit replaced an existing unit	98.6%	50.0%	90.5%
Newly installed unit is the first such unit purchased by the company	0.0%	28.6%	4.8%
Newly installed unit did not replace	1.4%	7.1%	2.4%

an existing unit, but is not the first such unit installed by the company			
Not sure if newly installed unit is the first such unit purchased by the company	0.0%	14.3%	2.4%

Units Replaced by Smart $aver-rebated Equipment

As seen in Table 43, most Fluorescent Lighting installations that replaced existing systems replaced systems that were more than 20 years old (56.5% or 39 out of 69), whereas 42.9% (3 out of 7) of Occupancy Sensor installations which replaced existing systems replaced systems that were more than 20 years old.

Table 43. Age of replaced units

Base: new unit replaced an existing unit	**Linear Fluorescent Lighting N=69**	**Occupancy Sensors N=7**	**Total N=76**
Replaced a unit less than 5 years old	2.9%	14.3%	3.9%
Replaced a unit 5 to less than 10 years old	5.8%	0.0%	5.3%
Replaced a unit 10 to less than 20 years old	21.7%	42.9%	23.7%
Replaced a unit 20 years to less than 30 years old	29.0%	14.3%	27.6%
Replaced a unit 30 or more years old	27.5%	28.6%	27.6%
Don't know age of replaced unit	13.0%	0.0%	11.8%

As seen in Table 44, only 15.9% (11 out of 69) of the Fluorescent Lighting units replaced were in poor condition, while none (0.0% or 0 out of 7) of the Occupancy Sensor units that were replaced were in poor condition. Every unit that was replaced was still in working condition (0.0% or 0 out of 76 replaced units were not working).

Table 44. Condition of unit replaced by Smart $aver installation

Base: new unit replaced an existing unit	**Linear Fluorescent Lighting N=69**	**Occupancy Sensors N=7**	**Total N=76**
Replaced unit was in good condition	47.8%	57.1%	48.7%
Replaced unit was in fair condition	34.8%	42.9%	35.5%
Replaced unit was in poor condition	15.9%	0.0%	14.5%
Replaced unit was not in working condition	0.0%	0.0%	0.0%
Don't know replaced unit's condition	1.4%	0.0%	1.3%

Influence of the Non-Residential Smart $aver Program

Table 45 indicates that a third (33.3% or 28 out of 84) of the respondents in this survey say that without the Smart $aver program, their companies would have purchased their new units when they did anyway, and at about the same rates for both types of rebate recipient. But respondents who installed new Occupancy Sensors are more likely to say they would have waited up to three years to replace their old unit without Smart $aver (42.9% or 6 out of 14) compared to Fluorescent Lighting rebate recipients (24.3% or 17 out of 70). Respondents whose companies installed new Fluorescent Lighting were more likely to say that without Smart $aver they would have kept using their old units (including “until old unit fails”, “until budget permits”, and “don’t know when”) – 37.1% (26 out of 70), versus just 21.4% (3 out of 14) giving these responses among respondents whose companies installed Occupancy Sensors.

Table 45. Actions taken if Smart $aver program had not been available

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Would have bought the new unit at the same time	32.9%	35.7%	33.3%
Would have bought the new unit within a year	7.1%	7.1%	7.1%
Would have bought the new unit one to three years from now	17.1%	35.7%	20.2%
Would have bought the new unit more than three years from now	5.7%	0.0%	4.8%
Would have replaced old units as they failed	4.3%	0.0%	3.6%
Would have waited for budget to permit funding of new units	2.9%	0.0%	2.4%
Would have waited to purchase new units, don’t know how long	1.4%	0.0%	1.2%
Would have continued using the old unit	28.6%	21.4%	27.4%

Figure 5 indicates that a strong majority of respondents in this survey (84.5% or 71 out of 84) believe the Duke Energy incentive payment was a factor in their company’s choice to install more efficient equipment, with similar percentages for both types of installation. Respondents from companies with Fluorescent Lighting installations were more likely to rate the influence of the incentive payment as a “10 out of 10” (highest possible rating) on the installation decision (17.1% or 12 out of 70) than those who installed Occupancy Sensors (7.1% or 1 out of 14). Overall, 60.7% (51 out of 84) of respondents in this survey rated the influence of the Smart $aver incentive payment at “7” or higher on a 10-point scale of influence.

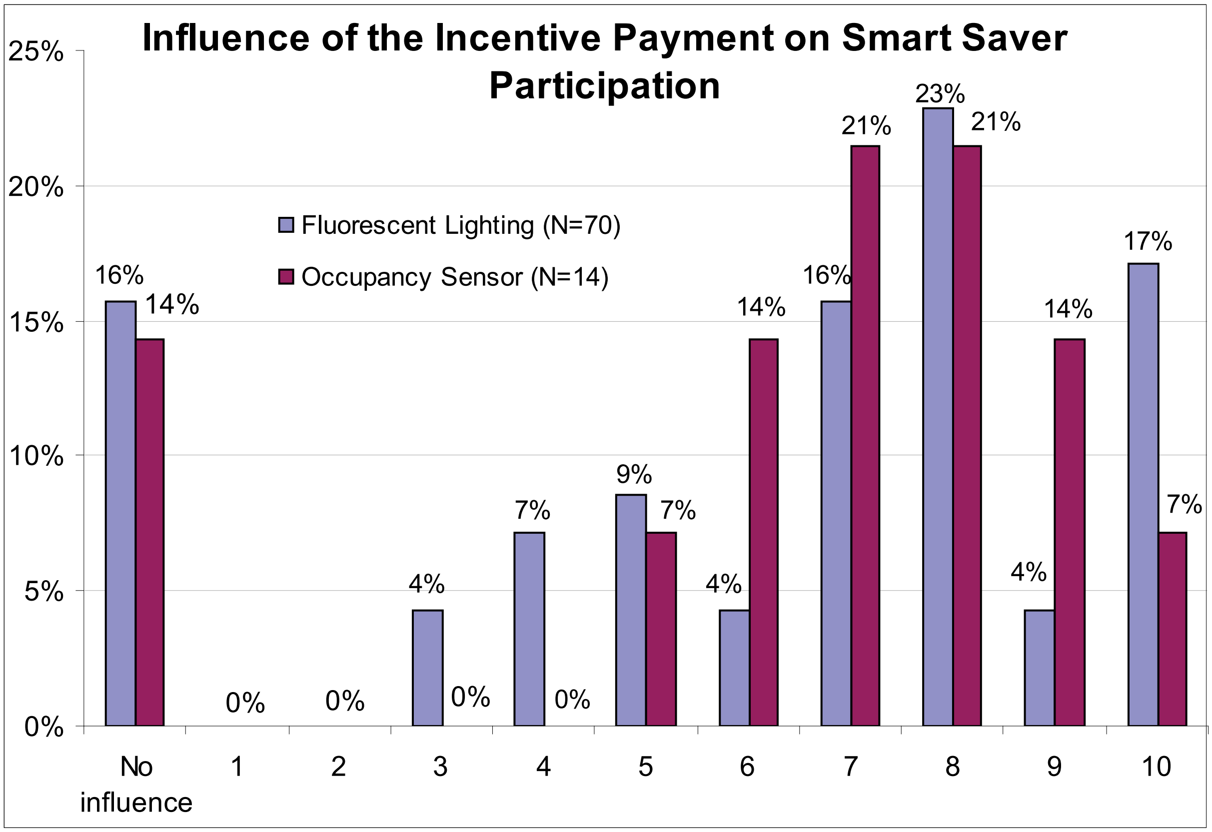


Figure 5. Influence of the incentive payment on Smart $aver participation

According to Figure 6, a plurality of respondents in this survey (39.3% or 33 out of 84) felt the program information on Smart $aver had "no influence" on their company's participation, while only 7.1% (6 out of 84) rated the influence of the program information a "10 out of 10" (highest possible rating).

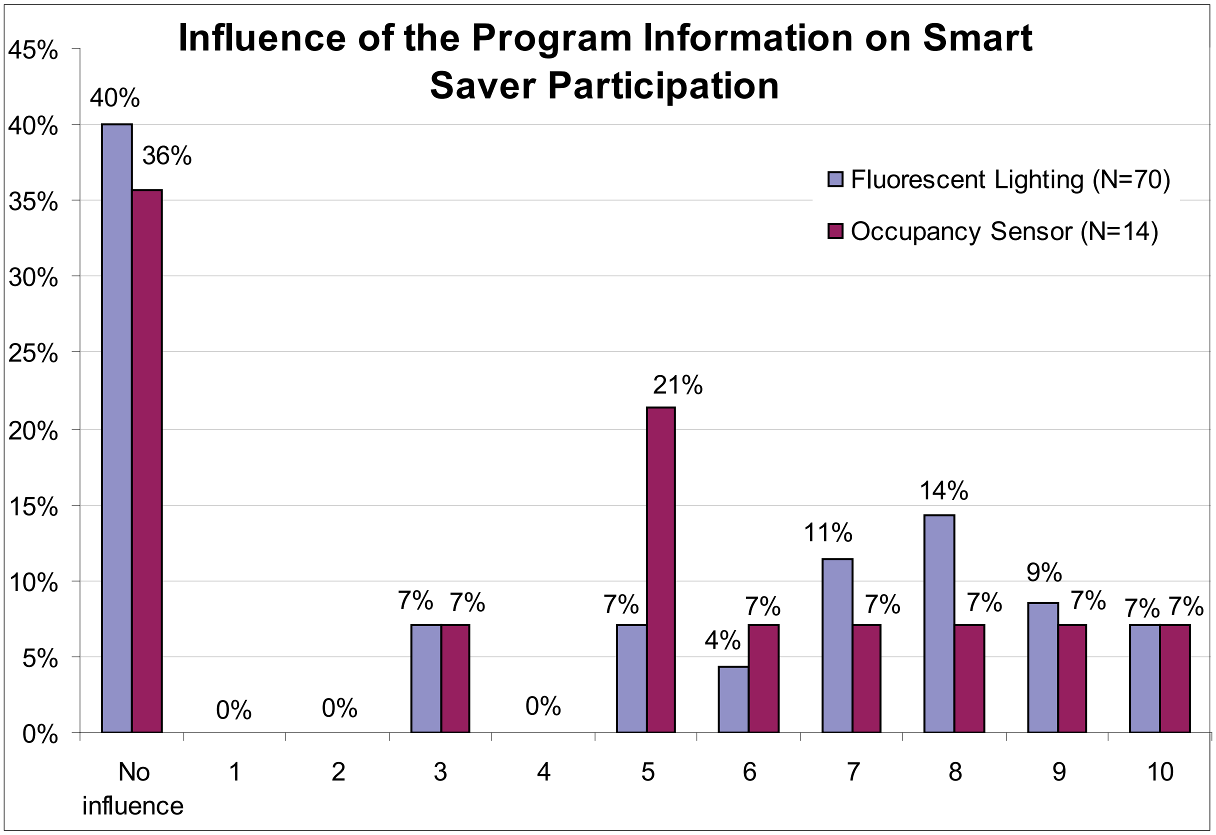


Figure 6. Influence of the program information on Smart $aver participation

Most respondents (59.5% or 50 out of 84) say they would have purchased exactly the same equipment without the Smart $aver incentive rebate, as shown in Table 46. Only about one in four (23.8% or 20 out of 84) were sure their company would have installed something different without the incentive payment.

Table 46. Actions taken if Smart $aver financial incentive had not been available

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Would have selected exactly the same energy efficiency without the financial incentive	62.9%	42.9%	59.5%
Would have selected a somewhat different energy efficiency without the financial incentive	20.0%	42.9%	23.8%
Not sure what company would have done without the financial incentive	17.1%	14.3%	16.7%

Table 47 shows that the technical assistance provided with the program had about the same effect on installation choices as the incentive payment – most respondents (59.5% or 50 out of

84) say their organizations would have purchased the same equipment without the technical assistance, and about one in four (26.2% or 22 out of 84) believe their companies would have made a different purchase without the technical assistance.

Table 47. Actions taken if Smart $aver technical assistance had not been available

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Would have selected exactly the same energy efficiency without the technical assistance	60.0%	57.1%	59.5%
Would have selected a somewhat different energy efficiency without the technical assistance	25.7%	28.6%	26.2%
Not sure what company would have done without the technical assistance	14.3%	14.3%	14.3%

A little over half of the respondents surveyed have installed more high efficiency equipment since participating in Smart $aver, including installations at the respondents' location and other locations (combined 53.6% or 45 out of 84). However, Table 48 also shows that 42.9% (36 out of 84) of companies surveyed have not installed more high energy efficiency equipment.

Table 48. Other high efficiency installations since Smart $aver

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Installed more high efficiency equipment – only at this location	31.4%	42.9%	33.3%
Installed more high efficiency equipment – only at other locations	8.6%	7.1%	8.3%
Installed more high efficiency equipment – at both this and other locations	11.4%	14.3%	11.9%
Have not installed more high energy efficiency equipment	44.3%	35.7%	42.9%
Don't know	4.3%	0.0%	3.6%

Table 49 shows what types of equipment were installed by companies that made other high efficiency installations after participating in Smart $aver. The most common category was lighting (overall 42.2% or 19 out of 45 respondents who installed more high efficiency equipment), with about a third of these being LED lighting installations (overall 13.3% or 6 out of 45). Other common installations included HVAC upgrades (overall 22.2% or 10 out of 45), heavy industrial equipment upgrades (20.0% or 9 out of 45), boiler / water heater upgrades (17.8% or 8 out of 45), occupancy / motion sensors (17.8% or 8 out of 45), and variable frequency drives / soft starters (11.1% or 5 out of 45). Four respondents (8.9% of 45) could not mention any specific installations, though they had indicated their organization made high efficiency equipment installations since participating in Smart $aver.

Table 49. Other energy efficient installations which were influenced by Smart $aver

Base: respondents who said they installed more high energy efficient equipment since participating in Smart $aver	**Linear Fluorescent Lighting N=36**	**Occupancy Sensors N=9**	**Total N=45**
Total lighting upgrades	38.9%	55.6%	42.2%
LED lighting upgrades	13.9%	11.1%	13.3%
Other lighting upgrades (including unspecified)	27.8%	44.4%	31.1%
HVAC upgrades	19.4%	33.3%	22.2%
Heavy industrial equipment (motors, chillers, fans, etc.)	19.4%	22.2%	20.0%
Boiler / water heater upgrades	22.2%	0.0%	17.8%
Occupancy / motion sensors	19.4%	11.1%	17.8%
Variable frequency drives / soft starters	13.9%	0.0%	11.1%
Refrigeration upgrades	11.1%	0.0%	8.9%
Air compressor upgrades	8.3%	0.0%	6.7%
Programmable / computerized thermostats	8.3%	0.0%	6.7%
Solar power generation	5.6%	11.1%	6.7%
Solar water heaters	2.8%	11.1%	4.4%
Energy management system / computerized automation	2.8%	11.1%	4.4%
Energy star rated appliances / office equipment / computers & servers	5.6%	0.0%	4.4%
Water saving devices (faucets, toilets, etc.)	5.6%	0.0%	4.4%
Don't Know / Not Specified / Nothing	11.1%	0.0%	8.9%

Multiple responses were accepted for this question, so columns total to more than 100%.

Respondents were asked how they knew the installation was energy efficient; their responses are shown in Table 50. The most frequent response was standard efficiency ratings like Energy Star and SEER (by 40.0% or 18 out of 45 respondents who made other efficiency installations since participating in Smart $aver). Equipment specifications and information from the manufacturer was also commonly mentioned (28.9% or 13 out of 45), as was information from trade allies (26.7% or 12 out of 45). A smaller number did their own research (15.6% or 7 out of 45) or had in-house experts to call on (11.1% or 5 out of 45). Two respondents (4.4% of 45) did not say how they knew the installations were energy efficient.

Table 50. How do you know this equipment is high efficiency?

Base: respondents who said they installed more high energy efficient equipment since participating in Smart $aver	**Linear Fluorescent Lighting N=36**	**Occupancy Sensors N=9**	**Total N=45**
Energy Star, SEER or other standard efficiency ratings	41.7%	33.3%	40.0%
Equipment specifications / literature / info from manufacturer	25.0%	44.4%	28.9%
Information from trade allies	25.0%	33.3%	26.7%
Did own research	16.7%	11.1%	15.6%
In-house experts / engineers	13.9%	0.0%	11.1%
Cost comparison	5.6%	11.1%	6.7%
Based on past installations / previous experience	8.3%	0.0%	6.7%
This installation reduces the usage of other equipment	5.6%	11.1%	6.7%
Data analysis / testing equipment	5.6%	0.0%	4.4%
Information from Duke Energy	5.6%	0.0%	4.4%
Don't Know / Not Specified / Nothing	5.6%	0.0%	4.4%

Multiple responses were accepted for this question, so columns total to more than 100%.

Figure 7 shows that respondents with Occupancy Sensor installations felt they were more influenced by Smart $aver to make more energy efficiency purchases compared to those with Fluorescent Lighting installations: twice as many with Occupancy Sensors (40.0% or 4 out of 10) rated the influence of Smart $aver a "10 out of 10" (highest possible rating) compared to those with Fluorescent Lighting (18.5% or 10 out of 54). There were also many more respondents with Fluorescent Lighting installations who didn't know whether Smart $aver was influential on other installations or not (27.8% or 15 out of 54) compared to respondents with Occupancy Sensor installations (0.0% or 0 out of 10).

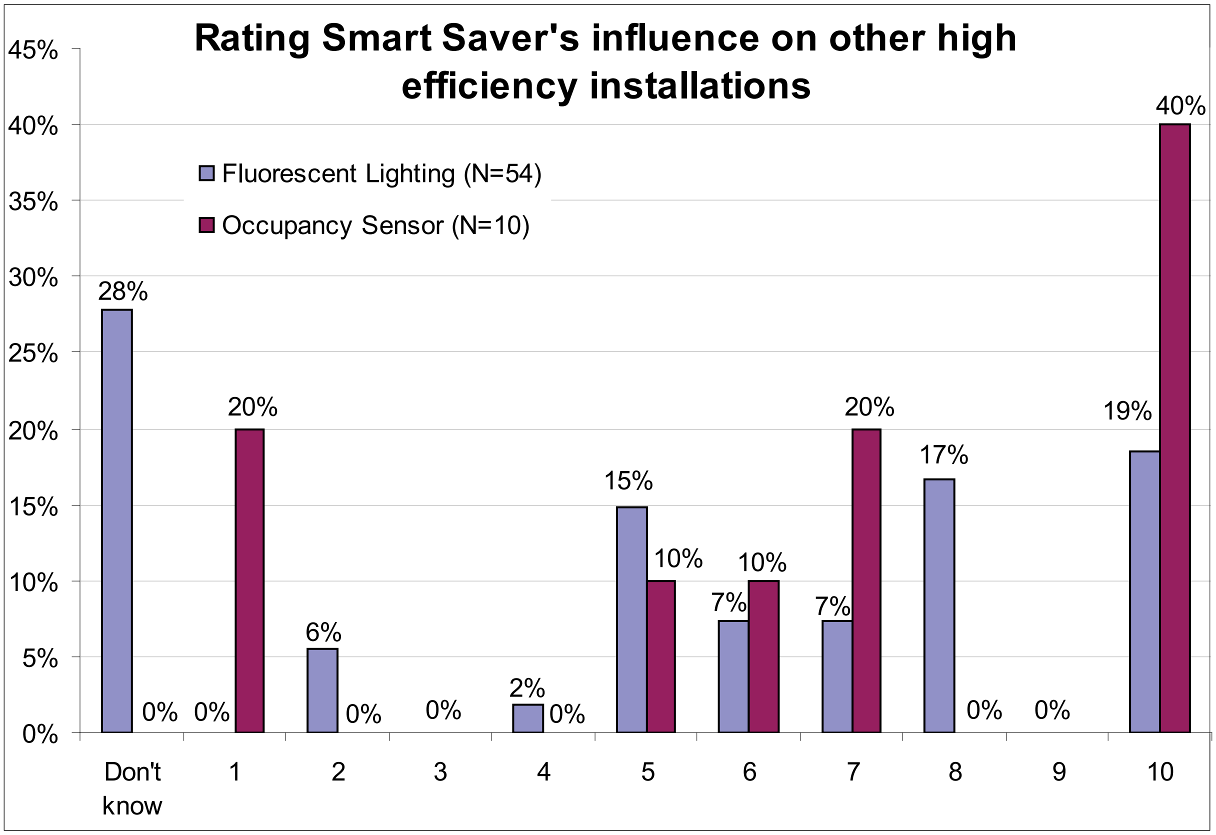


Figure 7. Influence of Smart $aver on installation of other high efficiency equipment *(Base: N=64 respondents who installed other high efficiency equipment since participating in Smart $aver)*

Other efficiency actions taken by organizations that participated in Smart $aver are shown in Table 51. The most common action among Fluorescent Lighting rebate recipients was educating their employees (or in some cases tenants or students) about turning things off to save energy (22.9% or 16 out of 70), while more lighting upgrades was second (at 12.9% or 9 out of 70). Companies that installed Occupancy Sensors were more likely to mention installing more occupancy sensors (and timers and BERT controls; 14.3% or 2 out of 14), installing programmable thermostats (14.3% or 2 out of 14), upgrading small appliances (14.3% or 2 out of 14), and “more closely monitoring energy usage” (14.3% or 2 out of 14).

Table 51. Other efficiency actions taken which were influenced by Smart $aver

Percentage mentioning factor as ranked #1 in importance (including “tied for #1”)	**Linear Fluorescent Lighting N=70**	**Occupancy Sensors N=14**	**Total N=84**
Educating employees / tenants / students to save energy (turn things off)	22.9%	0.0%	19.0%
More lighting upgrades	12.9%	7.1%	11.9%
New energy policy / energy	8.6%	7.1%	8.3%

management system / energy manager / energy team			
Occupancy sensors / timers / BERT controls	7.1%	14.3%	8.3%
More closely monitoring energy usage	4.3%	14.3%	6.0%
Programmable thermostats	4.3%	14.3%	6.0%
New windows / doors / roofs	5.7%	7.1%	6.0%
Upgraded heavy equipment (trucks, transformers, pump stations, etc.)	7.1%	0.0%	6.0%
Upgraded water heater / boiler / cooling tower	4.3%	7.1%	4.8%
Water saving measures (sinks, bathrooms, etc.)	5.7%	0.0%	4.8%
Upgraded small appliances (water fountains, vending machines, coffee makers, etc.)	2.9%	14.3%	4.8%
Using more natural light	4.3%	0.0%	3.6%
Insulation / weatherization	2.9%	7.1%	3.6%
Adjusted temperature settings / HVAC usage	4.3%	0.0%	3.6%
Maintenance to improve performance / efficiency of equipment	1.4%	7.1%	2.4%
Solar panels / solar power	2.9%	0.0%	2.4%
Changed schedule / work hours / work days	2.9%	0.0%	2.4%
Recycling	2.9%	0.0%	2.4%
Unique actions (see list below)	5.7%	21.4%	8.3%
Don't know	37.1%	21.4%	34.5%

Multiple responses were accepted for this question, so columns total to more than 100%.

Seven respondents (8.3% of 84) mentioned unique actions they had done to improve energy efficiency. These are listed below.

- Lowered energy capacity contract
- Pursuing LEED certification
- HVAC upgrade
- Converting from propane to natural gas and combining gas meters
- Started a school program (for recycling)
- Open the doors for ventilation (instead of using AC)
- "*We are more conscious of the new technologies*"

Satisfaction with the Smart $aver Program

Figure 8 indicates that Smart $aver participants were generally satisfied with the program as a whole: overall, 89.3% (75 out of 84) of respondents rated their overall satisfaction with Smart $aver an "8" or better on a 10-point scale, and nearly a third (31.0% or 26 out of 84) gave a "10 out of 10" rating. Only one respondent (1.2% or 1 out of 84) rated their experience with Smart $aver a "5" or less on a 10-point scale.

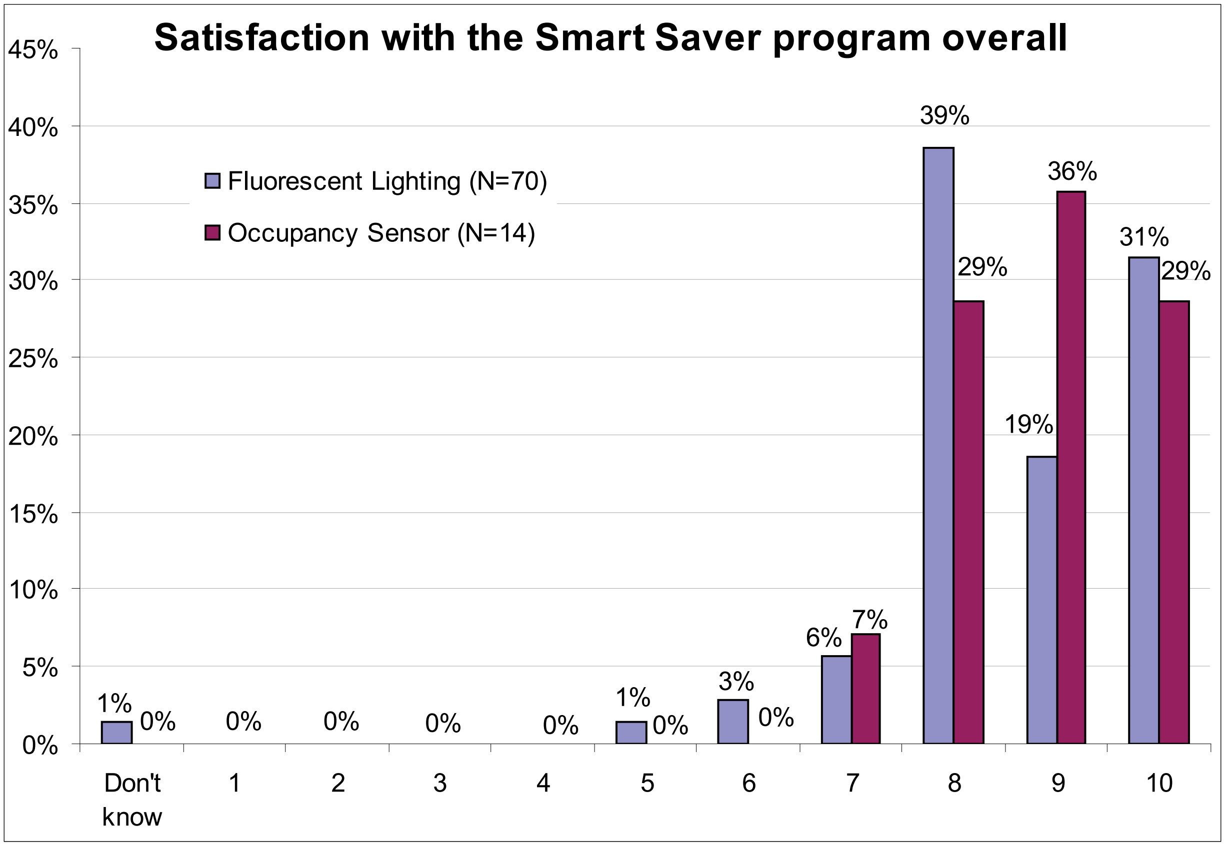


Figure 8. Satisfaction with the Smart $aver program overall

Eight respondents (9.5% of 84) rated their overall satisfaction with Smart $aver a "7" or less on a 10 point scale. They were asked what could be done to improve the program, and their answers are listed below.

- "*The paperwork should be reduced.*"
- "*Duke should have energy assessors exclusively devoted to the program.*"
- "*Use Progress Energy's similar program as a how-to model.*"
- 5 respondents (6.0% of 84) had no specific suggestions

Figure 9 shows that participants were less satisfied with the amount of the rebate provided than other aspects of the program (as seen in Figure 10 through Figure 14). Only 23.8% (20 out of 84) rated the rebate level a "10 out of 10", while 32.1% (27 out of 84) rated the level of the rebate a "7" or lower out of 10.

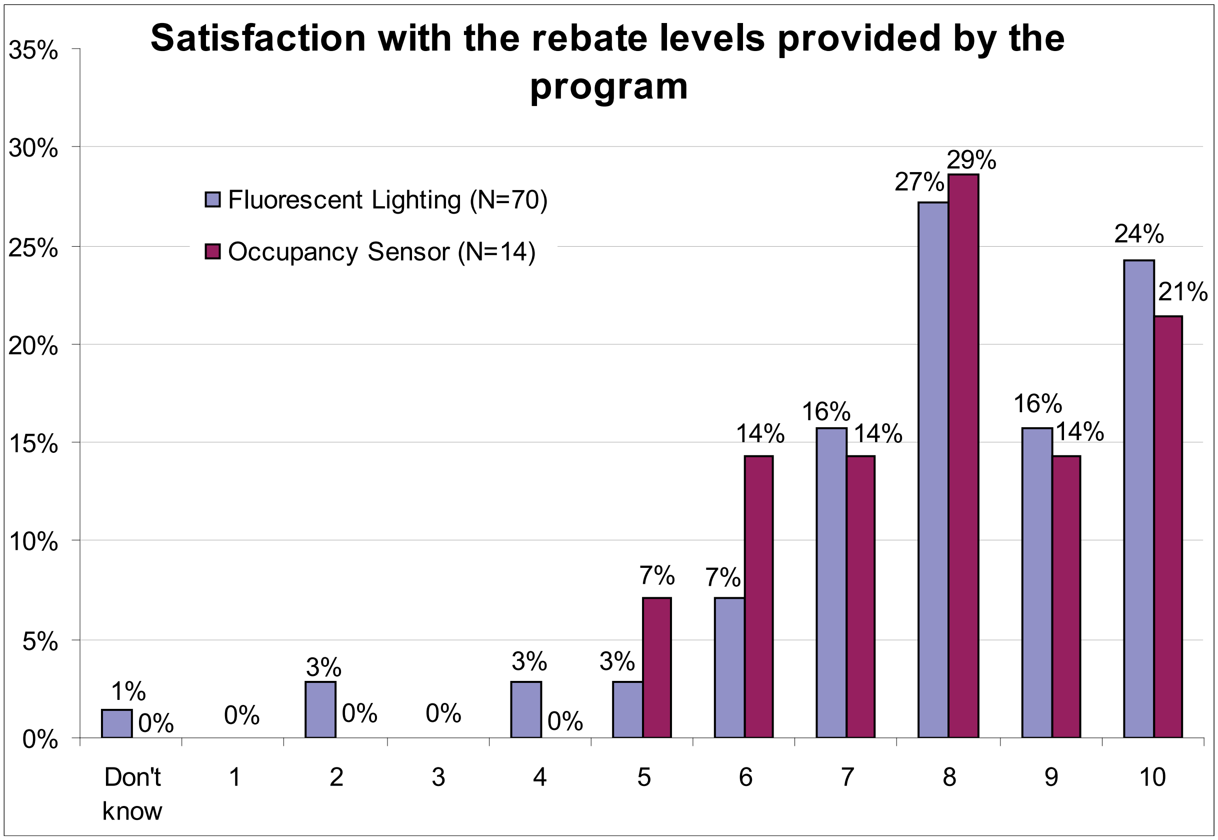


Figure 9. Satisfaction with the rebate levels provided by the program

Twenty-seven respondents (32.1% of 84) rated their satisfaction with the rebate levels for Smart $aver a "7" or less on a 10 point scale. They were asked what could be done to improve this aspect of the program, and their answers are characterized below.

- 24 respondents (28.6% of 84) felt that the rebate amounts should be larger. Ten (11.9% of 84) of these respondents had additional comments about particular circumstances in which rebates should be higher, which are listed below.
  - "*Higher incentives for certain types of metal halide lighting replacements*."
  - "*Higher incentives for LED lighting*."
  - "*Increase incentives for HVAC units*."
  - "*The rebate program could cover more technologies*."
  - "*More residual rebates*."
  - "*The rebate levels for custom programs are higher. The rebates for the prescriptive programs could be made more generous for smaller projects*."

  - "*Higher rebates proportional to the amount spent*."
  - "*Large quantity upgrades should be given higher incentives*."
  - "*The rebates should be higher for high efficiency equipment. With higher-efficiency equipment, the current incentives don't really help you break even*."
  - "*Duke Energy's program incentives are less than those offered in comparable programs by TVA, Portland Energy Authority, and SC Edison*."

- 3 respondents (3.6% of 84) had other comments, listed below.

  - "*The rebate forms were very paper-intensive. I was sending in 13-page forms for $4 in rebates.*"
  - "*The incentives were reduced between us beginning the project and finishing the project, so we did not get as much as we had planned on.*"
  - "*The incentives actually seemed pretty fair.*"

Another aspect of the Smart $aver program with relatively lower satisfaction was the ease of understanding and completing the rebate form, shown in Figure 10. Only 29.8% (25 out of 84) rated this aspect of the program a "10 out of 10", and 31.0% (26 out of 84) rated the ease of paperwork a "7" or less out of 10. Another 11.9% (10 out of 84) could not give a rating for this aspect of Smart $aver.

Those who received rebates for Occupancy Sensors gave the program significantly higher ratings for the ease of understanding and completing the rebate form (p<.05 using student's t-test). Three-quarters (78.6% or 11 out of 14) of Occupancy Sensor recipients rated the program an "8" or higher on a 10-point scale, compared to only about half (52.9% or 37 out of 70) of Fluorescent Lighting rebate recipients rating the program that highly.

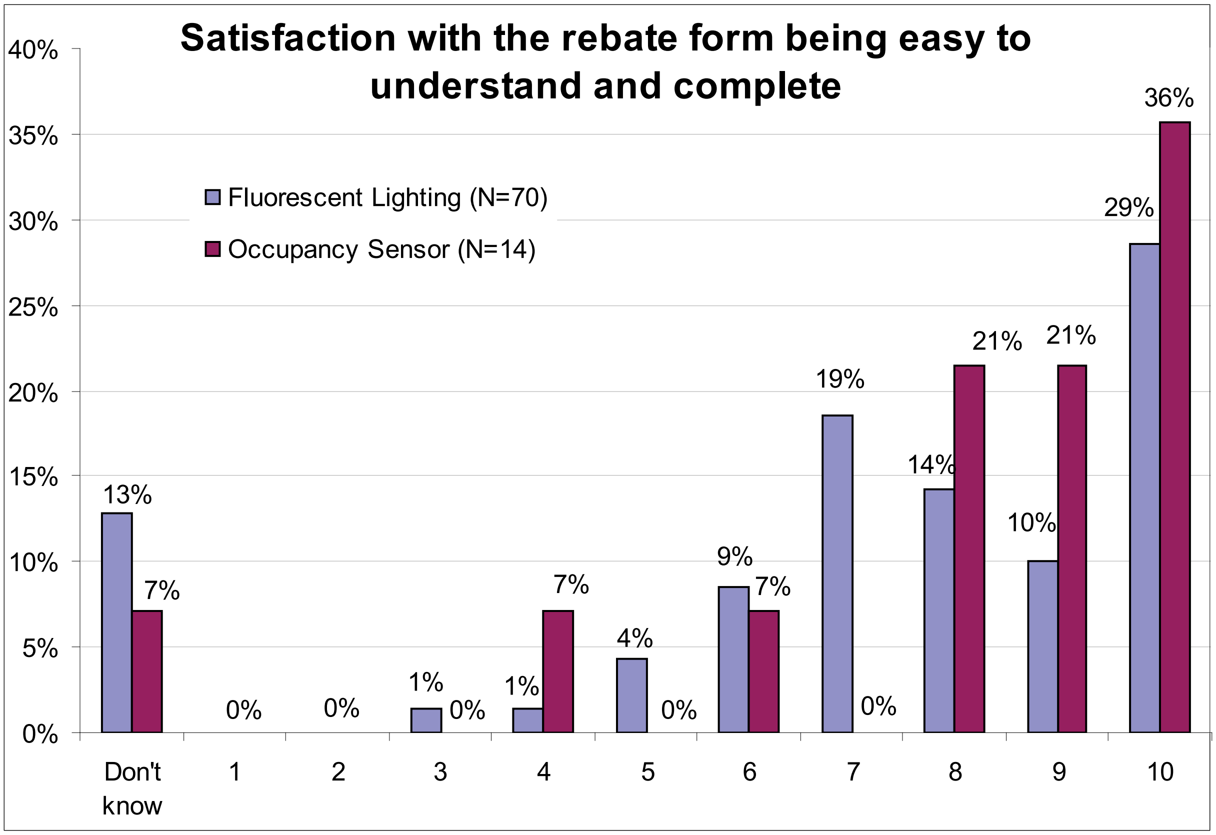


Figure 10. Satisfaction with the Smart $aver rebate form being easy to understand and complete

Twenty-six respondents (31.0% of 84) rated their satisfaction with the rebate form being easy to understand and complete a "7" or less on a 10 point scale. They were asked what could be done to improve this aspect of the program, and their answers are listed below.

- 12 respondents (14.3% of 84) felt that the rebate forms should be made easier to complete and/or shorter. Their comments are listed below.
  - "*Make the form shorter, easier to understand and easier to submit*."
  - "*Make the form itself larger in size - the spaces currently provided are too small*."
  - "*For large quantity purchasers, please make the forms more streamlined, easier*."
  - "*Simplify the form - it was too busy and had too much information on it*."
  - "*The form should have less extra information on it*."
  - "*Simplify the form. There is currently too much math and technical specifics required*."
  - "*Easier equipment-type groupings*."
  - "*Simplify the equipment list*."
  - "*It would have helped to have more model numbers instead of just descriptions of fixtures*."
  - "*Make the Custom section less difficult to fill out*."

  - "*The parts and labor costs on the form could be easier to reconcile with the invoices from contractors and vendors*."
  - "*The program's guidelines could be more in line with the code requirements we have to meet*."

- 8 respondents (9.5% of 84) wanted clearer language and for the forms to be easier to understand. Their comments are listed below.

  - "*Clear instructions with a key and/or guide*."
  - "*Simplify & clarify the content if possible*."
  - "*Duke should make the form more user-friendly, especially in layman's terms*."
  - "*Use less technical jargon and/or have the technical terms more clearly defined*."
  - "*There could be less technical language and more easily understood language*." *You have to know a lot of technical lingo to understand the form*."
  - "*Clarify the list of equipment covered by the program*."
  - "*The form could make it easier to sort out information about specific products and model numbers. We needed help from the contractor and electrician on some of the specifics*."
  - "*Clarify the instructions on the web site*."

- 6 respondents (7.1% of 84) had no specific suggestions

Figure 11 shows that respondents who received rebates for Occupancy Sensors were more satisfied with the number and kind of technologies covered by Smart $aver than those who received rebates for Fluorescent Lighting. Only 7.1% (1 out of 14) of respondents who installed Occupancy Sensors rated this aspect of the program a "7" or lower on a 10-point scale, compared to 28.6% (20 out of 70) of those who installed Fluorescent Lighting (this difference is significant at $p<.05$ using student's t-test).

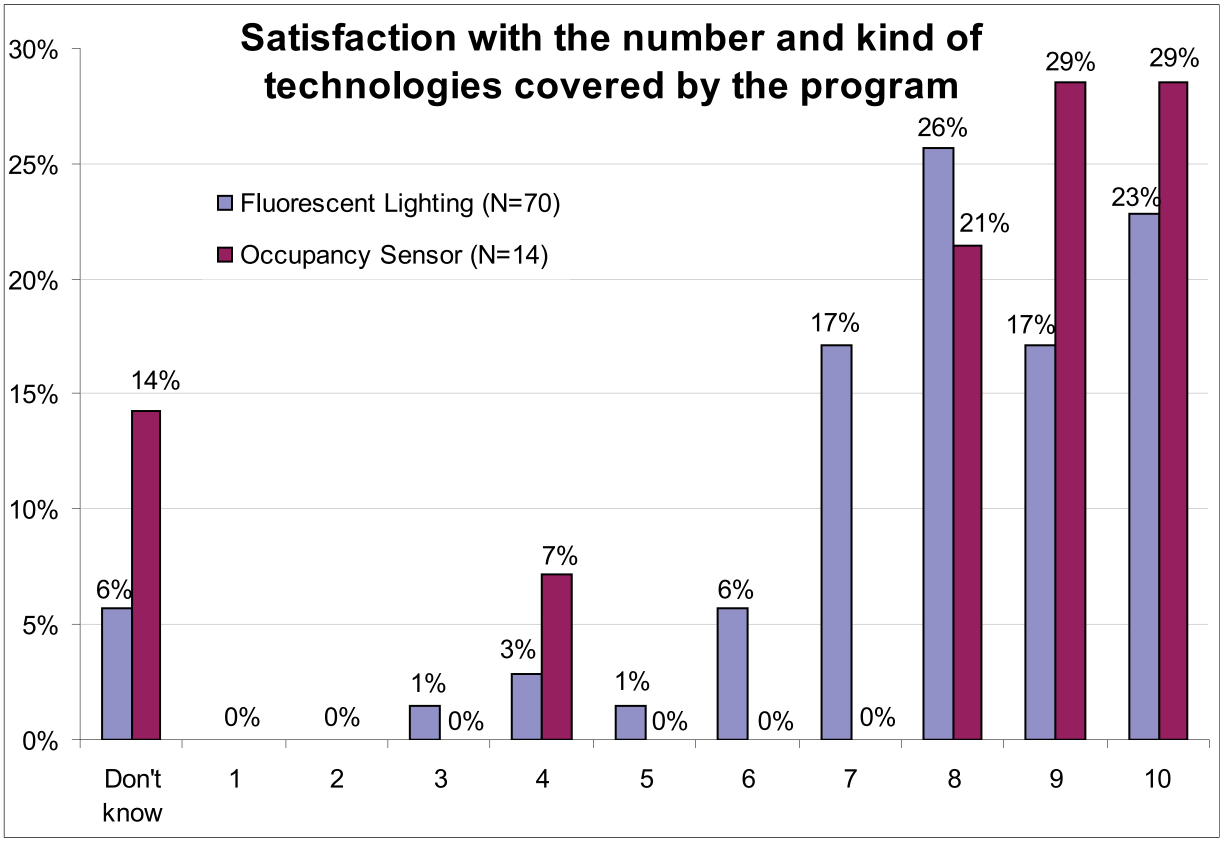


Figure 11. Satisfaction with the number and kind of technologies covered by the program

Twenty-one respondents (25.0% of 84) rated their satisfaction with the number and kind of technologies covered by Smart $aver a "7" or less on a 10 point scale. They were asked what could be done to improve this aspect of the program, and their answers are listed below.

- 5 respondents (6.0% of 84) mentioned specific types of equipment that should be covered by Smart $aver, listed below.
    - "*Duke could provide incentives for LED lighting*."
    - "*I would like to see different billing rates for mechanical equipment, and incentives for variable frequency drives*."
    - "*Include PVC cooling tower technology*."
    - "*The addition of solar energy incentives*."
    - "*The program could include more LED lighting, more induction lighting, exterior lighting, and street lighting*."

- 4 respondents (4.8% of 84) had suggestions related to custom programs, listed below.
    - "*Duke could offer more custom programs*."
    - "*Duke could make the program easier to customize*."

- "*Our project needs do not always match Duke's retrofit specifications, so the custom program is all that we can qualify for. Customers should be given a little more time and should not have to be pre-approved if they can prove that a project saves energy*."
- "*The program could include soft-start motors and induction lighting under its prescriptive options instead of just custom*."

- 4 respondents (4.8% of 84) wanted more information, education or time; their comments are listed below.

  - "*Duke could provide better information about what is covered by the programs. There needs to be more information about this online*."
  - "*More education*."
  - "*Please provide vendor & qualifying equipment lists*."
  - "*Extend the length of time the program is active*."

- 8 respondents (9.5% of 84) had no specific suggestions about technologies covered by the program.

Respondents in this survey were generally very satisfied with the time it took to receive the rebate. Figure 12 indicates that 40.5% (34 out of 84) rated this aspect of the program a "10 out of 10", and only 20.2% (17 out of 84) rated it a "7" or lower.

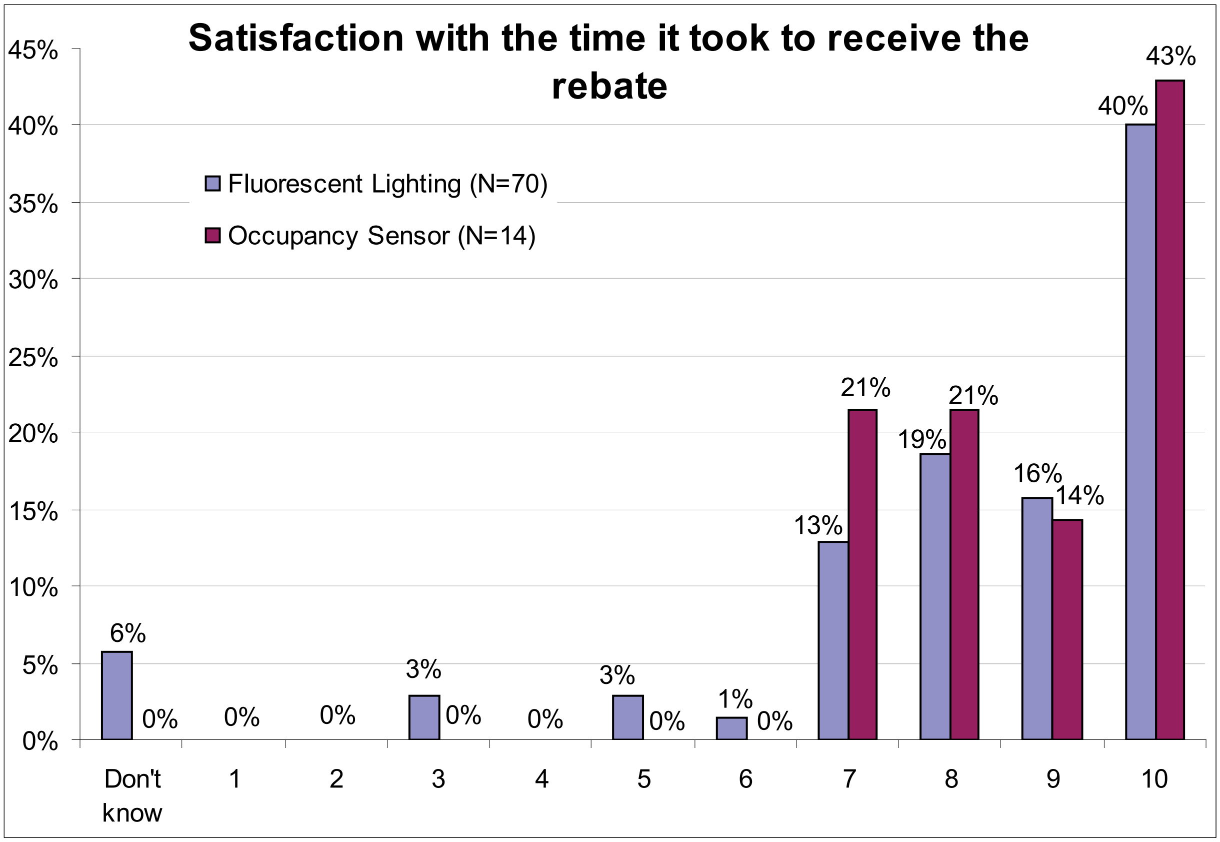


Figure 12. Satisfaction with the time it took to receive the rebate

Seventeen respondents (20.2% of 84) rated their satisfaction with the time it took to receive their rebate at "7" or less on a 10 point scale. They were asked what could be done to improve this aspect of the program, and their answers are listed below.

- 7 respondents (8.3% of 84) felt their rebates should have come faster. Their comments are listed below.
  - "*The rebate could have come more quickly, and the amount of paperwork delayed it*."
  - "*A 3-5 day turnaround would be ideal*."
  - "*Duke could speed up its process by at least 15 to 25 business days*."
  - "*It could have been faster*."
  - "*Minimize delays for rebate payments*." (3 respondents)

- 6 respondents (7.1% of 84) wanted better communication from Duke Energy. Their comments are listed below.
  - "*Clarify the rebate form and better communication*."
  - "*Clarify the rebate submission and status process*."
  - "*Duke could have done more to notify us about the progress of our application*."

- *"Duke Energy did not tell us how long it would take to receive the rebate when we submitted our paperwork."*
- *"It could be easier to work out paperwork problems with Duke staff."*
- *"Make conference calls available to discuss issues."*

- 4 respondents (4.8% of 84) had no specific suggestions about how to improve the speed of the rebate process.

Figure 13 shows that satisfaction with interactions and communications with Duke Energy staff were generally very high. A strong plurality (44.0% or 37 out of 84) rated this aspect of the program a "10" on a 10-point scale, while only 15.5% (13 out of 84) rated interactions and communications with Duke Energy staff a "7" or less on a 10 point scale.

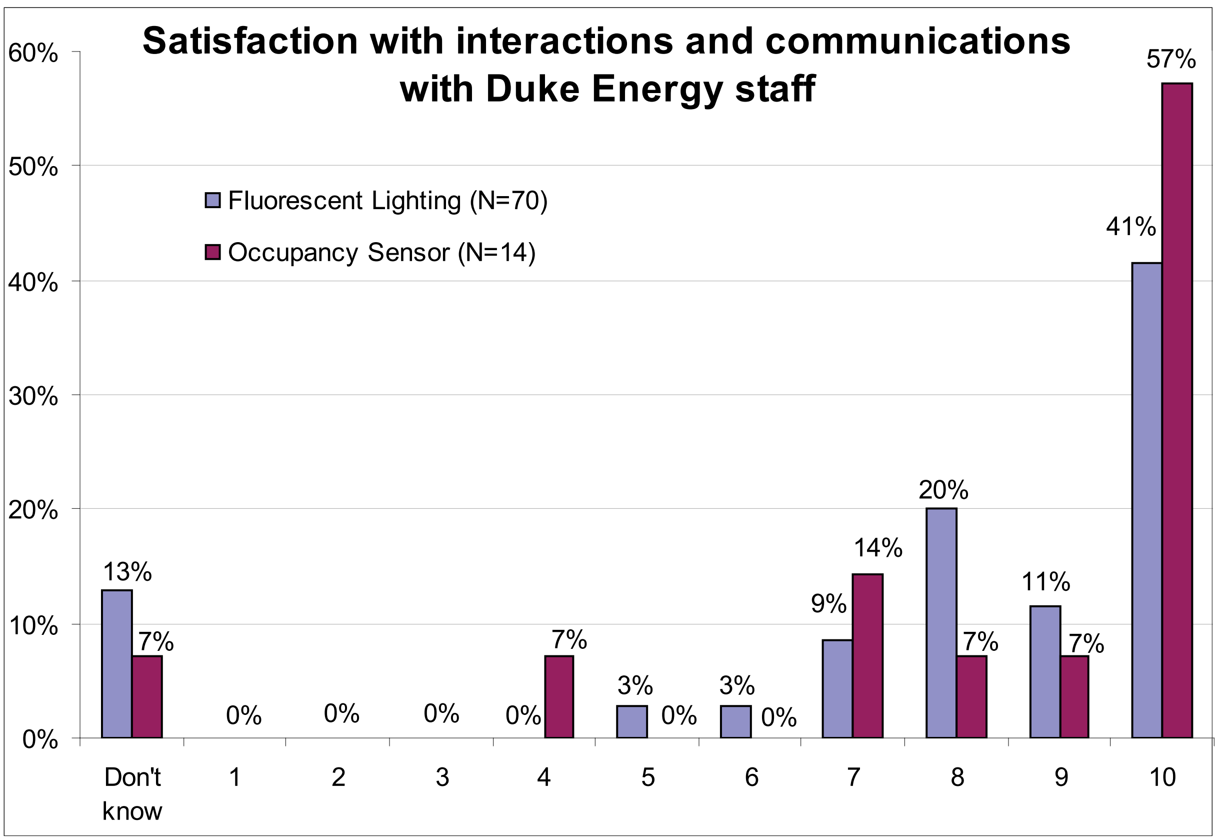


Figure 13. Satisfaction with interactions and communications with Duke Energy staff

Thirteen respondents (15.5% of 84) rated their satisfaction with their interactions and communications with Duke Energy staff a "7" or lower on a 10 point scale. They were asked what could be done to improve this aspect of the program, and their answers are characterized below.

- 4 respondents (4.8% of 84) expressed concerns about the speed of response from Duke Energy staff. Their comments are listed below.
  - "*The staff could have responded more quickly to my questions*."
  - "*They could do a much better job answering and returning calls & emails*."
  - "*Through quicker reaction time to questions either through phone or web*."
  - "*Duke could have been quicker about getting the rebate out*."
- 4 respondents (4.8% of 84) expressed concerns about getting access to information. Their comments are listed below.
  - "*Customer Service employees could be more knowledgeable about the program*."
  - "*The staff were always responsive, but I had trouble trying to get information about custom incentives. There could be better ways to access custom incentive applications*."
  - "*Duke staff should be better-versed on the requirements of the program*."
  - "*There should be easier access to energy experts via phone*."
- 1 respondent (1.2% of 84) expressed another concern, listed below.
  - "*I think Duke is a little too concerned that somebody is trying to cheat them. They should not treat people like they are trying to take advantage*."
- 4 respondents (4.8% of 84) had no specific suggestions about how to improve communications and interactions with Duke Energy staff.

Satisfaction with the information provided explaining the program was high, particularly among Occupancy Sensor rebate recipients (50.0% or 7 out of 14 rated this aspect a "10" on a 10-point scale, versus 34.3% or 24 of 70 Fluorescent Lighting rebate recipients). Overall, only 10.7% (9 out of 84) of respondents rated the information they were provided explaining the program at "7" or less on a 10 point scale, as shown in Figure 14.

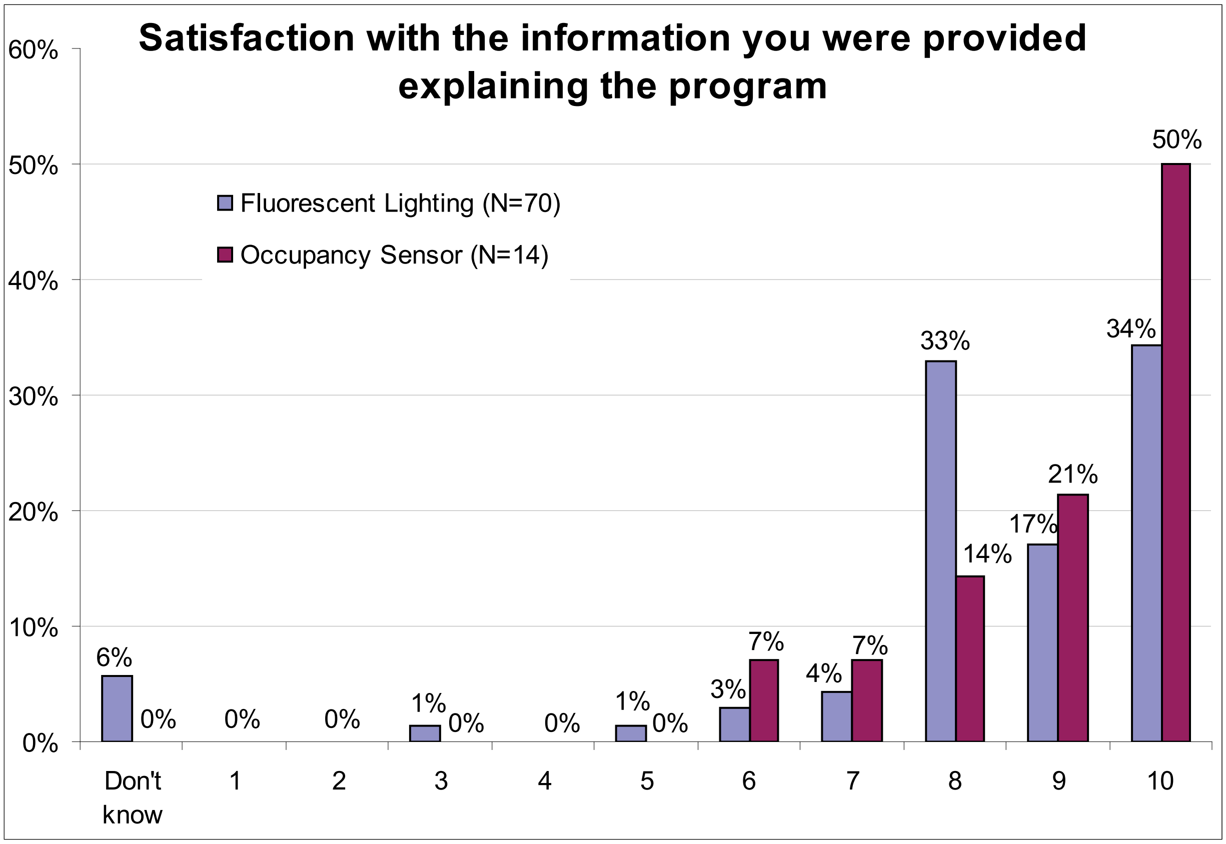


Figure 14. Satisfaction with the information you were provided explaining the program

Nine respondents (10.7% of 84) rated their satisfaction with information they were provided explaining the Smart $aver program at "7" or lower on a 10 point scale. They were asked what could be done to improve this aspect of the program, and their answers are characterized below.

- 3 respondents (3.6% of 84) wanted more human contact from Duke Energy. Their comments are listed below.
  - "*The information is very technical in nature. If Duke had someone to walk you through the process, it would help get past some of the technical hurdles.*"
  - "*Local representatives could check in with yearly updates on changes to the program.*"
  - "*More human accessibility & interaction.*"
- 2 respondents (2.4% of 84) wanted more technological options. Their comments are listed below.
  - "*I would have liked to see the information available in different formats, namely a thumb drive, videos, and more examples of what the program covered.*"
  - "*By having clear & accurate information available online.*"

- 1 respondent (1.2% of 84) wanted the information to be simplified; this comment is listed below.
    - "*Duke should put more of the form information in layman's terms*."
- 3 respondents (3.6% of 84) had no specific suggestions about how to improve the information that explains the program.

What Participants Liked Most and Least about the Smart $aver Program

Table 52 categorizes the open-ended responses of participants when they were asked what they liked most about non-residential Smart $aver. Half (51.2% or 43 out of 84) mentioned the incentive payment, with saving money on bills in the long run being the next most frequent response (15.5% or 13 out of 84). Occupancy Sensor rebate recipients were more significantly likely to mention the ease and simplicity of participation (35.7% or 5 out of 14) compared to Fluorescent Lighting rebate recipients (10.0% or 7 out of 70; this difference is significant at p<.05 using student's t-test).

Table 52. What do you like most about the non-residential Smart $aver program?

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Like immediate rebate / incentive / recouping some upfront costs	51.4%	50.0%	51.2%
Like saving money on bills / return on investment	14.3%	21.4%	15.5%
Like how easy it was / simplicity	10.0%	35.7%	14.3%
Like saving energy / helping the environment	10.0%	0.0%	8.3%
Like Duke Energy for doing this	8.6%	0.0%	7.1%
Like that our organization is now more interested in efficiency / justifies further upgrades	7.1%	7.1%	7.1%
Like upgraded equipment / better lighting	7.1%	0.0%	6.0%
Liked learning about efficiency / knowledge gained	2.9%	7.1%	3.6%
Liked speed of rebate	2.9%	7.1%	3.6%
Like variety of products covered	1.4%	0.0%	1.2%
Liked being able to do it online	1.4%	0.0%	1.2%
Don't know / Nothing	2.9%	0.0%	2.4%

Multiple responses were accepted for this question, so columns total to more than 100%.

Next, Table 53 categorizes respondents' least favorite things about participating non-residential

Smart $aver. Though a plurality (38.1% or 32 out of 84) did not have any complaints about Smart $aver, about one in four (26.2% or 22 out of 84) said their lease favorite part of the program had to do with the application process and filing paperwork. Another 11.9% (10 out of 84) complained about the size or speed or proportionality of the incentive rebate.

Table 53. What do you like least about the non-residential Smart $aver program?

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Difficulties with filing application / amount of paperwork	24.3%	35.7%	26.2%
Size / proportion / speed of rebate payment	11.4%	14.3%	11.9%
Limitations / lack of customization / what is covered	7.1%	0.0%	6.0%
Duke Energy did not do enough to help / promote	5.7%	0.0%	4.8%
Difficulty understanding information / application / jargon	5.7%	0.0%	4.8%
Having to rely on a third party (trade ally, consultant)	4.3%	0.0%	3.6%
Timeframe of program (start sooner / last longer)	2.9%	0.0%	2.4%
Losing employee time to upgrade project	2.9%	0.0%	2.4%
Difficult to sell or donate old equipment	0.0%	7.1%	1.2%
Lack of promotion in Spanish	1.4%	0.0%	1.2%
Being questioned about equipment usage	1.4%	0.0%	1.2%
Don’t know/Nothing	37.1%	42.9%	38.1%

Multiple responses were accepted for this question, so columns total to more than 100%.

Overall Satisfaction with Duke Energy

As seen in Figure 15, about a third of respondents (32.1% or 27 out of 84) rate their overall satisfaction with Duke Energy a “10 out of 10”, and 83.3% (70 out of 84) rate their satisfaction with Duke Energy an “8” or higher. Only 4.8% (4 out of 84) rated their satisfaction with Duke Energy a “5” or lower on a 10-point scale.

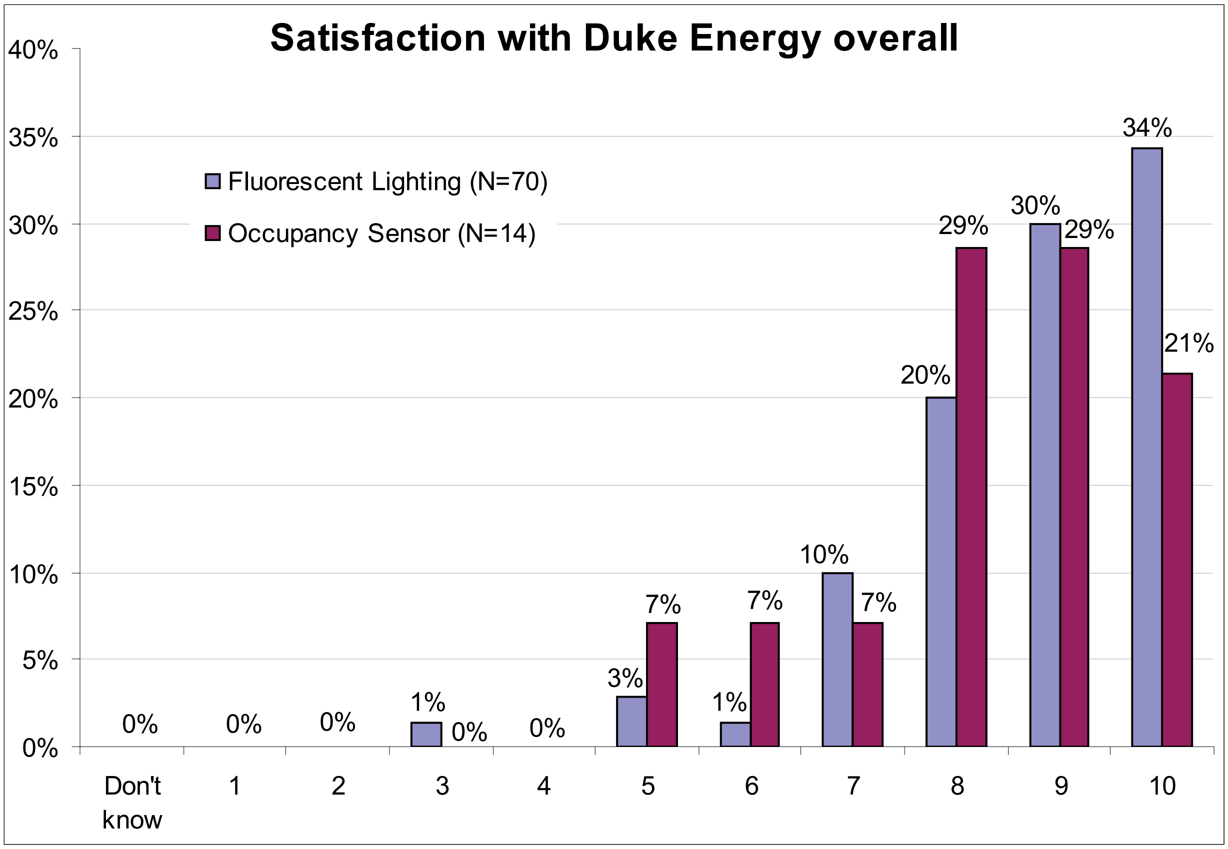


Figure 15. Satisfaction with Duke Energy overall

Fourteen respondents (16.7% of 84) rated their overall satisfaction with Duke Energy a "7" or lower on a 10 point scale. They were asked what could be done to improve their satisfaction with Duke Energy.

- 5 respondents (6.0% of 84) mentioned issues with Duke Energy's rates. Their comments are listed below.
  - "*By not raising rates. Recent rate increases negated what we were saving with new measures*."
  - "*Duke Energy should try to limit the frequency and amount of rate increases*."
  - "*Duke should not bill an organization by the peak energy usage of the month. Duke should charge people for what they use*."
  - "*Decrease energy rates*." (2 respondents)
- 4 respondents (4.8% of 84) mentioned issues with information and communications with Duke Energy and its staff. Their comments are listed below.
  - "*Duke's communication with field engineers needs to be improved, namely on construction projects. Duke also needs to better supervise its subcontractors*."

- "*Duke could be more proactive in providing us information that would save us money outside of the incentive programs*."
- "*It is difficult to get in touch with Duke Energy staff. The employees could be more accessible*."
- "*Duke is very bureaucratic and difficult to get quick answers from. Duke could be more open to new ideas and change. Progress Energy's rebate system is much more flexible and provides greater incentives. We are trying to get street-lighting prototypes, and the program for that could be improved. Their cost-sharing programs could be more equitable*."

- 2 respondents (2.4% of 84) mentioned issues with maintenance and performance. Their comments are listed below.
  - "*Eliminate power outages & surges*."
  - "*Maintenance of Duke Energy equipment (transformers)*."

- 2 respondents (2.4% of 84) mentioned issues with mergers and acquisitions. Their comments are listed below.
  - "*Duke Energy should abandon plans to purchase Progress Energy. Also, better maintain right-of-ways (trees)*."
  - "*More competition, less monopoly*."

- 1 respondent (1.2% of 84) had no suggestions.

Improving the Non-Residential Smart $aver Program

Respondents were asked what additional services they'd like to see provided by the Smart $aver program. Although half (50.0% or 42 out of 84) had no suggestions, a significant portion of the remaining respondents (21.4% or 18 out of 84) wanted to see more types of technology covered by the program (their verbatim suggestions are listed after Table 54). The only other suggestion category to be mentioned by more than 10% of respondents was making more experts from Duke Energy available (10.7% or 9 out of 84).

Table 54. What additional services would you like the Smart $aver program to provide?

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Incentives for more types of equipment (listed below)	22.9%	14.3%	21.4%
Make experts more available on-site, through workshops or over the phone	10.0%	14.3%	10.7%
More custom programs & options / post-approval of energy efficient	7.1%	0.0%	6.0%

installations			
More info / updates / literature / education about programs	4.3%	7.1%	4.8%
More recommendations from Duke Energy / more pro-active recommendations	4.3%	0.0%	3.6%
Higher incentives / bigger rebates	4.3%	0.0%	3.6%
Help organizations review their energy decisions	1.4%	7.1%	2.4%
Use more Smart Meters / better metering & monitoring	1.4%	7.1%	2.4%
Rebates and incentives tied to metering	1.4%	7.1%	2.4%
Use newer tech / opportunity to test market new tech	2.9%	0.0%	2.4%
Include smaller items with smaller rebates	2.9%	0.0%	2.4%
Push for more participation from large facilities	1.4%	0.0%	1.2%
Don't know / Nothing	50.0%	50.0%	50.0%

Multiple responses were accepted for this question, so columns total to more than 100%.

Eighteen respondents (21.4% of 84) suggested that more types of equipment should be covered by Non-Residential Smart $aver. Their verbatim comments are listed below. The most commonly mentioned technologies are LED lighting (mentioned by 5 respondents or 6.0% of 84), HVAC systems (mentioned by 4 respondents or 4.8% of 84) and energy management systems (mentioned by 3 respondents or 3.6% of 84).

- "*I would like to see a rebate program that covers more HVAC upgrades, LED lighting, and energy-management systems*."
- "*Duke could provide more HVAC incentives*."
- "*I would like to see broader choices for smaller HVAC solutions and smaller fans. A lot of what the incentive program is for covers big stuff, but many of our buildings have small systems, and those still add up across a lot of buildings*."
- "*I would like to see a wider technology variety in the lighting incentives, and better incentives for HVAC units. Some efficient HVAC units do not currently qualify for Duke's incentives*."
- "*I would like to see more coverage of LED lighting projects*."
- "*I would like to see more incentives specific to our current projects, for instance LED lighting in parking lots*."
- "*It could cover more LED options, and more options for replacing variable speed drives*."
- "*It needs to expand its options for LEDs, parking-lot lights, and roadway lights. Currently, LEDs require a custom application*."
- "*Vending machine fluorescent lighting upgrades*."
- "*I would like the North Carolina programs to cover energy management systems*."
- "*Incentives for energy monitoring equipment and/or software*."

- "*I would like to see more emphasis on motors and compressors, not just lighting upgrades*."
- "*I would like the program to provide more incentives for solar power*."
- "*Solar*."
- "*The program could cover energy efficient multi-deck refrigeration*."
- "*Energy efficient computer server upgrade incentives*."
- "*Water heater incentives*."
- "*Add more types of efficiency equipment covered by program*."

As a follow-up question, respondents were asked if there were any other things they would like to change about the Smart $aver program. Only 16 respondents (19.0% of 84) had further suggestions; their verbatim comments are listed below.

- "*Contractors should be well-informed and forthcoming about the program*."
- "*Duke should be more clear about the window of time you have to apply for the rebate once you have completed a project*."
- "*More promotion of the program itself*."
- "*More promotion of the program*."
- "*More promotion within the Spanish-speaking community*."
- "*On-site energy consultant visits*."
- "*Increase eligibility for new, different measures*."
- "*Some of the incentives could be higher*."
- "*Geothermal hot water heaters added to prescriptive rebate program*."
- "*Higher incentives for T12 retrofits*."
- "*Lighting incentives offered to residential customers*."
- "*Simplify the process & paperwork*."
- "*Simplify the rebate application*."
- "*I would like to be able to submit more of the forms online, and track their movement through the process*."
- "*I would like to see the program extended so that more customers can participate*."
- "*It would be great if the program could partner with some of our Girl Scouts programs for youth, and help us with girls involved in science, technology, engineering and math*."

- 68 respondents (81.0% of 84) had no further suggestions for things they would like to see changed about Smart $aver.

Increasing Participation in Non-Residential Smart $aver

Respondents were asked what they though could be done to increase interest in participating in Smart $aver; their suggestions are shown in Table 55. The most frequent suggestion was that Duke Energy should make more effort to advertise, promote, educate and spread awareness of Smart $aver, mentioned by a third of participants (33.3% or 28 out of 84). Other common suggestions include direct mail (20.2% or 17 out of 84), more partnerships with trade allies

(13.1% or 11 out of 84), using email and the web more (15.5% or 13 out of 84), personal contact from Duke Energy Representatives by phone or in-person (10.7% or 9 out of 84), and providing more testimonials and examples of energy savings (10.7% or 9 out of 84). Only 6.0% (5 out of 84) of respondents had no suggestions at all.

Table 55. What can be done to increase interest in participating in Smart $aver?

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
More info / education / awareness / advertising / etc.	34.3%	28.6%	33.3%
Direct mail / inserts with bills	20.0%	21.4%	20.2%
More trade ally participation & partnerships	12.9%	14.3%	13.1%
Email customers / use Duke Energy website more	11.4%	35.7%	15.5%
Personal contact from Duke Energy representatives (phone or on site)	10.0%	14.3%	10.7%
Examples / testimonials / notify customers of their own savings	12.9%	0.0%	10.7%
Target specific industries or job titles	7.1%	21.4%	9.5%
Reach out to industry groups / associations / conferences / publications	5.7%	0.0%	4.8%
More / larger / quicker rebates	4.3%	0.0%	3.6%
Make application easier	4.3%	0.0%	3.6%
More cooperation with government / info on tax credits	2.9%	0.0%	2.4%
Don't know / nothing	7.1%	0.0%	6.0%

Multiple responses were accepted for this question, so columns total to more than 100%.

Ranking the Reasons Why an Organization Tries to Save Energy

Figure 16 shows respondents' rankings of five statements in terms of how well they describe their company's view on saving energy. The five statements are listed below.

A. Our energy efficiency efforts contribute to increased customer satisfaction.
B. We want to project a "green" (sustainable) image to the community.
C. Our organization is concerned about the environment.
D. Saving energy is not important to our organization.
E. Saving energy is important because it reduces costs, but not for any other reason.

Respondents from companies that received Smart $aver rebates for Occupancy Sensors favored statement C "our organization is concerned about the environment" (50.0% or 7 out of 14 ranking this item their #1 reason for saving energy). The next most popular statements among this group were statement E “saving energy is important because it reduces costs” (ranked #1 by 28.6% or 4 out of 14) and statement B “we want to project a "green" (sustainable) image to the community” (ranked #1 by only 7.1% or 1 out of 14, but ranked #2 by 28.6% or 4 out of 14).

Among respondents who received a rebate for installing Fluorescent Lighting, opinion was more evenly divided, with statement B “we want to project a "green" (sustainable) image to the community” (ranked #1 by 30.0% or 21 out of 7) statistically tied with statement C “our organization is concerned about the environment” (ranked #1 by 25.7% or 18 out of 70) and statement E “saving energy is important because it reduces costs, but not for any other reason” (also ranked #1 by 25.7% or 18 out of 70).

None of the respondents in this study (0.0% or 0 out of 84) chose statement D “saving energy is not important to our organization”, and for respondents who received either type of rebate statement A “our energy efficiency efforts contribute to increased customer satisfaction” was the least frequently mentioned (ranked at all by only 22.9% or 16 out of 70 Fluorescent Lighting rebate recipients, and 21.4% or 3 out of 14 Occupancy Sensor rebate recipients).

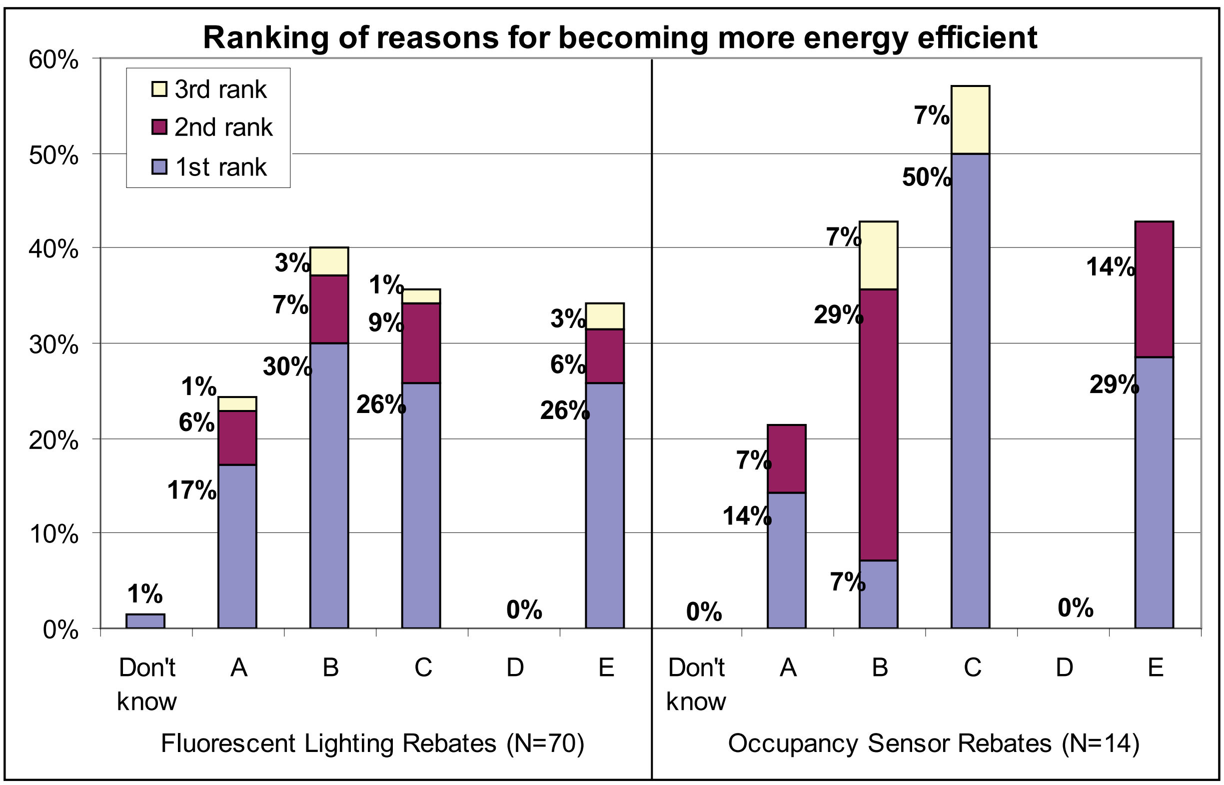


Figure 16. Ranking of reasons for becoming more energy efficient
Percentages total to more than 100% because respondents could rank multiple statements.

Characteristics of Respondent Companies

A little over one-third (35.7% or 30 out of 84) of the respondents in this survey installed their Smart $aver-rebated equipment at a non-profit, community or public sector organization. About one in five (21.4% or 18 out of 84) are industrial organizations, and the remaining 41.7% (35 out of 84) are other commercial entities. Occupancy Sensor installations were more likely to be done by warehouses (14.3% or 2 out of 14), construction or contracting concerns (14.3% or 2 out of 14) and property managers (14.3% or 2 out of 14). Fluorescent Lighting installations were more likely to be done by offices (11.4% or 8 out of 70) and "other industrial" concerns (11.4% or 8 out of 70).

Table 56. Survey respondent's organization

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Total non-profit and public sector	**37.1%**	**28.6%**	**35.7%**
Community Service / Church / Temple / Municipality	20.0%	14.3%	19.0%
School	10.0%	7.1%	9.5%
College/ University	4.3%	0.0%	3.6%
Government	2.9%	7.1%	3.6%
Total industrial	**22.9%**	**14.3%**	**21.4%**
Electronics and machinery	7.1%	0.0%	6.0%
Petroleum, plastic, rubber, chemicals	2.9%	7.1%	3.6%
Mining, metals, stone, glass, concrete	1.4%	7.1%	2.4%
Other industrial	11.4%	0.0%	9.5%
Total other commercial	**38.6%**	**57.1%**	**41.7%**
Office	11.4%	0.0%	9.5%
Retail (non-food)	7.1%	7.1%	7.1%
Transport / Automotive	4.3%	7.1%	4.8%
Construction / Contracting	1.4%	14.3%	3.6%
Warehouse	1.4%	14.3%	3.6%
Property management	1.4%	14.3%	3.6%
Personal service	2.9%	0.0%	2.4%
Grocery store	2.9%	0.0%	2.4%
Convenience store	1.4%	0.0%	1.2%
Healthcare / Hospital	1.4%	0.0%	1.2%
Bank	1.4%	0.0%	1.2%
Country club	1.4%	0.0%	1.2%
Refused	1.4%	0.0%	1.2%

The customer sample list provided by Duke Energy for this survey also included information about the type of building where the installation took place, shown in Table 57. According to these records, most installations were either at commercial (41.7% or 35 out of 84) or manufacturing or industrial sites (19.0% or 16 out of 84). Ten records (11.9% of 84) did not contain any information about the type of building.

Table 57. Survey respondent's building type

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Commercial	40.0%	50.0%	41.7%
Manufacturing and Industrial	20.0%	14.3%	19.0%
Institutional	10.0%	7.1%	9.5%
School	7.1%	7.1%	7.1%
Office	5.7%	0.0%	4.8%
Warehouse	1.4%	7.1%	2.4%
Other (including government and house of worship)	4.3%	0.0%	3.6%
No information	11.4%	14.3%	11.9%

Table 58 shows that most participants (78.6% or 66 out of 84) in this survey own the buildings where the installation of Smart $aver-rebated equipment took place

Table 58. Ownership of property where installation took place

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Own space where installation took place	80.0%	71.4%	78.6%
Lease space where installation took place	17.1%	21.4%	17.9%
Own part and lease part of space where installation took place	0.0%	7.1%	1.2%
Don't know	2.9%	0.0%	2.4%

Companies that installed Occupancy Sensors tend to have somewhat more square footage at the locations where they installed their new equipment, as seen in Table 59; 64.3% (9 out of 14) of respondents whose companies installed Occupancy Sensors had more than 30,000 square feet, compared to only 41.4% (29 out of 70) of Fluorescent Lighting installations having that many square feet. Conversely, 24.3% (17 out of 70) of Fluorescent Lighting installations were at companies with under 10,000 square feet, and none (0.0% or 0 out of 14) of the Occupancy Sensor companies reported having that little square footage.

Table 59. Size of facility where installation took place

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Under 10,000 sq ft	24.3%	0.0%	20.2%
10,000 – 29,999 sq ft	18.6%	28.6%	20.2%
30,000 – 99,999 sq ft	18.6%	35.7%	21.4%
100,000 or more sq ft	22.9%	28.6%	23.8%
Don't know	15.7%	7.1%	14.3%

Table 60 shows the number of employees working at respondent's organizations. Overall, nearly half (47.6% or 40 out of 84) of the participating organizations surveyed have 25 or fewer employees at the location were the Smart $aver-rebated equipment was installed, although 21.4% (18 out of 84) have more than 100 employees.

Table 60. Number of employees at facility where installation took place

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Less than 10	28.6%	21.4%	27.4%
11 to 25	21.4%	14.3%	20.2%
26 to 40	5.7%	7.1%	6.0%
41 to 75	12.9%	7.1%	11.9%
76 to 100	7.1%	14.3%	8.3%
More than 100	20.0%	28.6%	21.4%
Don't know	4.3%	7.1%	4.8%

Respondents in this survey were asked their job title at the organization where the Smart $aver-rebated equipment was installed, which is reported in Table 61. At organizations where Occupancy Sensors were installed, the most common job titles were Energy Manager/Energy Coordinator (21.4% or 3 out of 14); jobs with "Real Estate" or "Property" in the title (14.3% or 2 out of 14); and assorted "other Manager/Director/Supervisor" titles (21.4% or 3 out of 14). At organizations where Fluorescent Lighting was installed, the most common job titles were Facilities Manager/Facilities Director (14.3% or 10 out of 70); assorted Engineering titles, electricians, inspectors and researchers (11.4% or 8 out of 70); Proprietor/Owner (10.0% or 7 out of 70); top management positions like President, CEO, General Manager (10.0% or 7 out of 70); and assorted "other Manager/Director/Supervisor" titles (14.3% or 10 out of 70).

Table 61. Survey respondent's job title at company

	Linear Fluorescent Lighting N=70	Occupancy Sensors N=14	Total N=84
Facilities Manager / Director	14.3%	7.1%	13.1%
Energy Manager / Coordinator	2.9%	21.4%	6.0%
Other facilities management / maintenance position	7.1%	7.1%	7.1%
Operations Manager / Director	4.3%	7.1%	4.8%
Proprietor / Owner	10.0%	7.1%	9.5%
President / CEO / COO / VP / GM	10.0%	7.1%	9.5%
Other Manager / Director / Supervisor	14.3%	21.4%	15.5%
Other financial / administrative position	8.6%	0.0%	7.1%
Engineer / electrician / inspector / researcher	11.4%	0.0%	9.5%
"Environmental" title	1.4%	7.1%	2.4%
"Real Estate" or "Property" title	4.3%	14.3%	6.0%
Government position	4.3%	0.0%	3.6%
Other job title	5.7%	0.0%	4.8%
Don't know	1.4%	0.0%	1.2%

Net to Gross Methodology

Freeridership

TecMarket Works utilized two sets of questions from the participant survey to estimate freeridership[13].

For the first set of calculations, the primary "gateway" question asks when they might have replaced their units without the Smart $aver program, and the second question asks those who say they would have delayed their purchase to estimate how long they would have delayed the purchase.

The gateway question asked survey respondents what their behavior would have been if the Smart $aver rebate program had not been available. The four categories of responses were:

a.) bought the same unit at the same time
b.) bought the same unit at a later time
c.) bought a used unit at the same time
d.) continued to use the currently installed unit and not purchase a new or used unit

Participants who indicated that they would have bought the same unit at the same time were assigned 100% freeridership. Participants answering that they would have continued using the currently installed unit were assigned 0% freeridership.

Freeridership for participants who indicated that they would have bought their units at a later time was determined by when they said they would have purchased the units in the absence of the program.

The equivalent freerider rate (the number of units that count toward freeridership) in the case of customers who indicated they would have purchased the unit at a later time, is the product of the freerider percentage multiplied by the number of respondents/units (each respondent was surveyed about one recently installed unit).

The second set of calculations is based on questions which ask what participants would have done without the Smart $aver incentive, and without the Smart $aver program information and technical assistance.

The three categories of responses to these questions were:

a.) bought unit with at least the same efficiency level
b.) bought a unit with a different efficiency level
c.) not sure what organization would have done

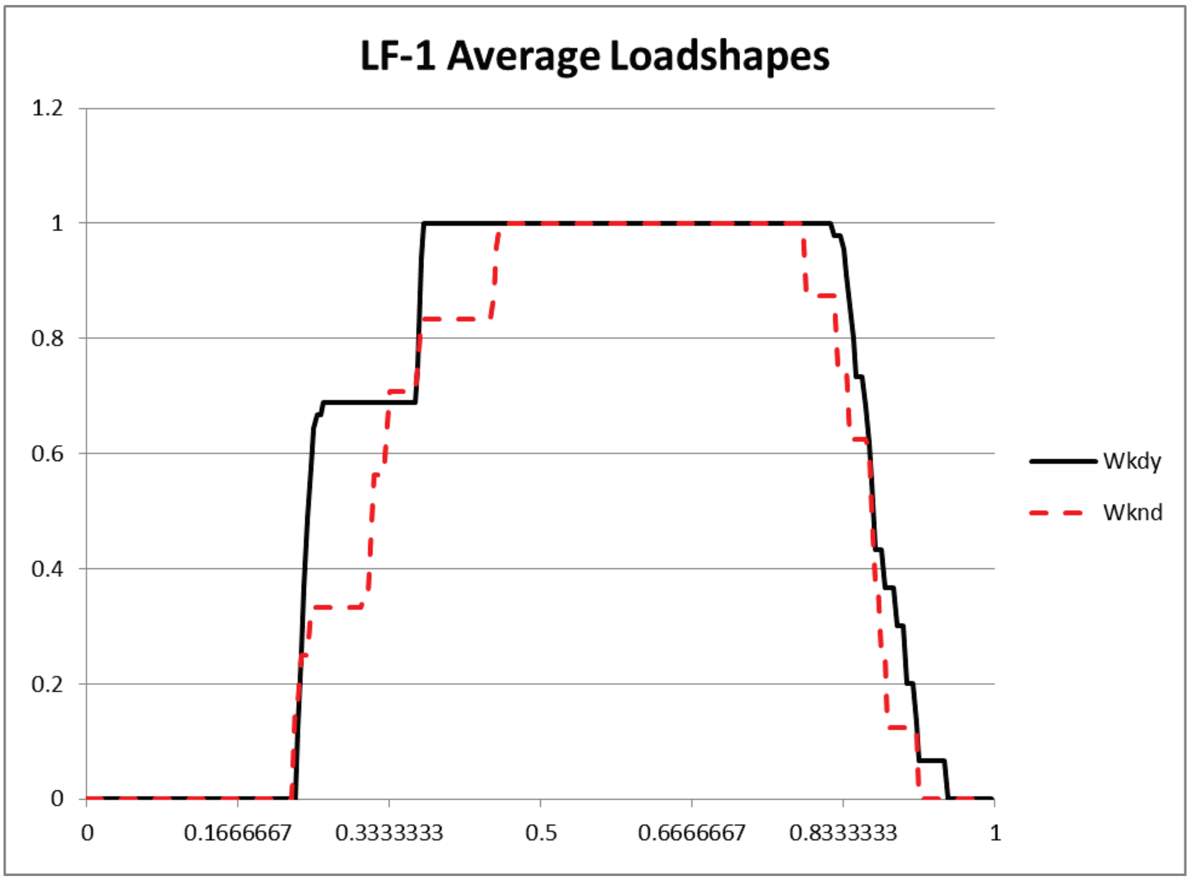
[13] Going forward an expanded approach will be used that employs three or more questions in compliance with Commission suggestions.

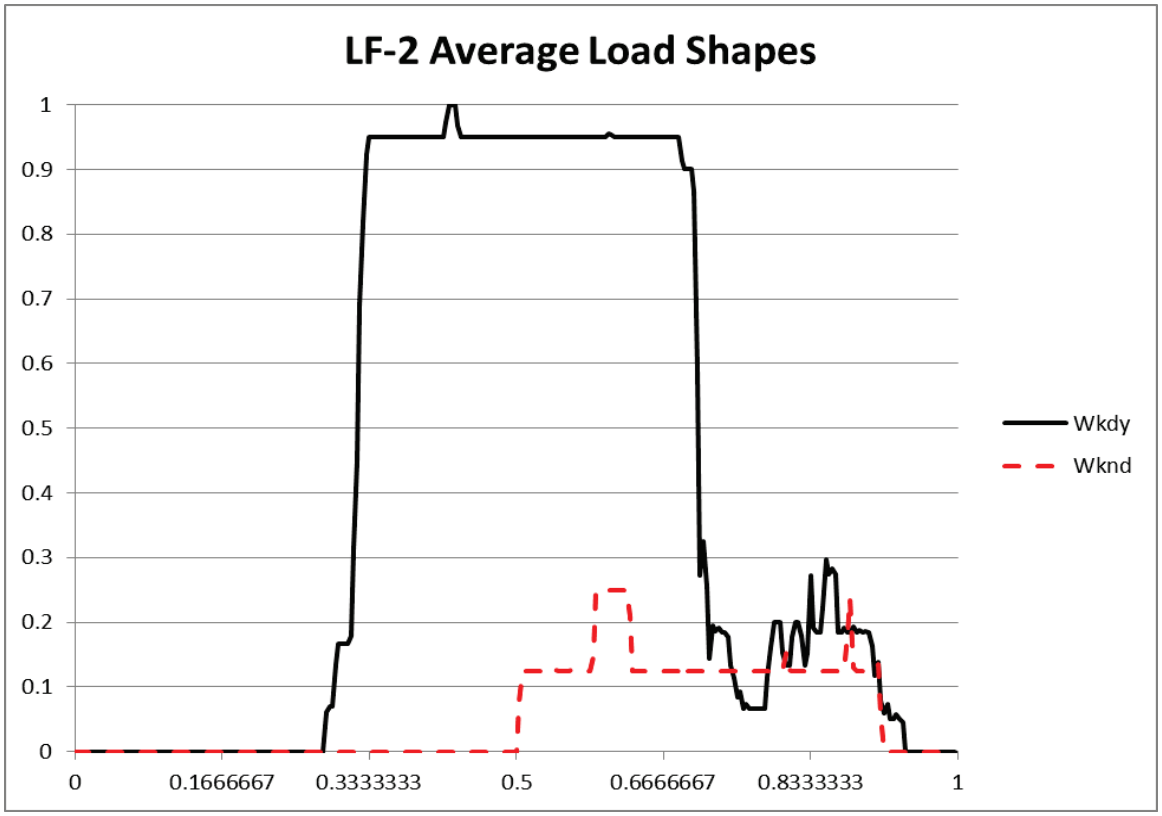
The results of the Freerider analysis will be presented in the energy impact report to be submitted under separate cover.

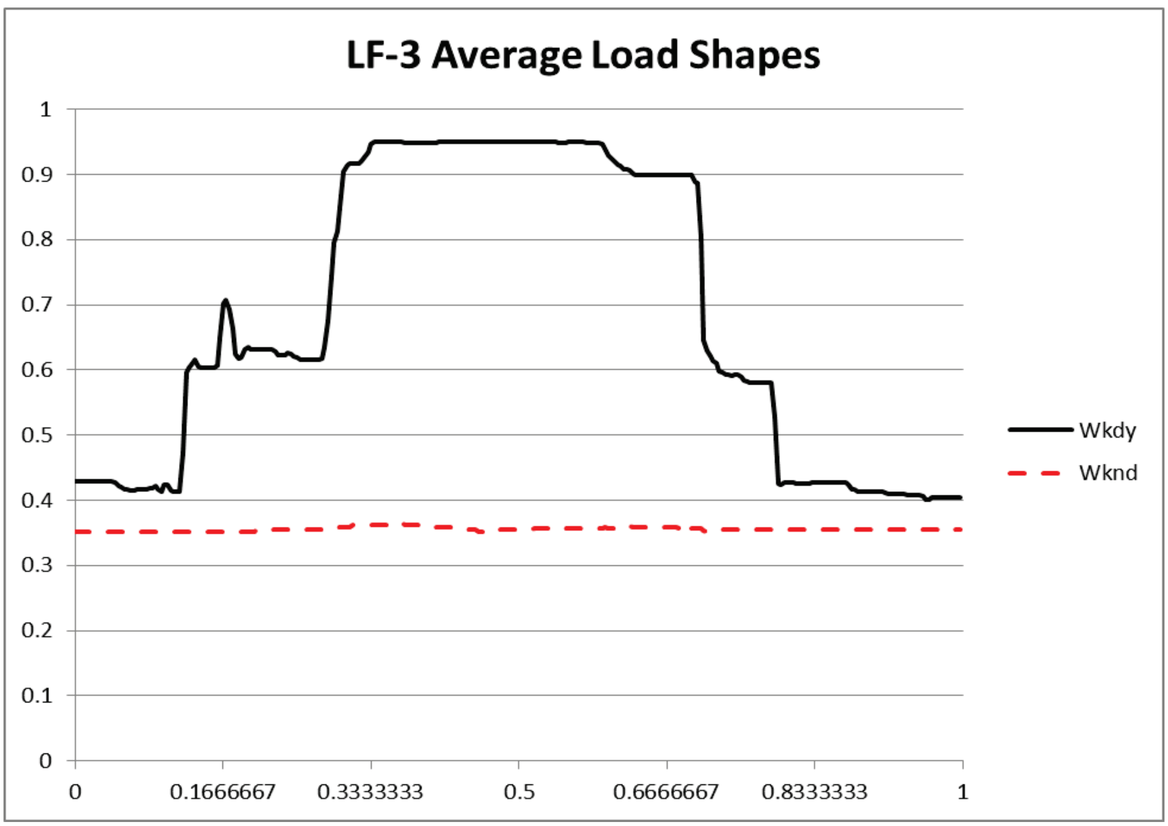
Appendix A: Load Shapes

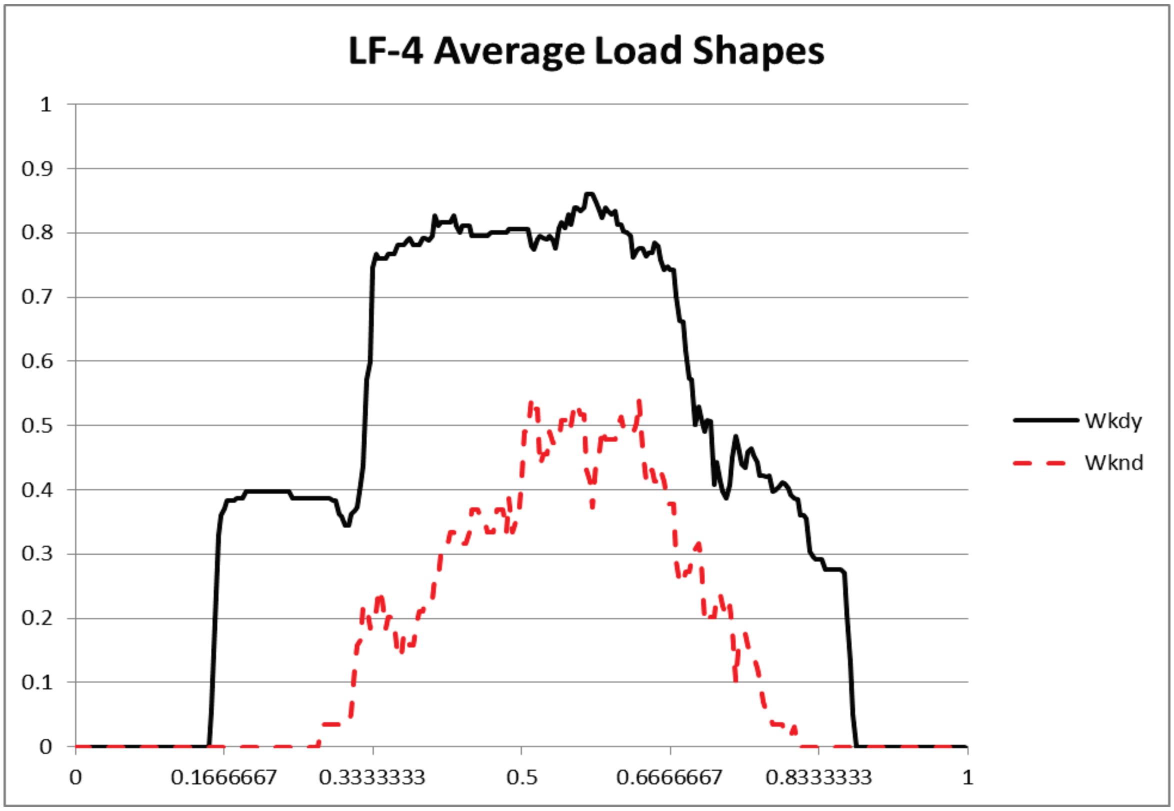
Average weekday and weekend/holiday load shapes from the logger data are shown for each site in the study.

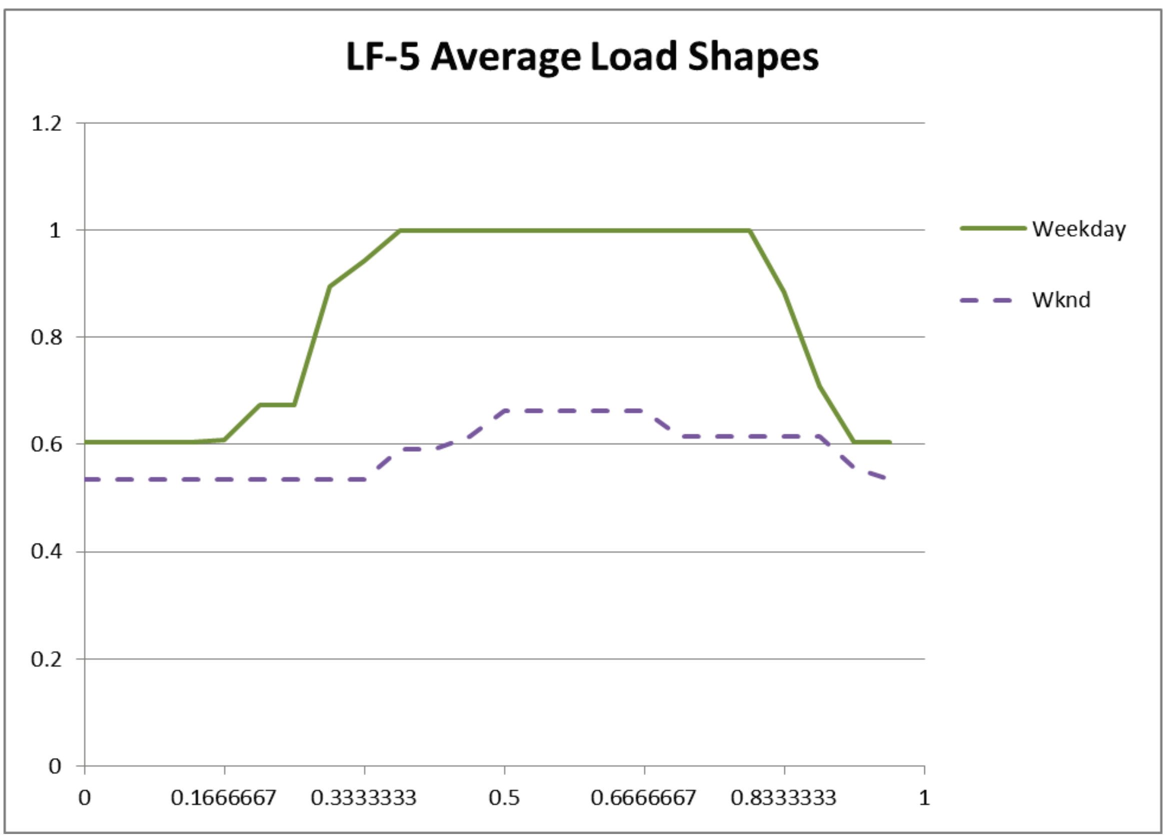
Linear Fluorescent Sites

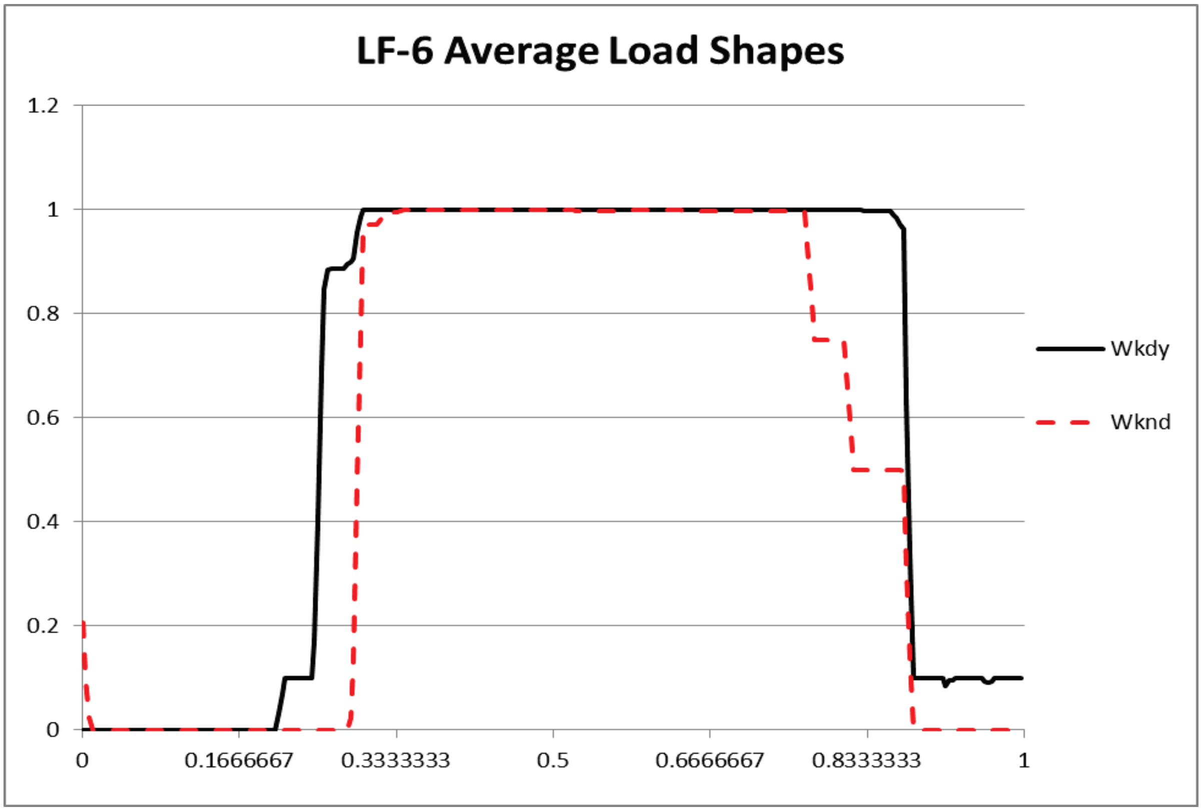


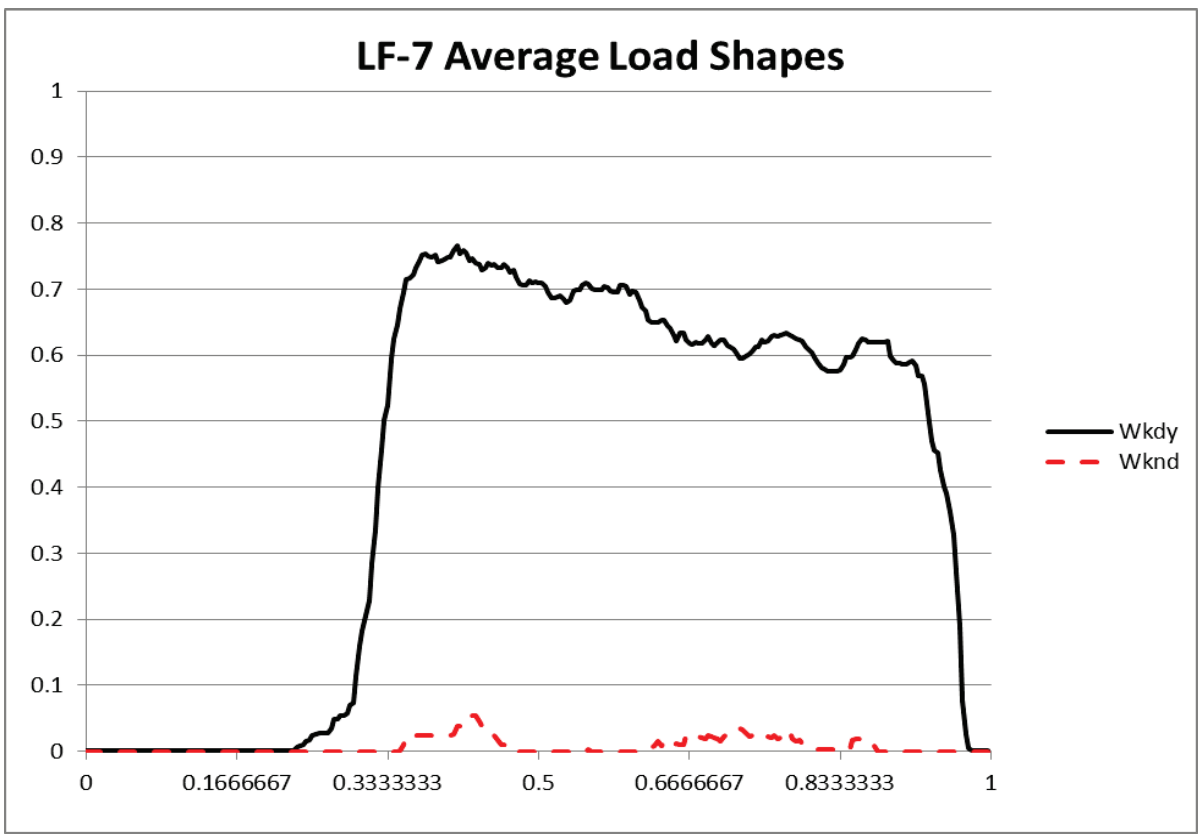

LF-2 Average Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

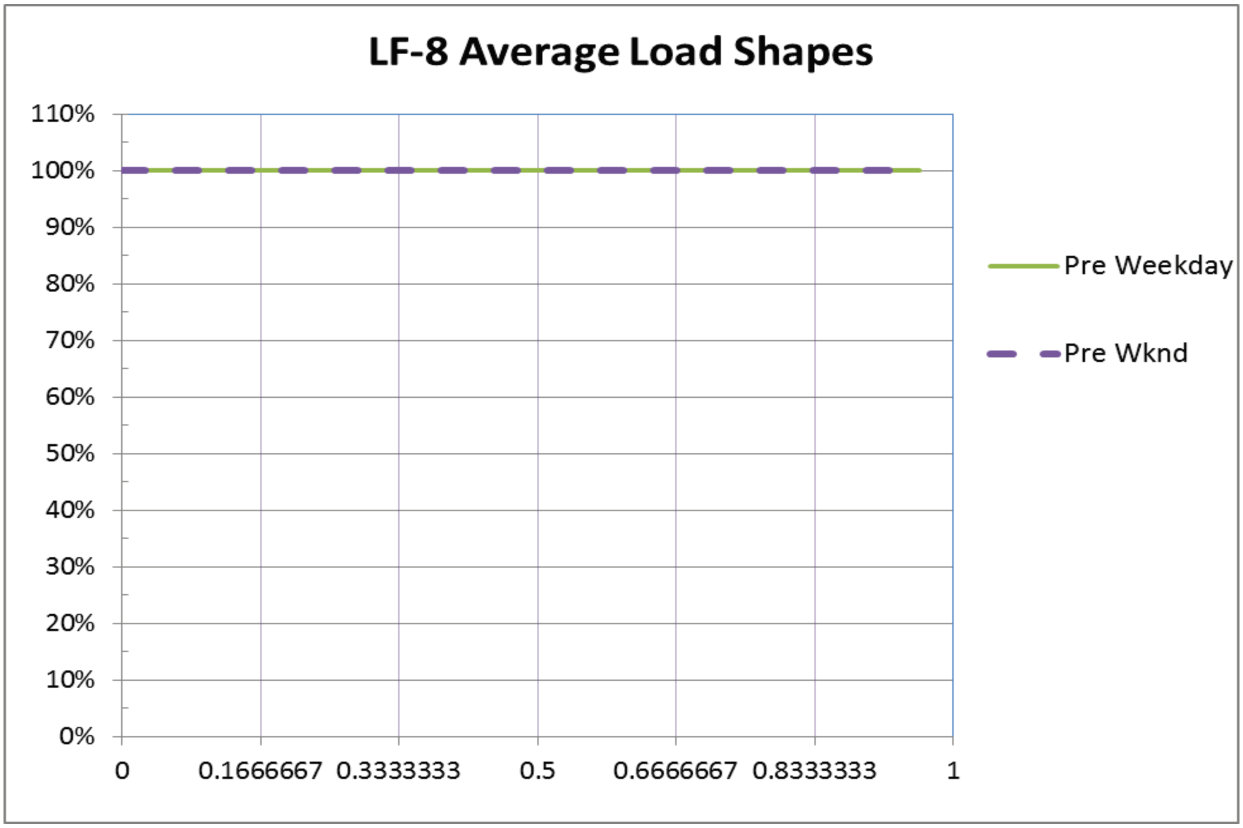

LF-3 Average Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

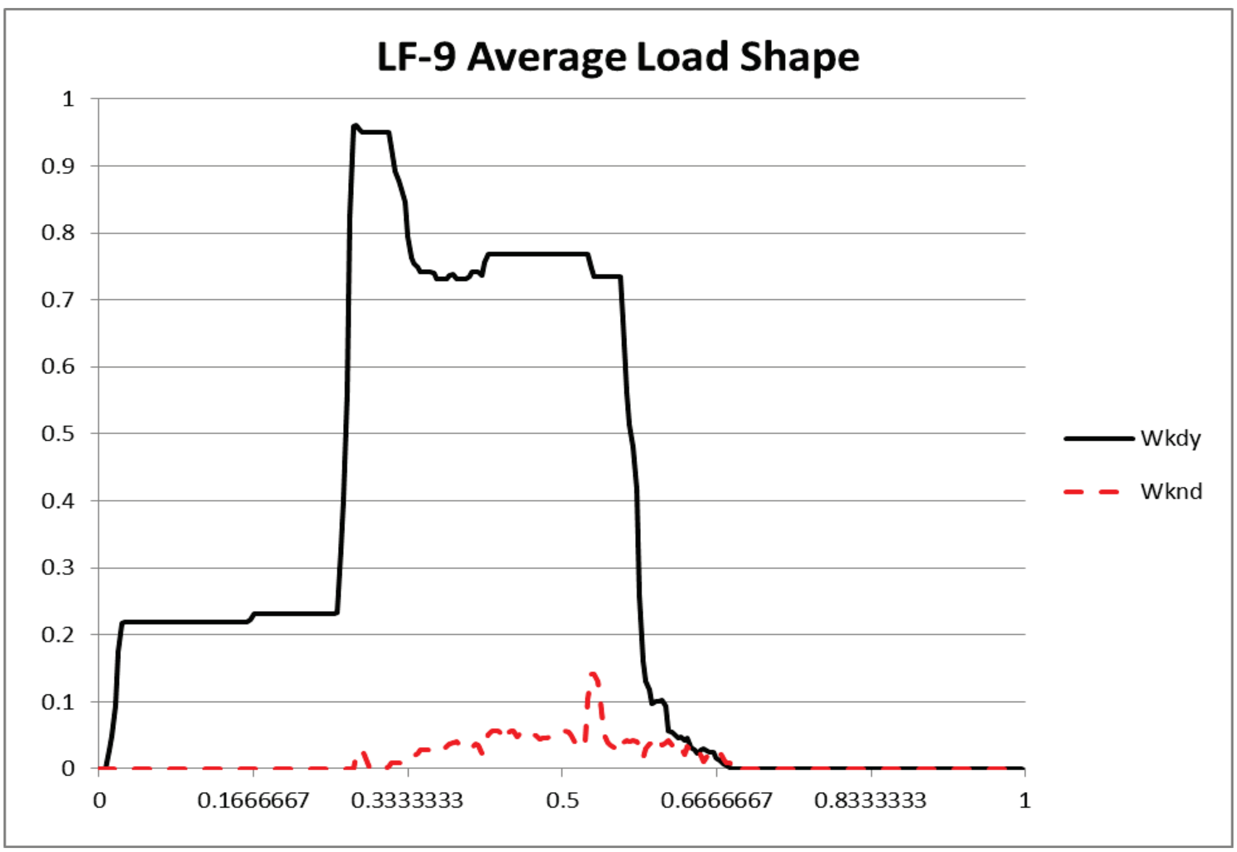

LF-4 Average Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

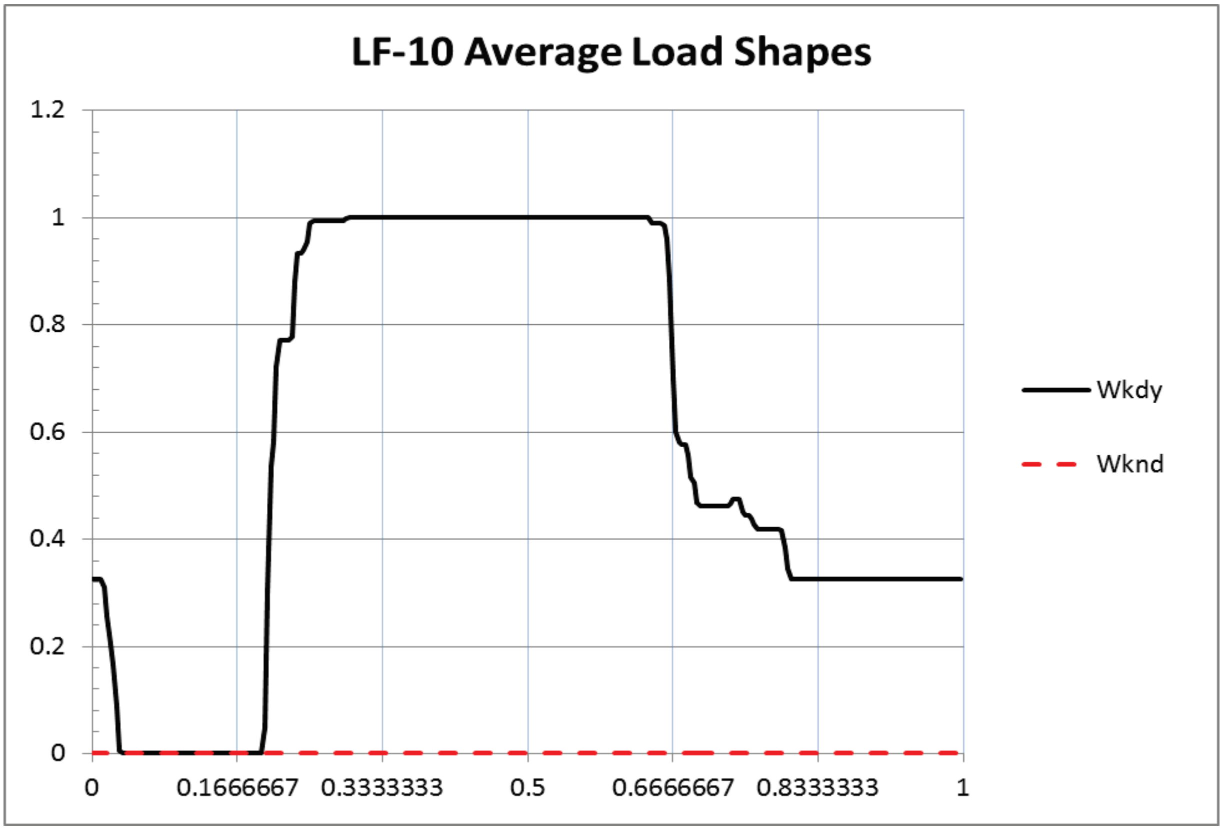

LF-5 Average Load Shapes
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Weekday
Wknd

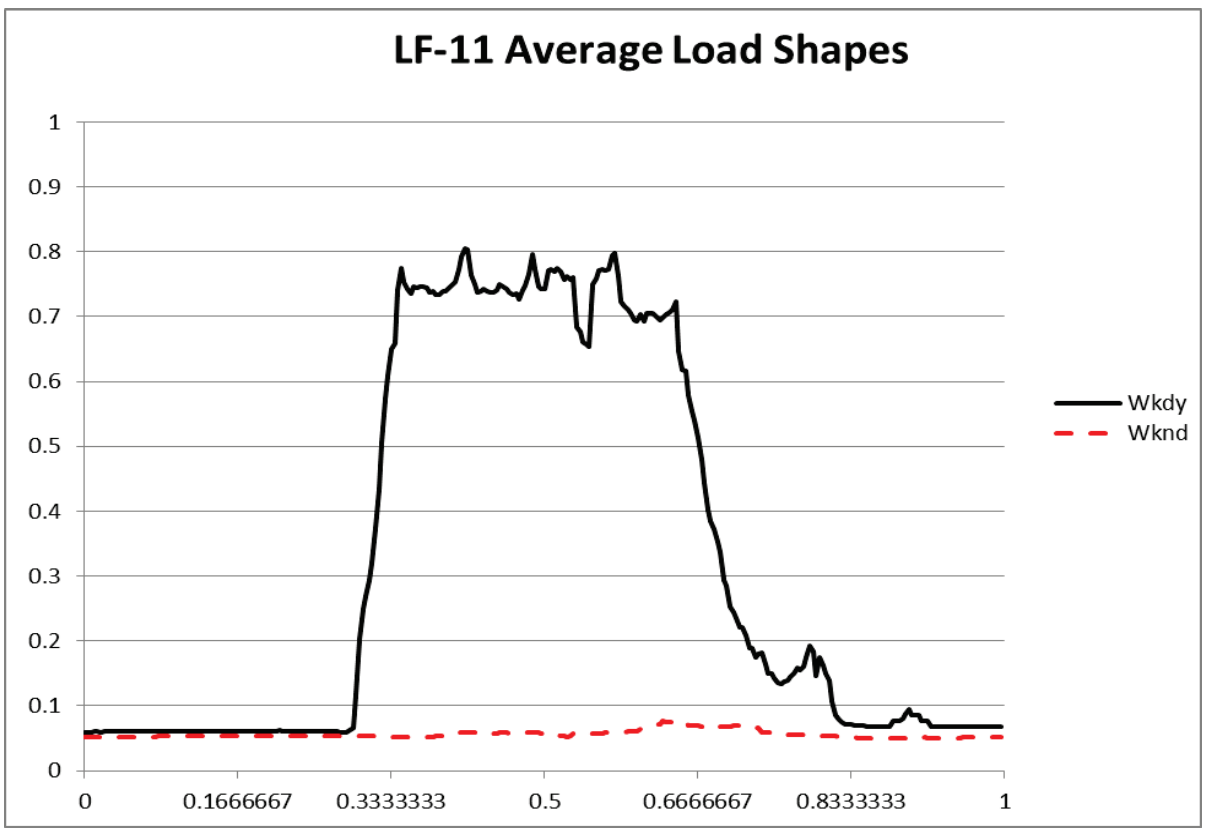

LF-6 Average Load Shapes
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

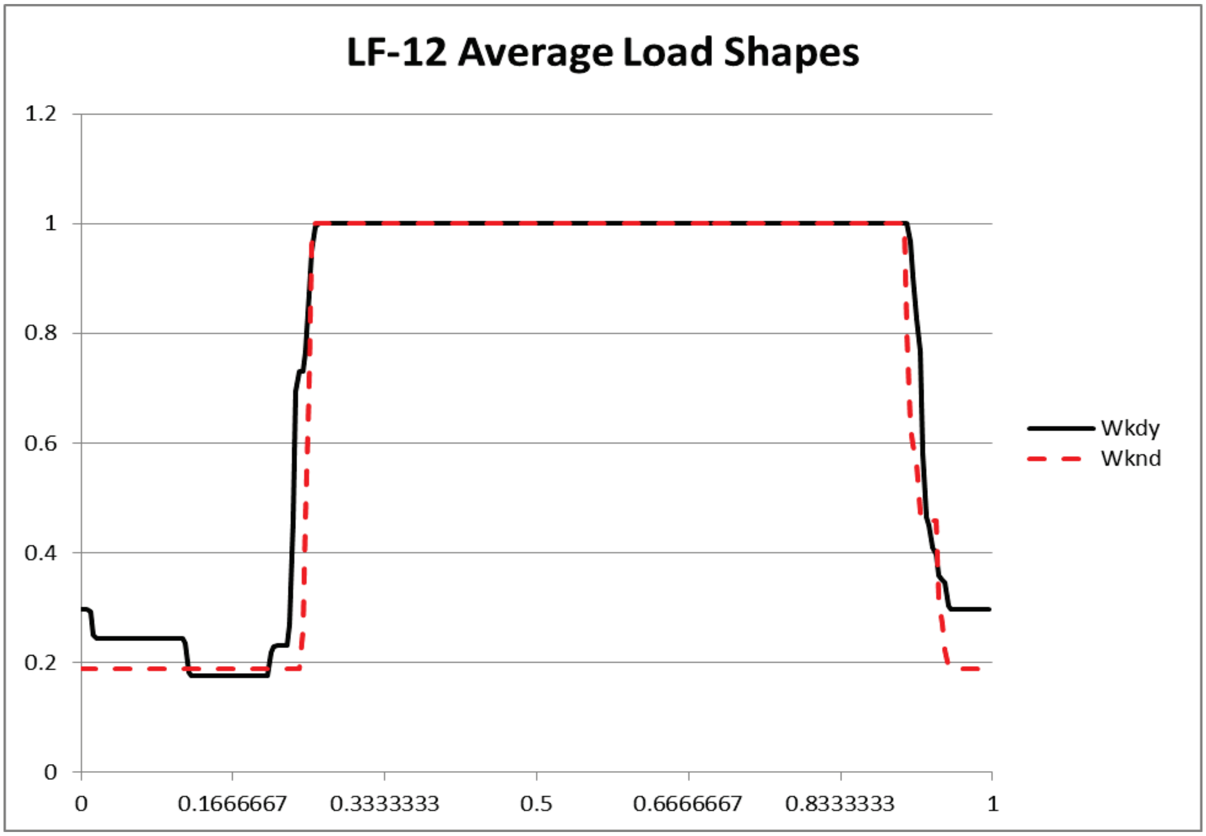

LF-7 Average Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

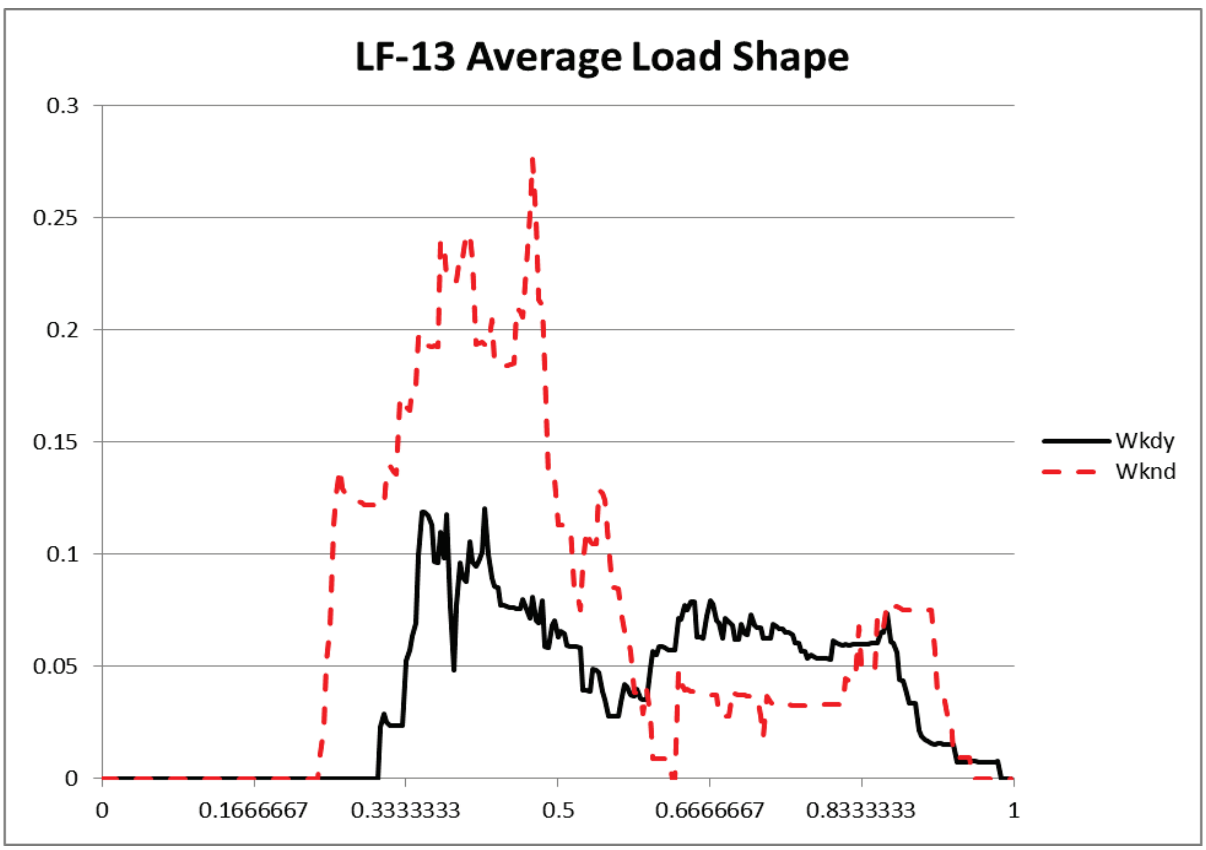

LF-8 Average Load Shapes
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Pre Weekday
Pre Wknd

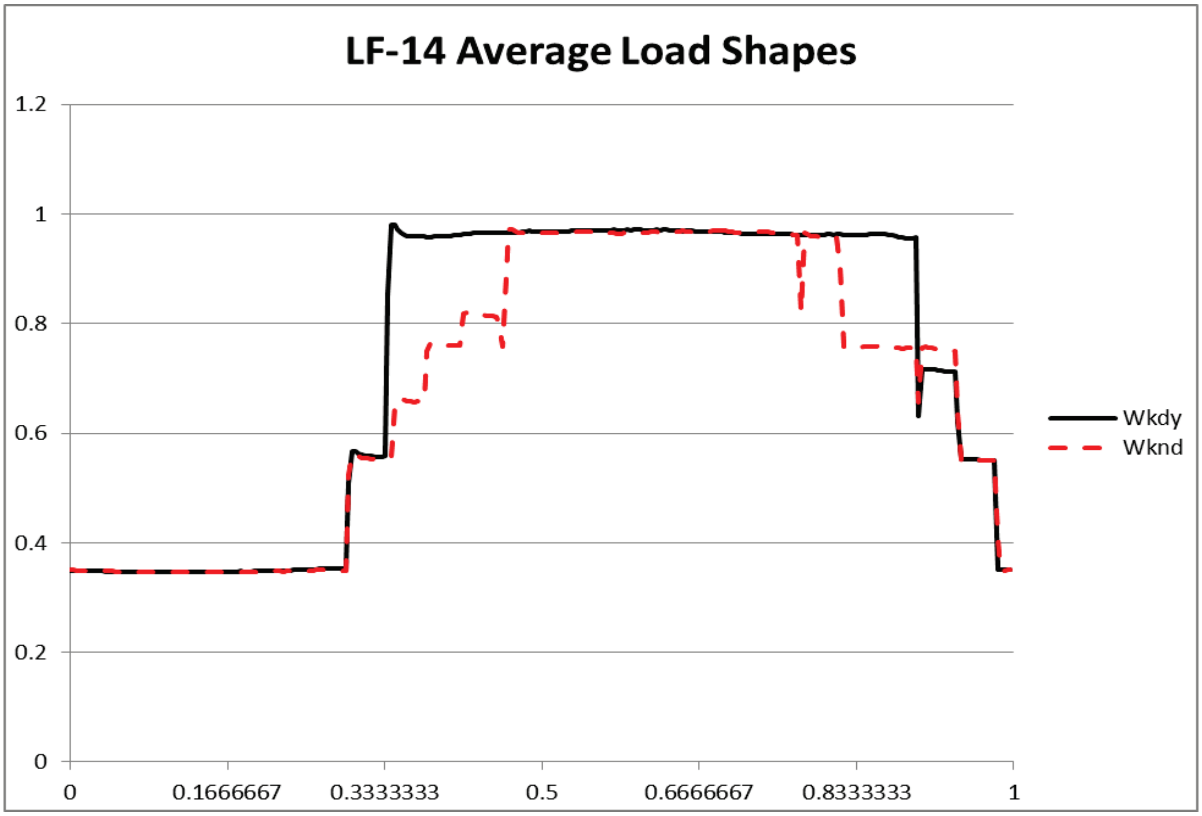

LF-9 Average Load Shape
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd


LF-10 Average Load Shapes
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

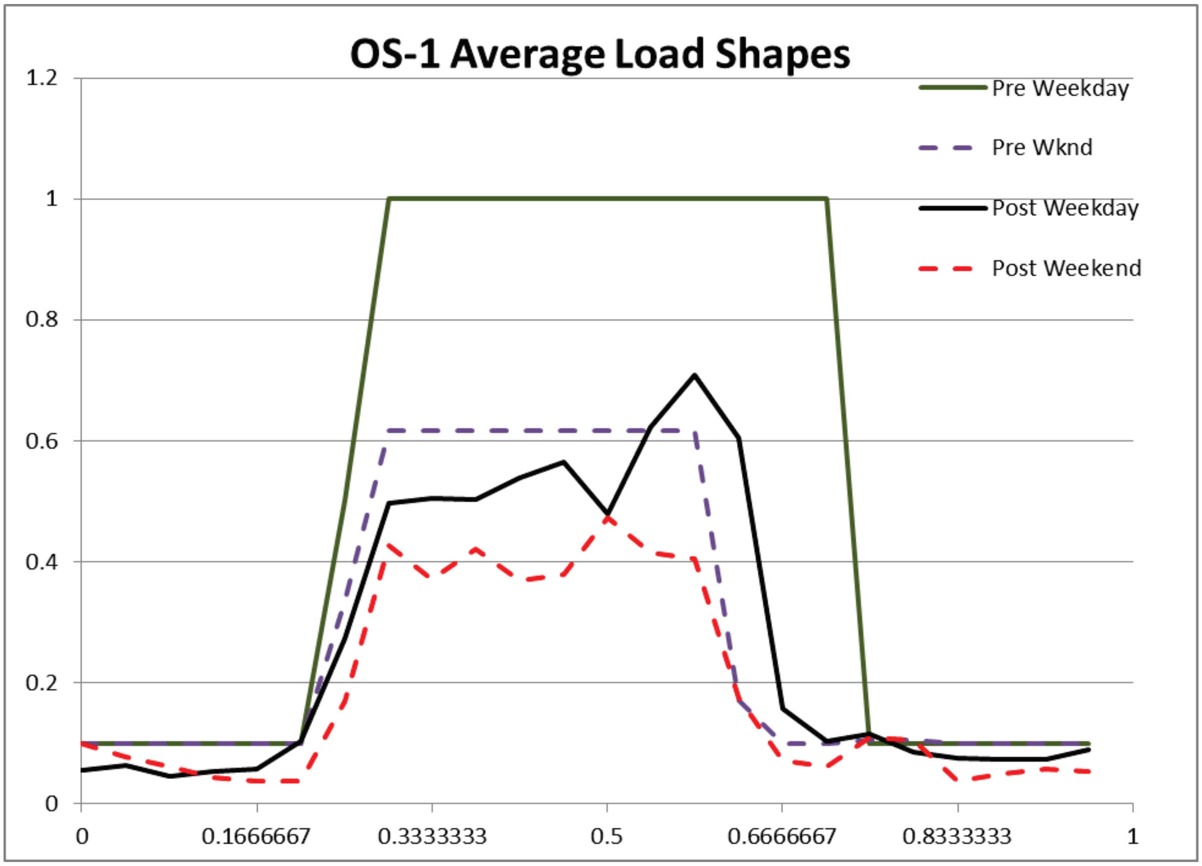

LF-11 Average Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

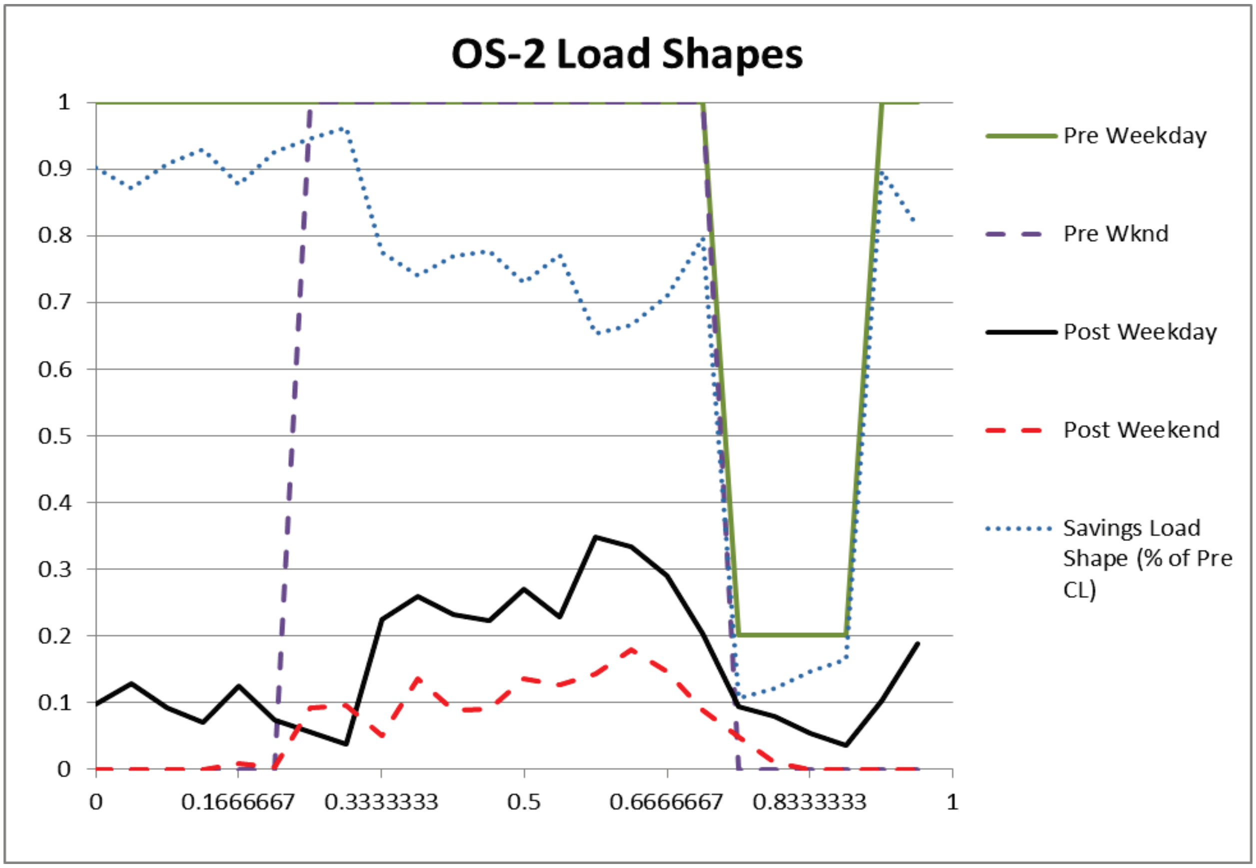

LF-12 Average Load Shapes
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

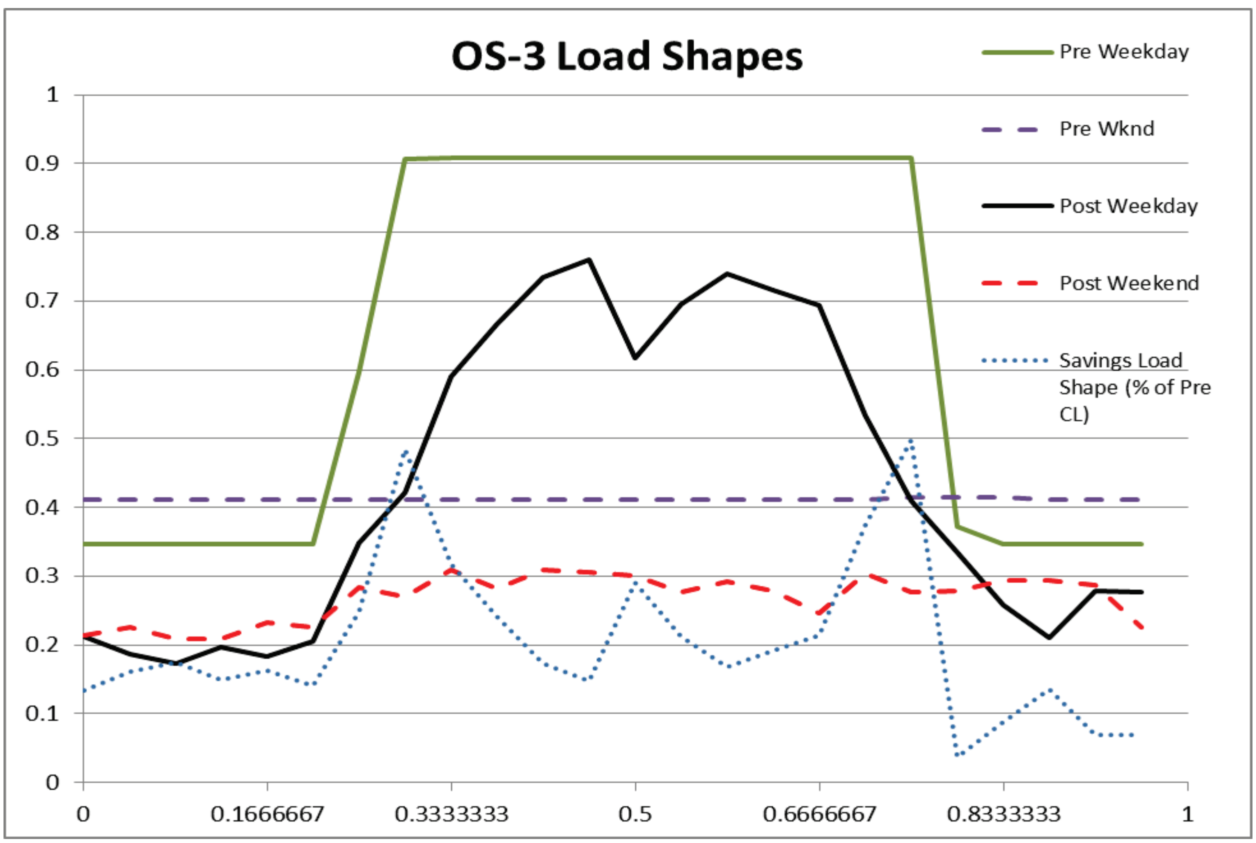

LF-13 Average Load Shape
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

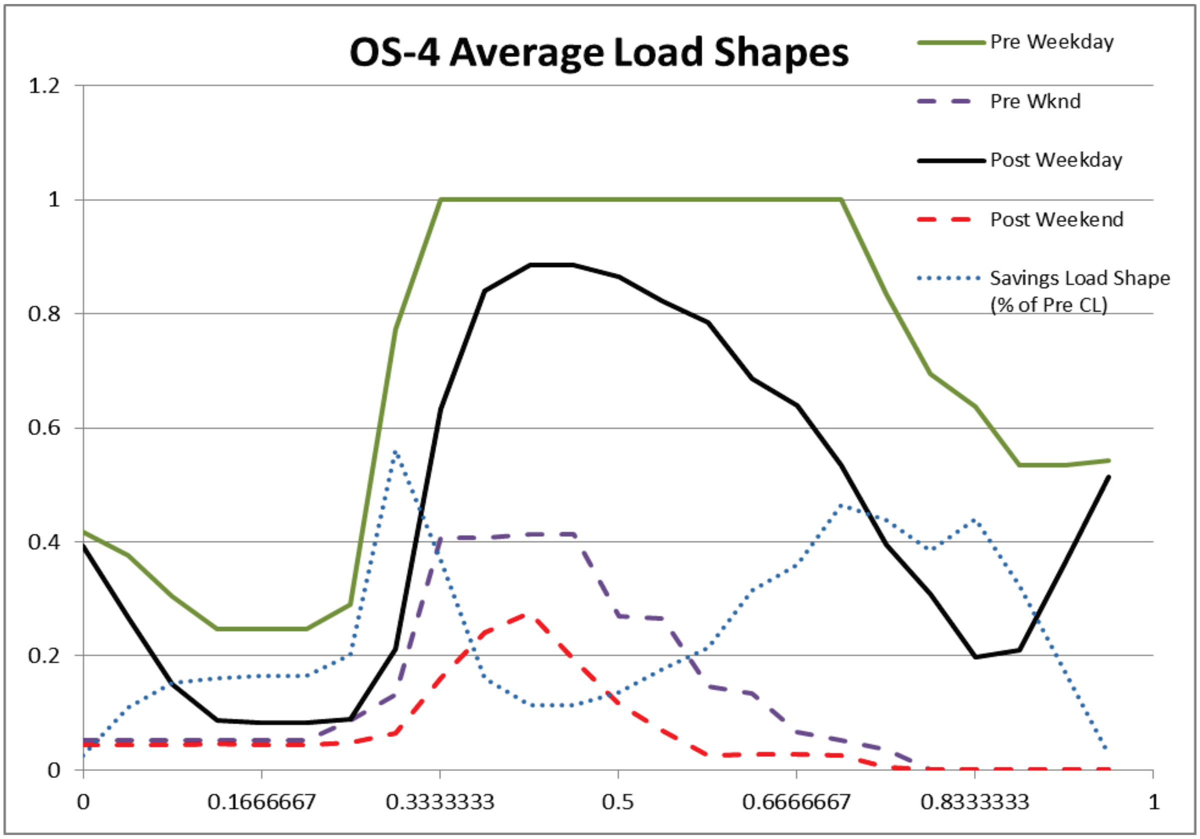

LF-14 Average Load Shapes
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Wkdy
Wknd

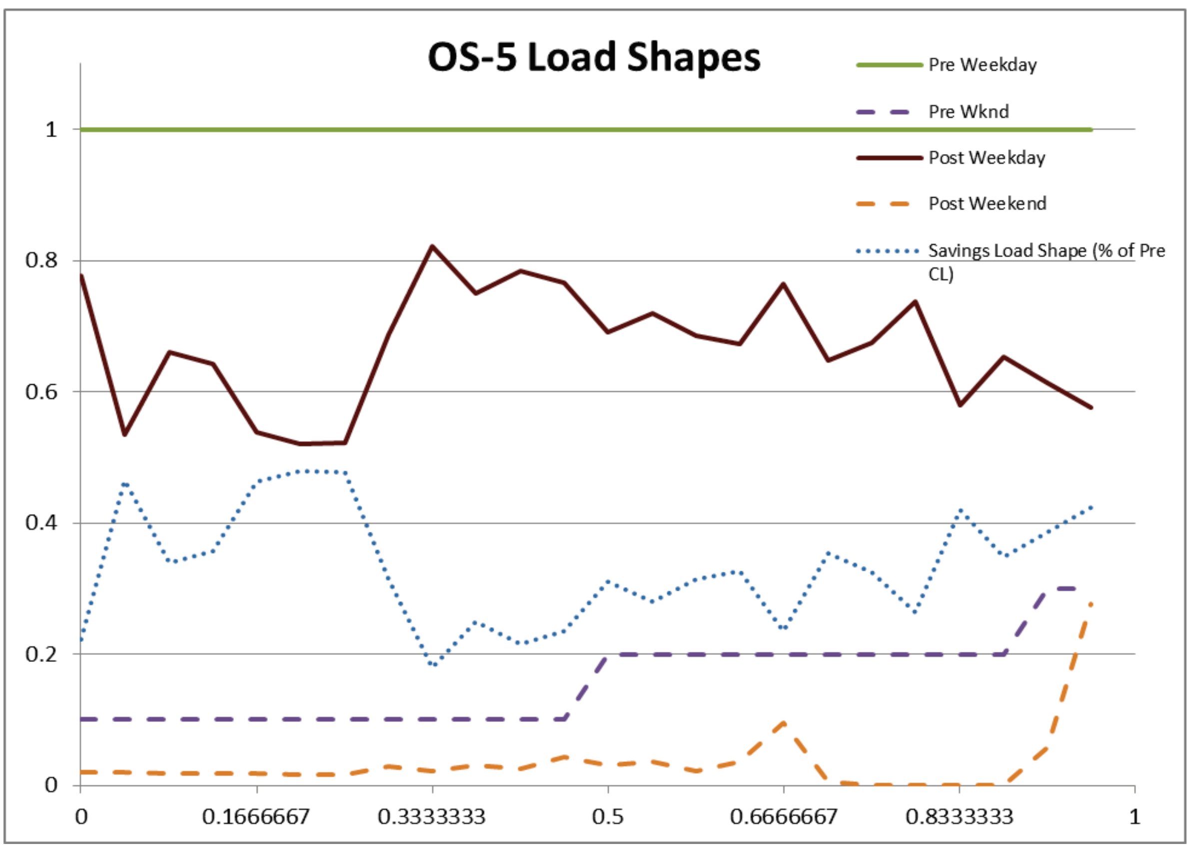
Occupancy Sensor Sites

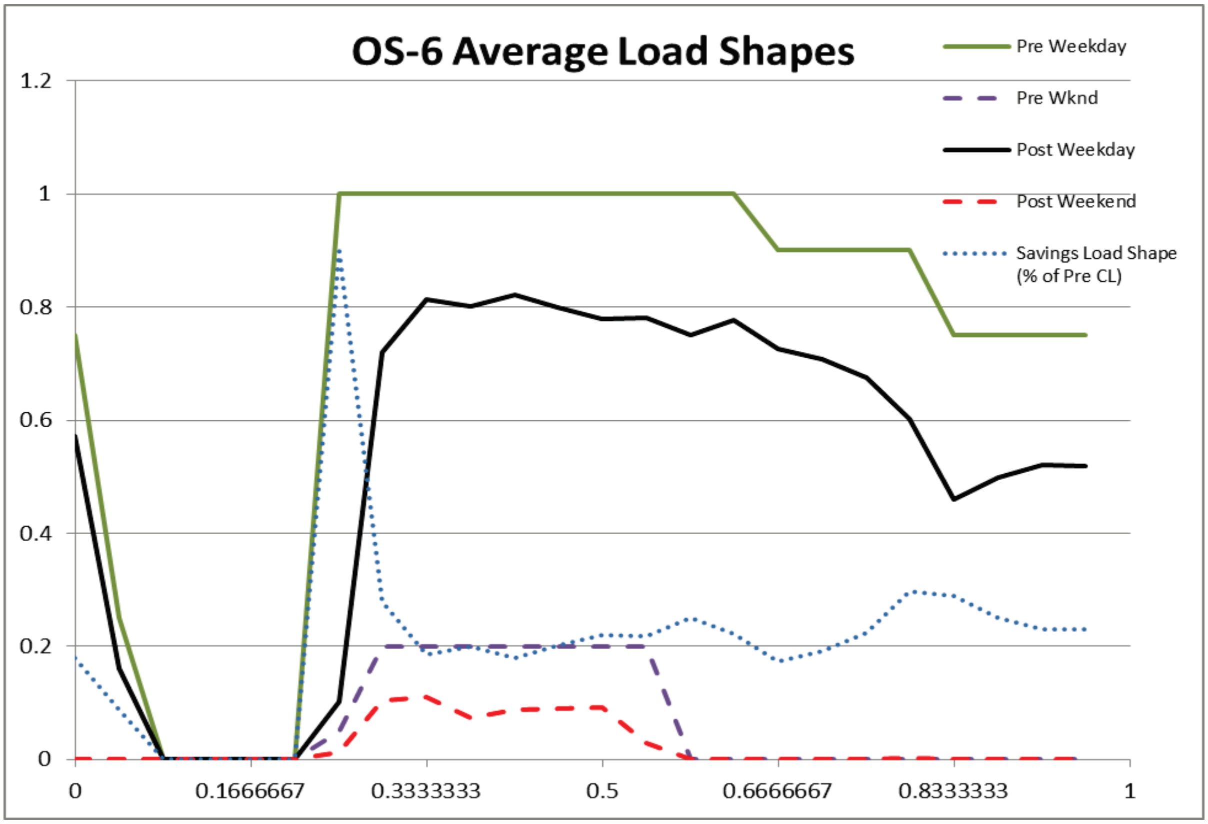


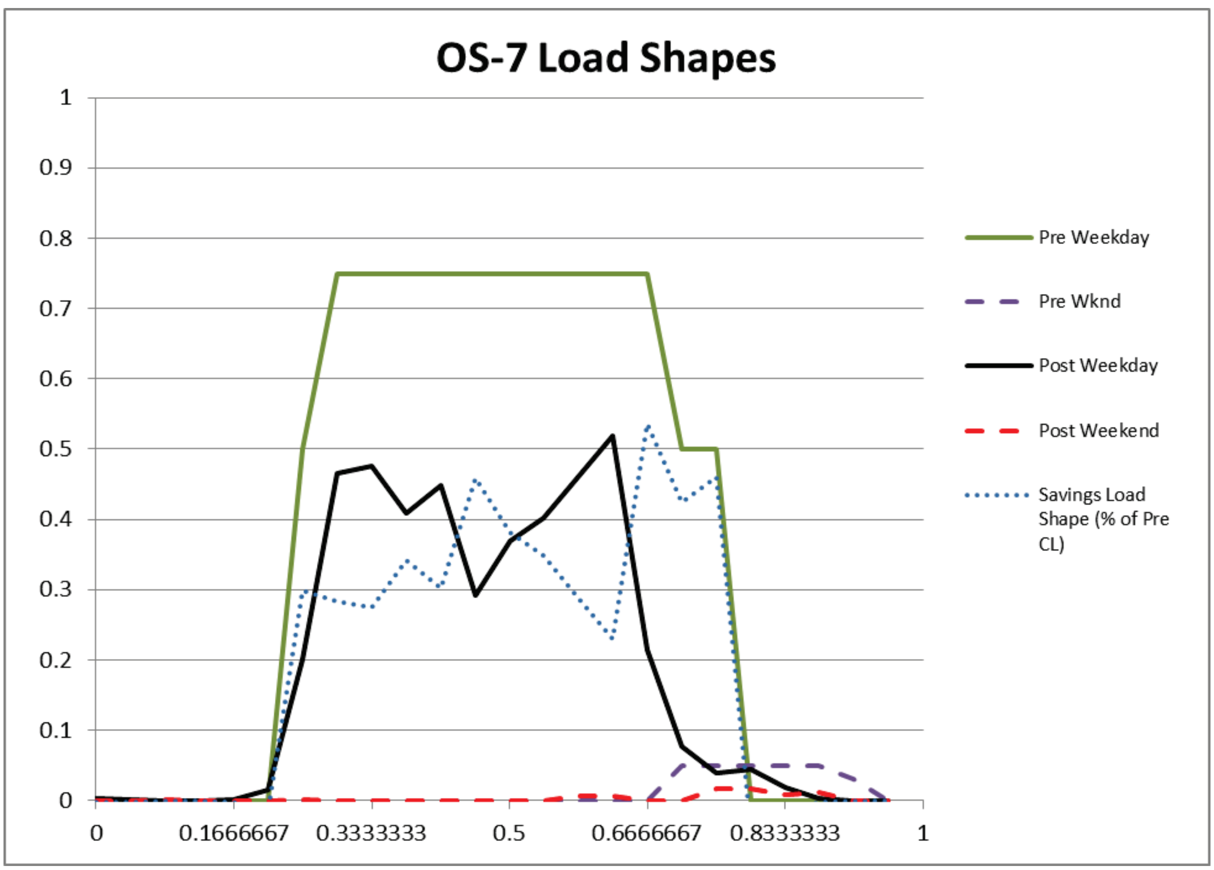

OS-2 Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Pre Weekday
Pre Wknd
Post Weekday
Post Weekend
Savings Load Shape (% of Pre CL)

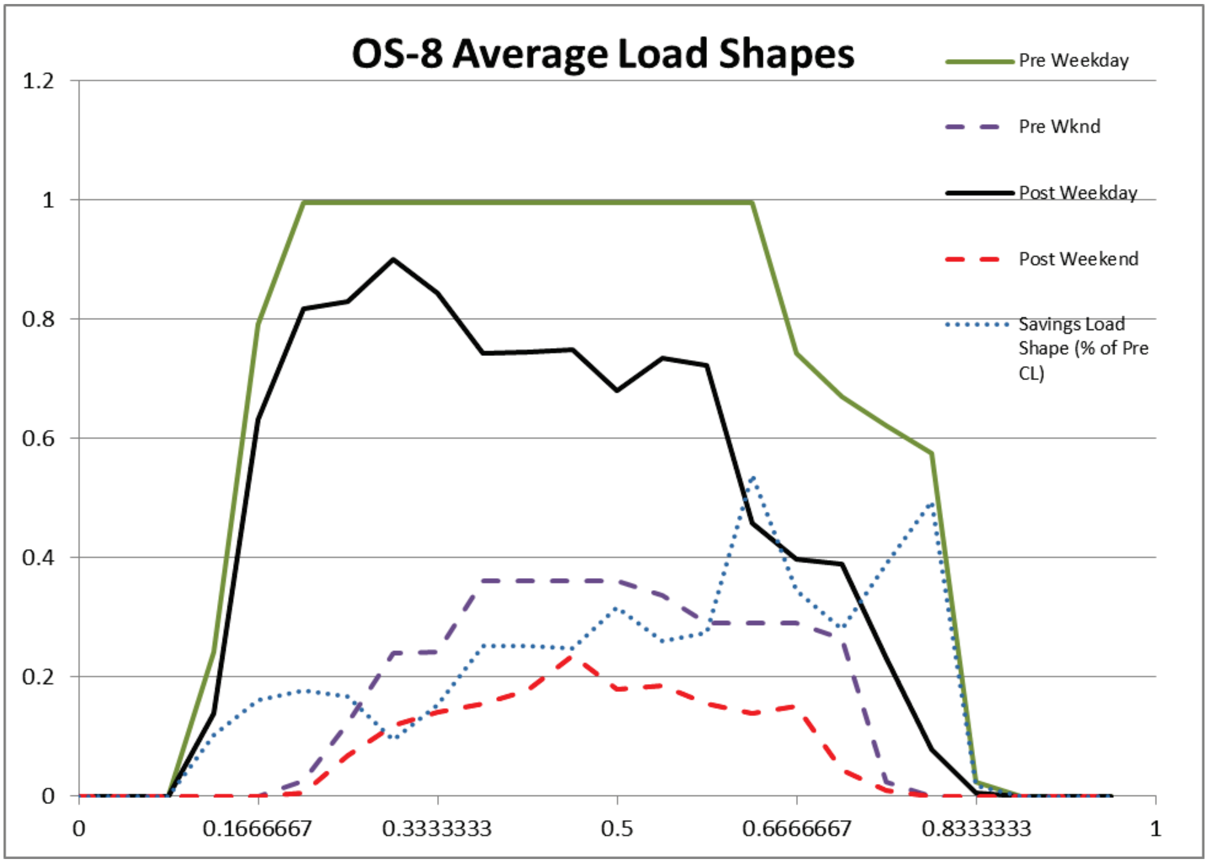

OS-3 Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Pre Weekday
Pre Wknd
Post Weekday
Post Weekend
Savings Load Shape (% of Pre CL)


OS-4 Average Load Shapes
Pre Weekday
Pre Wknd
Post Weekday
Post Weekend
Savings Load Shape (% of Pre CL)
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1


OS-5 Load Shapes
Pre Weekday
Pre Wknd
Post Weekday
Post Weekend
Savings Load Shape (% of Pre CL)
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1


OS-6 Average Load Shapes
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Pre Weekday
Pre Wknd
Post Weekday
Post Weekend
Savings Load Shape (% of Pre CL)


OS-7 Load Shapes
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1
Pre Weekday
Pre Wknd
Post Weekday
Post Weekend
Savings Load Shape (% of Pre CL)


OS-8 Average Load Shapes
Pre Weekday
Pre Wknd
Post Weekday
Post Weekend
Savings Load Shape (% of Pre CL)
1.2
1
0.8
0.6
0.4
0.2
0
0
0.1666667
0.3333333
0.5
0.6666667
0.8333333
1

Appendix B: Results of HVAC Interactive Effects Simulations

Building	System	City					
		Asheville		Charlotte		Greenville	
		WHFe	WHFd	WHFe	WHFd	WHFe	WHFd
Assembly	AC / gas heat with economizer	0.134	0.179	0.168	0.211	0.153	0.225
	AC / gas heat no economizer	0.149	0.179	0.197	0.211	0.187	0.225
	AC / electric heat with economizer	-0.255	0.171	-0.133	0.201	-0.181	0.218
	AC / electric heat no economizer	-0.239	0.171	-0.102	0.201	-0.149	0.218
	Heat pump with economizer	-0.003	0.171	0.059	0.201	0.033	0.219
	Heat pump no economizer	0.013	0.171	0.091	0.201	0.066	0.219
	Electric heat only	-0.405	0.000	-0.314	0.000	-0.342	0.000
Big Box	AC / gas heat with economizer	0.091	0.249	0.142	0.268	0.130	0.258
	AC / gas heat no economizer	0.144	0.249	0.182	0.268	0.173	0.258
	AC / electric heat with economizer	-0.173	0.249	-0.055	0.227	-0.112	0.256
	AC / electric heat no economizer	-0.121	0.249	-0.013	0.228	-0.070	0.256
	Heat pump with economizer	-0.033	0.250	0.055	0.228	0.030	0.257
	Heat pump no economizer	0.019	0.250	0.098	0.228	0.073	0.257
	Electric heat only	-0.279	0.000	-0.215	0.000	-0.256	0.000
Fast Food	AC / gas heat with economizer	0.078	0.155	0.140	0.196	0.127	0.256
	AC / gas heat no economizer	0.105	0.155	0.166	0.196	0.155	0.256
	AC / electric heat with economizer	-0.485	0.155	-0.225	0.188	-0.340	0.255
	AC / electric heat no economizer	-0.458	0.155	-0.199	0.188	-0.312	0.255
	Heat pump with economizer	-0.166	0.155	0.003	0.189	-0.065	0.255
	Heat pump no economizer	-0.139	0.154	0.029	0.189	-0.037	0.255
	Electric heat only	-0.600	0.000	-0.390	0.000	-0.502	0.000
FS Restaurant	AC / gas heat with economizer	0.111	0.305	0.162	0.301	0.147	0.326
	AC / gas heat no economizer	0.140	0.305	0.187	0.301	0.171	0.326
	AC / electric heat with economizer	-0.570	0.293	-0.254	0.296	-0.369	0.304
	AC / electric heat no economizer	-0.542	0.293	-0.230	0.296	-0.345	0.304
	Heat pump with economizer	0.115	0.293	0.164	0.296	0.149	0.304
	Heat pump no economizer	0.143	0.293	0.189	0.296	0.173	0.304
	Electric heat only	-0.720	0.000	-0.442	0.000	-0.555	0.000
Grocery	AC / gas heat with economizer	0.000	0.629	0.000	0.448	0.000	0.482
	AC / gas heat no economizer	0.138	0.629	0.162	0.448	0.156	0.482
	AC / electric heat with economizer	0.000	0.595	0.000	0.375	0.000	0.436
	AC / electric heat no economizer	-0.280	0.595	-0.184	0.375	-0.220	0.436
	Heat pump with economizer	0.000	0.595	0.000	0.375	0.000	0.436

Building	System	City					
		Asheville		Charlotte		Greenville	
		WHFe	WHFd	WHFe	WHFd	WHFe	WHFd
	Heat pump no economizer	0.032	0.595	0.067	0.375	0.056	0.436
	Electric heat only	0.000	0.000	0.000	0.000	0.000	0.000
Hospital	AC / gas heat with economizer	0.066	0.159	0.068	0.161	0.072	0.187
	AC / gas heat no economizer	0.076	0.158	0.078	0.165	0.077	0.174
	AC / electric heat with economizer	0.062	0.158	0.069	0.165	0.066	0.173
	AC / electric heat no economizer	0.072	0.156	0.075	0.165	0.073	0.173
	Heat pump with economizer	0.065	0.158	0.071	0.165	0.068	0.173
	Heat pump no economizer	0.074	0.156	0.077	0.165	0.075	0.173
	Electric heat only	-0.001	0.000	0.000	0.000	0.001	0.000
Light Industrial	AC / gas heat with economizer	0.095	0.192	0.134	0.194	0.123	0.185
	AC / gas heat no economizer	0.070	0.192	0.113	0.194	0.098	0.185
	AC / electric heat with economizer	-0.288	0.188	-0.142	0.192	-0.191	0.183
	AC / electric heat no economizer	-0.312	0.188	-0.163	0.192	-0.217	0.183
	Heat pump with economizer	-0.059	0.188	0.016	0.192	-0.005	0.184
	Heat pump no economizer	-0.084	0.188	-0.005	0.192	-0.031	0.184
	Electric heat only	-0.403	0.000	-0.285	0.000	-0.332	0.000
Motel	AC / gas heat with economizer	0.000	0.000	0.000	0.000	0.000	0.000
	AC / gas heat no economizer	0.844	0.044	0.932	0.047	0.919	0.045
	AC / electric heat with economizer	0.000	0.000	0.000	0.000	0.000	0.000
	AC / electric heat no economizer	0.680	0.044	0.814	0.047	0.778	0.045
	Heat pump with economizer	0.000	0.000	0.000	0.000	0.000	0.000
	Heat pump no economizer	0.557	0.044	0.650	0.047	0.624	0.045
	Electric heat only	0.000	0.000	0.000	0.000	0.000	0.000
Nursing Home	AC / gas heat with economizer	0.157	0.426	0.184	0.217	0.178	0.404
	AC / gas heat no economizer	0.165	0.425	0.191	0.217	0.184	0.404
	AC / electric heat with economizer	0.129	0.426	0.164	0.219	0.154	0.405
	AC / electric heat no economizer	0.136	0.426	0.170	0.219	0.160	0.405
	Heat pump with economizer	0.139	0.422	0.169	0.210	0.163	0.401
	Heat pump no economizer	0.145	0.422	0.175	0.210	0.168	0.401
	Electric heat only	-0.028	0.000	-0.020	0.000	-0.026	0.000
Primary School	AC / gas heat with economizer	0.102	0.239	0.143	0.265	0.117	0.279
	AC / gas heat no economizer	0.058	0.239	0.098	0.265	0.071	0.279
	AC / electric heat with economizer	-0.647	0.234	-0.422	0.264	-0.528	0.280
	AC / electric heat no economizer	-0.690	0.234	-0.466	0.264	-0.575	0.280
	Heat pump with economizer	-0.205	0.234	-0.091	0.265	-0.138	0.280
	Heat pump no economizer	-0.249	0.234	-0.136	0.265	-0.185	0.280

Building	System	City					
		Asheville		Charlotte		Greenville	
		WHFe	WHFd	WHFe	WHFd	WHFe	WHFd
	Electric heat only	-0.707	0.000	-0.513	0.000	-0.577	0.000
Small Office	AC / gas heat with economizer	0.148	0.137	0.170	0.149	0.158	0.136
	AC / gas heat no economizer	0.096	0.137	0.115	0.149	0.103	0.136
	AC / electric heat with economizer	-0.069	0.137	0.015	0.151	-0.032	0.136
	AC / electric heat no economizer	-0.122	0.137	-0.040	0.151	-0.087	0.136
	Heat pump with economizer	0.058	0.138	0.103	0.152	0.077	0.136
	Heat pump no economizer	0.005	0.138	0.047	0.152	0.023	0.137
	Electric heat only	-0.228	0.000	-0.145	0.000	-0.195	0.000
Warehouse	AC / gas heat with economizer	0.092	0.229	0.106	0.192	0.095	0.203
	AC / gas heat no economizer	0.087	0.229	0.102	0.192	0.092	0.203
	AC / electric heat with economizer	-0.259	0.221	-0.179	0.127	-0.209	0.205
	AC / electric heat no economizer	-0.264	0.221	-0.183	0.127	-0.212	0.205
	Heat pump with economizer	-0.005	0.221	0.015	0.126	-0.001	0.205
	Heat pump no economizer	-0.009	0.221	0.011	0.126	-0.003	0.205
	Electric heat only	-0.353	0.000	-0.286	0.000	-0.306	0.000

Appendix C: Management Interview Instrument

Name: ____

Title: ____

Position description and general responsibilities:

____

____

____

We are conducting this interview to obtain your opinions about and experiences with the Smart $aver® program. We'll talk about the Smart $aver® Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The purpose of this study is to capture the program's current operations as well as help identify areas where the program might be improved. Your responses will feed into a report that will be shared with Duke Energy and the state regulatory agency. I want to assure you that the information you share with me will be kept confidential; we will not identify you by name. However, you may provide some information or opinions that could be attributed to you by virtue of your position and role in this program. If there is sensitive information you wish to share, please warn me and we can discuss how best to include that information in the report.

The interview will take about an hour to complete. Do you have any questions for me before we begin?

Program Background and Objectives (15 min)

1. Please describe your role and scope of responsibility in detail.
2. How long have you been involved with the Smart $aver program?
3. (PM only) Describe the evolution of the Smart $aver® Program. Why was the program created, and has the program changed since it was it first started?
4. Have there been any recent changes been made to your duties since you started?
    a. If YES, please tell us what changes were made and why they were made. What are the results of the change?
5. In your own words, please describe the Smart $aver® Program's objectives. (e.g. enrollment, energy savings, non-energy benefits)

6. (PM only) Can you please walk me through the program's implementation, starting with how the program is marketed and how you target your customers, through how the customer participates and finishing with how savings are verified?

    a. Marketing/Targeting: How & Who

    b. Enrollment/Participation

    c. Rebate processing

    d. Savings verification: How & Who

7. Of the program objectives you mentioned earlier, do you feel any of them will be particularly easy to meet, and why?

8. Which program objectives, if any, do you feel will be relatively difficult to meet, and why?

9. Are there any objectives you feel should be revised prior to the end of this program cycle? If yes, why?

Vendors (10 min)

10. (PM only) Do you use any vendors or contractors to help implement the program?

    a. What responsibilities do they have?

    b. Are there any areas in which think they can improve their services?

11. *(If not captured earlier)* Please explain how activities of the program's vendors, customers and Duke Energy are coordinated.

    a. Do you think methods for coordination should be changed in any way? If so, how and why?

Rebates (15 min)

12. (PM only) How do you determine which pieces of equipment are included in the program? For example, how do you determine what level of efficiency the rebated equipment should have?

    a. Do you use any outside vendors or experts to help with this process?

    b. What should be changed about this selection process?

13. Describe your quality control and process for tracking participants, rebates, and other program data.

14. Do you believe that the program currently offers rebates on enough energy efficient products to meet your customers' needs?
    a. If not, what products would you like to add? Are these currently being considered?
15. Is the program offering enough of a rebate to motivate your customers to participate?
    a. If not, which rebates do you think should be changed, and why?

Contractor Training (5 min)

16. Describe Smart $aver's contractor program orientation training and development approach.
    a. (PM and WECC only) How do you ensure that contractors are getting adequate program training and updated program information?
    b. Can we obtain training materials that are being used?
    c. Are there any new areas where you think contractors could be trained?
17. Do you have any suggestions for improving contractor effectiveness?

Improvements (10 min)

18. Are you currently considering any changes to the program's design or implementation?
    a. What are the changes?
    b. What is the process for deciding whether or not to make these changes?
19. Do you have suggestions for improvements to the program that would increase participation rates, or is Duke Energy happy with the current level of participation?
20. Do you have suggestions for increasing energy impacts *per participant*, given the same participation rates, or is Duke Energy happy with the current per participant impact?
21. Overall, what would you say about the Smart $aver® program is working really well?
    a. Is there anything in this program you could highlight as a best practice that other utilities might like to adopt?
22. What area needs the most improvement, if any?
    a. (If not mentioned before) What would you suggest can be done to improve this?
23. Are there any other issues or topics we haven't discussed that you feel should be included in this report?

24. Do you have any further questions for me about this study or anything else?

25. Thank you!

Appendix D: Trade Ally Interview Instrument

Name: ____

Title: ____

Position description and general responsibilities:

____

____

____

We are conducting this interview to obtain your opinions about and experiences with Duke Energy's Non-Residential Smart $aver program. We'll talk about your understanding of the Smart $aver Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about 45 minutes to complete. May we begin?

Understanding the Program

We would like to ask you about your understanding of the Smart $aver program. We would like to start by first asking you to…

1. Please review for me how you are involved in the program and the steps you take in the participation process. Walk me though the typical steps you take to help a customer become eligible for this program and what you do to receive or help the customer receive the program incentive.

2. What kinds of problems or issues have come up in the Smart $aver program?

3. Have you heard of any customer complaints that are in any way associated with this program? Have callbacks increased due to the program technologies?

Program Design and Design Assistance

4. Do you feel that the proper technologies and equipment are being covered through the program?

5. Are the incentive levels appropriate? How do they impact the choice by the customers of the higher efficient equipment?

6. Are there other technologies or energy efficient systems that you think should be included in the program?

7. Are there components that are now included that you feel should not be included? What are they and why should they not be included?

Reasons for Participation in the Program

We would like to better understand why contractors become partners in the Smart $aver Program.

9. How long have you been a partner in the Smart $aver Program?

10. What are your primary reasons for participating in the program? Why do you continue to be a partner?…. *If prompts are needed*… Is this a wise business move for you, is it something you believe in professionally, does it provide a service to your customers, do you want to build a relationship with Duke Energy, or other reasons?

11. Has this program made a difference in your business? How?

12. How do you think Duke Energy can get more contractors to participate in this program?

Program Participation Experiences

The next few questions ask about the process for submitting participation forms and obtaining the incentive payments.

13. Do you think the process could be streamlined in any way? How?

14. How long does it take between the time that you apply for your incentive, to the time that you and your customer receive the payments? Is this a reasonable amount of time? What should it be? Why?

15. Do you have the right amount of materials such as forms, information sheets, brochures or marketing materials that you need to effectively show and sell your Smart $aver® heat pumps and air conditioners? What else do you need?

16. Overall, what about the Smart $aver Program do you think works well and why?

17. What changes would you suggest to improve the program?

18. Do you feel that communications between you and Duke Energy's Smart $aver program staff is adequate? How might this be improved?

19. What benefits do you receive as a result of participating in Duke Energy's Smart $aver Program or from selling Smart $aver items?

20. What do you think are the primary benefits to the people who buy a Smart $aver appliance? Are there other benefits that are important to a potential customer?

Market Impacts and Effects

21. How do you make customers aware of the Program?

22. Are customers more satisfied with this equipment? Why or why not?

23. Do you have fewer calls or more calls to correct problems with the Smart $aver appliances?

24. Do you market or sell the Smart $aver equipment differently than your other equipment? How?

25. What percent of Smart $aver buyers do you think are replacing older equipment that is still functioning, but less efficient? What percent of Smart $aver buyers do you think are replacing failed units?

26. Has the program influenced you to carry other energy efficient equipment that is not rebated through the program?

    a. *If yes*, what do you now carry?

    b. *If yes,* About how many of these units did you install/sell in the last year?

We would like to know what your practices were before you became a partner in the program, and what you would offer your customers without the program.

27. There are no plans to terminate the program, but we would like to know how the program affects contractors. If the program were to be discontinued, would you still offer the same energy efficient equipment options?

28. If the program were not offered, how would you structure pricing differently to make up for the program loss?

29. In your opinion is the Smart $aver program still needed? Why?

Recommended Changes from the Participating Contractors

30. Are there any other changes that you would recommend to Duke Energy for their Program not already discussed?

Appendix E: Participant Survey Instrument

Surveyor Name*

____

Survey ID*

____

Survey Identification*
Customer Name: __________________________

State*
( ) North Carolina
( ) South Carolina
( ) Ohio
( ) Kentucky
( ) Indiana

for answering machine 1st through penultimate attempts:
Hello, my name is [name] and I am calling on behalf of Duke Energy to conduct a customer survey about the Smart $aver Incentive Program. I'm sorry I missed you. I'll try again another time.

for answering machine - Final Attempt:
Hello, my name is [name] and I am calling on behalf of Duke Energy to conduct a customer survey about the Smart $aver Incentive Program. This is my last attempt at reaching you, my apologies for any inconvenience.

if person answers

Hello, my name is ______. I am calling on behalf of Duke Energy to conduct a customer survey about the Smart $aver Incentive Program. May I speak with _____________ please?

If person talking, proceed. If person is called to the phone reintroduce. If not home, ask when would be a good time to call and schedule the call-back:

We are conducting this survey to obtain your opinions about the Smart $aver Incentive Program in which you participated. We are not selling anything. The survey will take about 10-15 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1) Do you recall participating in the Smart $aver Program?*
( ) Yes

( ) No

( ) DK/NS

If No or DK/NS to question 1, ask:

This program was provided through Duke Energy. In this program, your company purchased a new energy efficient motor, pump, HVAC system or component, or lighting system. Duke Energy provided an incentive of [$xxx] for purchasing the qualifying item.

1a. **Do you remember participating in this program?**

( ) Yes
( ) No
( ) DK/NS

If No or DK/NS terminate interview and go to next participant.

2) Our records indicate that you purchased a [measure] Is this correct? If not, what was the rebated technology that you purchased?*

( ) Correct

( ) Pump

( ) Motor

( ) HVAC

( ) Lighting

( ) Refrigeration

( ) Other: _________________*

3) **Please think back to the time when you were deciding to buy the energy saving [measure], perhaps recalling things that occurred in your company shortly before and after your purchase. What kinds of factors motivated you to purchase energy saving [measure]?***

(Do not read list, place a "1" next to the response that matches best)

(Then ask: 3a. **Were there any other reasons?** *(Number responses above in the order they are provided - Repeat until 'no' response.)*

Old equipment didn't work: ___________________________

Old equipment working poorly: ___________________________

The program incentive: ___________________________

The program technical assistance: ___________________________

Recommendation of someone else (*ask:* **Who?**): ___________________________

Wanted to reduce energy costs: ___________________________

The information provided by the Program: ___________________________

Past experience with this program: ___________________________

Because of past experience with "Smart Energy Now" (or "Envision Charlotte"): ___________________________

Because of past experience with "Non-Residential Energy Assessment": ___________________________

Because of past experience with another Duke Energy program (*ask:* **What program?**): ___________________________

Recommendation from "Smart Energy Now" (or "Envision Charlotte"): ___________________________

Recommendation from "Non-Residential Energy Assessment": ___________________________

Recommendation from other utility program (*ask:* **What program?**): ___________________________

Recommendation of dealer/contractor: ___________________________

Advertisement in newspaper (*ask:* **For what program?**): ___________________________

Radio advertisement (*ask:* **For what program?**): ___________________________

Other *(Please specify:)*: ___________________________

DK/NS: ___________________________

4) **How did you hear about the program?***

(Do not read list, place a "1" next to the response that matches best)

The program technical assistance: ___________________________

Recommendation of someone else (*ask:* **Who?**): ___________________________

Wanted to reduce energy costs: ___________________________

The information provided by the Program: ___________________________

Past experience with this program: ___________________________

Because of past experience with "Smart Energy Now" (or "Envision Charlotte"): ___________________________

Because of past experience with "Non-Residential Energy Assessment": _________________________

Because of past experience with another Duke Energy program (*ask:* **What program?**): _________________________

Recommendation from "Smart Energy Now" (or "Envision Charlotte"): _________________________

Recommendation from "Non-Residential Energy Assessment": _________________________

Recommendation from other utility program (*ask:* **What program?**): _________________________

Recommendation of dealer/contractor: _________________________

Advertisement in newspaper (*ask:* **For what program?**): _________________________

Radio advertisement (*ask:* **For what program?**): _________________________

Other *(Please specify:)*: _________________________

DK/NS: _________________________

5) Did you get this [measure] to replace an existing [measure]?*

( ) Yes *(skip to question 5c)*

( ) No

( ) DK/NS *(skip to question 6)*

5a. Is this [measure] the first you have ever purchased for your company?

( ) Yes *(skip to question 6)*

( ) No

( ) DK/NS *(skip to question 6)*

5b. Did you get this [measure] because you wanted to add another/more [measure] to your facility?

( ) Yes

( ) No

( ) DK/NS *(skip to question 6)*

5c. About how old was the [measure] you replaced?

( ) Less than 5 years old

( ) 5 to less than 10 years old

( ) 10 to less than 20 years old

( ) 20 years to less than 30 years old

( ) 30 or more years old

( ) DK/NS

5d. Was the old [measure] working or not working?
( ) Yes, working

( ) No, not working *(skip to question 6)*

( ) DK/NS

5e. Was the old [measure] in good, fair, or poor working condition?
( ) Good

( ) Fair

( ) Poor

( ) DK/NS

6) Where did you get your rebate application?*
[Use list as prompt as necessary. Record one response.]

( ) Contractor or Equipment Vendor

( ) Website/on-line

( ) Utility

( ) Program staff

( ) Consulting Engineer, Architect or Energy Consultant

( ) Other *Please specify*: __________________*

( ) Refused

( ) DK/NS

7) Who filled out the program rebate application for your company?*
( ) I did (customer)

( ) Someone from my company did

( ) The contractor

( ) The salesperson

( ) Someone from Duke Energy

( ) Other: ________________

If they filled it out

7a.Was the rebate application easy to understand?

( ) Yes

( ) No

( ) Some of it

( ) DK/NS

If no or some of it,

7b. **Do you remember what it was that was not clear or which part of it was difficult?**

8) Who submitted the application to Duke Energy?*

( ) I did (customer)

( ) Someone from my company did

( ) The contractor

( ) The salesperson

( ) Someone from Duke Energy

( ) Other: ________________

9) Did you have any problems receiving the incentives?*

( ) Yes

( ) No

( ) DK/NS

If yes,

9a. **Please explain the problem and how it was resolved. Was it resolved to your satisfaction?**

10) Please indicate from the following choices what action you would have taken if the [program] had not been available:*

( ) I would have continued using old [measure]

( ) I would have bought a used [measure] at the same time or later time

( ) I would have bought new [measure] at the same time

( ) I would have bought new [measure] at a later time

10a. At what later date would you have bought a new [measure]?

____

11) Was the Duke Energy incentive payment a factor in your choice to install the more energy efficient equipment?*

( ) Yes, the incentive had an influence on the decision

( ) No, the incentive had no influence on the decision

11a. Please indicate how much of an influence the program incentive had on your energy efficient equipment choice. On a scale of 1 to 10, where a 1 means that the program had a minor influence and a 10 means that the program had a major influence please rate the level of influence the program incentive had on your choice to go with the higher efficiency choice?

minor influence

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

major influence

12) Did Duke Energy's program information explaining the benefits of making energy efficient equipment choices have any influence on your decision to purchase the more efficient equipment?*

( ) Yes, the information had an influence on the decision

( ) No, the information had no influence on the decision

Please indicate how much of an influence the program information had on your energy efficient equipment choice. On a scale of 1 to 10, where a 1 means that the program had a minor influence and a 10 means that the program had a major influence please rate the level of influence the program information had on your choice to go with the higher efficiency choice?
minor influence

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

major influence

13) Do you think that you would have selected the same level of energy efficiency if the program information and/or technical assistance would not have been available to you?*

( ) No. We would make a somewhat different equipment selection or not do the same project

( ) Not sure what we would do

( ) Yes. We would make exactly the same equipment choice

( ) other: __________________

14) Do you think that you would have selected the same level of energy efficiency if the program's financial incentive would not have been available to you?*
( ) No. We would make a somewhat different equipment selection or not do the same project

( ) Not sure what we would do

( ) Yes. We would make exactly the same equipment choice

( ) other: _________________

If State=OHIO and if a "bonus program" participant:

15) Were you aware that you received a bonus incentive (an increased incentive)?

( ) Yes

( ) No

( ) DK/NS

( ) NA

16) Since you participated in the Smart $aver Program, have you purchased and installed any other type of high efficiency equipment or made energy efficiency improvements at your company or at any other locations?*

( ) Yes, only at this company

( ) Yes, only at other locations

( ) Yes, at both company and other locations

( ) No

( ) Don't Know

a. What type and quantity of high efficiency equipment did your company install on its own?

(Probe to get exact type and quantity and location)

	Type	Quantity	Location
1	____	____	____
2	____	____	____
3	____	____	____
4	____	____	____

For each type listed above,

b. How do you know that this equipment is high efficiency? For example, was it Energy Star rated?

1: _________________________

2: _________________________

3: _________________________

4: ___________________________

I'm going to read a statement about this equipment that you purchased on your own. On a scale from 1-10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statement.

17) My experience with the Smart $aver Program in [2010, 2011] influenced my decision to install different types of high efficiency equipment on my own.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

( ) NA

18) What other actions, if any, have you taken in your company to save energy and reduce utility bills as a result of what you learned in this program?

Response 1: ___________________________

Response 2: ___________________________

Response 3: ___________________________

Response 4: ___________________________

Now I am going to ask you some general satisfaction statements. On a scale from 1-10, with 1 indicating that you were very dissatisfied , and 10 indicating that you very satisfied, please rate the following statements.

19) The rebate form being easy to understand and complete.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?

____

20) The interactions and communications with Duke Energy staff.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?

____

21) The rebate levels provided by the program*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?

____

22) The time it took to receive the rebate*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?

____

23) The number and kind of technologies covered in the program*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?

____

24) The information you were provided explaining the program*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?

____

25) The program overall.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?

____

26) Duke Energy overall.*

( ) 1

( ) 2

( ) 3

( ) 4

( ) 5

( ) 6

( ) 7

( ) 8

( ) 9

( ) 10

( ) DK/NS

If 7 or less,

How could this be improved?
____

27) What additional services would you like the program to provide that it does not now provide?*

28) Are there any other things that you would like to see changed about the program?*

29) What do you think can be done to increase people's interest in participating in the Smart $aver Program?*

Response 1: ____________________________

Response 2: ____________________________

Response 3: ____________________________

Response 4: ____________________________

30) What do you like most about this program?*

31) What do you like least about this program?*

32) Which category best describes your organization?*
[Single Choice]

( ) Office

( ) Retail (non-food)

( ) College/university

( ) School

( ) Grocery store

( ) Convenience store

( ) Restaurant

( ) Health care/hospital

( ) Hotel or motel

( ) Warehouse

( ) Personal Service

( ) Community Service/ Church/ Temple/Municipality

( ) Industrial Electronic & Machinery

( ) Industrial Mining, Metals, Stone, Glass, Concrete

( ) Industrial Petroleum, Plastic, Rubber and Chemicals

( ) Other Industrial

( ) Agricultural

( ) Condo Assoc/Apartment Mgmt

( ) Miscellaneous *[record verbatim]*: _________________*

( ) Refused

( ) DK/NS

33) What is your job title or role?*

( ) Facilities Manager

( ) Building Manager

( ) Energy Manager

( ) Other facilities management/maintenance position

( ) Chief Financial Officer

( ) Other financial/administrative position

( ) Proprietor/Owner

( ) President/CEO

( ) Other *(Specify)*: _________________*

( ) Refused

( ) DK/NS

34) Does your organization own or lease the space at [SITE_ADDRESS]?*

( ) Own

( ) Lease

( ) Own part and lease part

( ) DK/NS

35) What is the total square footage of the portion of the facility that you occupy at this location? Your best estimate will be fine.*
( ) Square feet: _________________*

( ) Refused

( ) DK/NS

36) About how many full time equivalent employees work at the facility at [SITE_ADDRESS]?*
( ) Less than 10

( ) 11 to 25

( ) 26 to 40

( ) 41 to 75

( ) 76 to 100

( ) More than 100

( ) Refused

( ) DK/NS

37) Many organizations try to save energy to reduce costs, but there may be other reasons as well. Please listen to the following 5 statements and tell me which statement best describes your organization's view on saving energy?*
(Choose one)

( ) a. **Our energy efficiency efforts contribute to increased customer satisfaction**

( ) b. We want to project a "green" (sustainable) image to the community

( ) c. Our organization is concerned about the environment

( ) d. Saving energy is not important to our organization

( ) e. Saving energy is important because it reduces costs, but not for any other reason

( ) Multiple reasons (ranked) (ie b 1, a 2): _________________*

We have reached the end of the survey. Do you have any comments that you would like for me to pass on to Duke Energy?

That's all the questions I have for you today. Thank you for your time!

Do you have any comments that you would like to pass on to your supervisor about this survey?

Appendix F: DSMore Table

Per Measure Impacts Summary for Nonresidential Smart$aver Prescriptive

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (customer peak/unit)	EM&V gross kW (coincident peak/unit)	Unit of measure	Combined spillover less freeridership adjustment	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
3 Lamp T5HO replacing T12		Carolinas	140.5	0.036	0.027	Fixture	105.5%	148.2	0.037	0.028	No	10
HPT8 4ft 2 lamp, T12 to HPT8		Carolinas	142.3	0.036	0.027	Fixture	105.5%	150.1	0.038	0.029	No	10
HPT8 4ft 4 lamp, T12 to HPT8		Carolinas	294.3	0.074	0.057	Fixture	105.5%	310.5	0.079	0.060	No	10
Low Watt T8 lamps, 4ft		Carolinas	25.5	0.006	0.005	Lamp	105.5%	26.9	0.007	0.005	No	10
LW HPT8 4ft 2 lamp, replace T8		Carolinas	83.5	0.021	0.016	Fixture	105.5%	88.1	0.022	0.017	No	10
LW HPT8 4ft 3 lamp, replace T8		Carolinas	108.3	0.027	0.021	Fixture	105.5%	114.2	0.029	0.022	No	10
LW HPT8 4ft 4 lamp, replace T8		Carolinas	159.6	0.040	0.031	Fixture	105.5%	168.4	0.043	0.032	No	10
T12 8ft 1 lamp retrofit to HPT8 T8 4ft 2 lamp		Carolinas	116.5	0.029	0.022	Fixture	105.5%	122.9	0.031	0.023	No	10
T8 2ft 1 lamp		Carolinas	44.7	0.011	0.009	Fixture	105.5%	47.2	0.012	0.009	No	10
T8 2ft 2 lamp		Carolinas	108.5	0.027	0.021	Fixture	105.5%	114.5	0.029	0.022	No	10
T8 4ft 2 lamp		Carolinas	89.4	0.023	0.017	Fixture	105.5%	94.3	0.024	0.018	No	10
T8 4ft 3 lamp		Carolinas	191.5	0.048	0.037	Fixture	105.5%	202.1	0.051	0.039	No	10
T8 4ft 4 lamp		Carolinas	204.3	0.052	0.039	Fixture	105.5%	215.5	0.054	0.041	No	10
T8 8ft 1 lamp		Carolinas	108.5	0.027	0.021	Fixture	105.5%	114.5	0.029	0.022	No	10
T8 8ft 2 lamp		Carolinas	70.2	0.018	0.013	Fixture	105.5%	74.1	0.019	0.014	No	10
Occupancy Sensors under 500 W		Carolinas	512.6	0.048	0.082	Sensor	105.5%	540.8	0.051	0.087	No	8
Occupancy Sensors over 500 W		Carolinas	1275.6	0.115	0.197	Sensor	105.5%	1,345.8	0.121	0.208	No	8
Program wide												

Notes: 1. Technology names should match the DSMore naming convention.
2. Energy impacts are average per installed unit for each DSMore technology and unit description (measure/ton/sq.ft., etc.)
3. Any analysis using a control group (such as billing analysis with a control group) does not need a freeridership adjustment (it is already in the analysis via the control group adjustment)
4. EM&V load shape: “no” if using standard DSMore load shape for technology units, “yes” if an evaluation-provided load shape should be used for DSMore.

Final Report

Impact Evaluation and Review of the 2012 Power Manager® Program in the Carolina System

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

June 11, 2013

Submitted by

Nick Hall
TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

Subcontractor:

Michael Ozog
Integral Analytics, Inc.

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Executive Summary

Summary of Findings

The approach used by Duke Energy for estimating the effect of the Power Manager® program is very reasonable and defensible. One particularly noteworthy feature is that they use an extensive history to estimate the model, rather than relying on only a handful of days as is common in many utilities which use less rigorous approaches (i.e., approaches that compare average usages from a pre-event period, for example, rather than conducting a multivariate regression model, as Duke Energy is doing).

In 2011, the behavior of some Cannon switches to deviate substantially from the shed times expected for the Target Cycle method was an issue since it increases the uncertainty of the program impacts. Duke Energy and Cooper determined that the root cause was a firmware flaw in the Target Cycle algorithm. Duke Energy and Cooper worked together to develop a solution that utilized radio signal communications (via the paging network) that changed the affected switches from the flawed Target Cycle algorithm to the True Cycle algorithm. This conversion of the affected switches was completed prior to the start of the 2012 event season. Therefore, inverse shed is no longer an issue.

Overall, based on our review, Duke Energy's impact evaluation is a very complete and innovative approach, and should result in accurate estimates of event impacts and the summer load reduction capacity under peak normal weather conditions, as summarized in Table 7 on page 13.

Introduction and Purpose of Study

This document presents the evaluation report for Duke Energy's Power Manager Program as it was administered in the Carolina System.

The evaluation was conducted by Duke Energy and the TecMarket Works evaluation team. Duke Energy conducted the impact analysis, and Integral Analytics (a TecMarket Works subcontractor) conducted the review of the methodology and results.

Summary Overview

This document presents a review of the impact evaluation for the Power Manager (PM) program conducted by Duke Energy as it was administered in the Carolina System.

Summary of the Evaluation

Power Manager is a voluntary residential program, available to homeowners with central air conditioning (AC). On days where energy demand and/or energy costs are expected to be high, Power Manager participants have agreed to allow Duke Energy to cycle their air conditioning off for a period of time.

The impact evaluation conducted by Duke Energy developed an air conditioner (AC) duty cycle model based on information from a sample of PM participants. This duty cycle was then used to simulate the expected natural duty cycle during the PM event days and under peak normal weather conditions for different PM program options and load control technologies to produce estimates of the potential load reduction. These estimates were then de-rated by the results of operability studies to give estimates of the realized load reductions.

Evaluation Objectives

The purpose of this evaluation was two-fold. The first objective is to summarize the actual kW and expected peak normal kW impacts determined by Duke Energy for 2012. The second objective is to determine if the approach used by Duke Energy in estimating these impacts is consistent with commonly accepted evaluation principles.

Summary of Review

The approach used by Duke Energy for estimating the effect of the Power Manager® program is very reasonable and defensible. One particularly noteworthy feature is that they use an extensive history to estimate the model, rather than relying on only a handful of days as is common in many utilities which use less rigorous approaches (i.e., approaches that compare average usages from a pre-event period, for example, rather than conducting a multivariate regression model, as Duke Energy is doing).

Overall, based on our review, Duke Energy's impact evaluation is a very complete and innovative approach, and should result in accurate estimates of event impacts and the summer load reduction capacity under peak normal weather conditions, as summarized in Table 5 and Table 7 on pages 12 and 13.

Description of Program

Power Manager is a voluntary residential program, available to homeowners with central air conditioning (AC). On days where energy demand and/or energy costs are expected to be high, Duke Energy has permission from Power Manager participants to cycle their air conditioning off for a period of time.

When customers enroll, Duke Energy installs a switch that allows the AC unit to be cycled off and on in response to signals sent over Duke Energy's paging system.

Within Duke Energy's portfolio, Power Manager is currently the only residential demand response program[1]. The Power Manager program plays a key role in capacity planning; every year, Power Manager provides an estimate as to how much capacity it can provide during the summer season, and this information is taken into account by the capacity planners.

Program Participation

Program	Participation Count for 2012
Power Manager Carolina System	EOM Sept. 2012 = 185,542

[1] Not including pilot programs.

Methodology

Overview of the Evaluation Approach

The impact evaluation for the Power Manager (PM) program was conducted by Duke Energy staff. The results presented in this report include a review by Integral Analytics of the impact evaluation methodology and results.

The impact evaluation developed an air conditioner (AC) duty cycle model based on information from a sample of PM participants. This duty cycle model was then used to simulate the expected natural duty cycle during the PM event days for estimates of event load reduction impacts and under peak normal weather conditions for different PM program options and load control technologies to produce estimates of the potential load reduction on a peak normal day. These estimates were then de-rated by the results of operability studies to give estimates of the realized load reductions.

The approach used by Duke Energy staff is nearly identical to the approach used in the prior evaluations reviewed by the TMW team.

This general approach is well established in the industry and the actual analysis was very thorough and well thought out. The resulting impact estimates are reasonable and accurate.

Data collection methods, sample sizes, and sampling methodology

The 2012 PM M&V sample in the Southeast consists of 160 households with 220 air-conditioner (AC) units. This includes 123 households from North Carolina and 37 households from South Carolina, closely reflecting the relative numbers of PM participants in each state. There are 80 holdovers from North Carolina 2011 M&V sample and 10 holdovers from South Carolina 2011 M&V sample that were randomly selected in either 2010 or 2011. The Southeast sample is designed to target at 10% relative precision at 90% confidence level plus extra households to compensate loss of the sample due to data issue or removal of the switch during the summer.

At households selected for the M&V sample, any older load control device was replaced by a Cannon load control device. The purpose of this study is to determine the load reduction achieved when the load control device functions as expected, so this device replacement does not introduce bias into the results. Completely separate operability studies are conducted to determine deviation from expected performance (the de-rating factor) for each load control technology. The M&V samples were used for both fixed and target cycling, as well as full shed impact analysis.

PM M&V samples are stratified into high, medium and low groups according to premise monthly kWh usage from the previous summer. The Dalenius-Hodges technique for selecting strata boundaries and the Neyman method for optimum sample allocation were employed to achieve reduced sample variance of load reduction estimates. The resulting stratification of PM M&V samples is shown in Table 1.

Table 1. M&V Sample Stratification

	Sample allocation			Population weight		
	High	Medium	Low	High	Medium	Low
NC & SC	51	49	60	8.2%	37.6%	54.2%

Hourly run-time of AC units in the M&V samples was collected during 2012 summer months (May through September). This was accomplished with Cannon load control devices, which record hourly run-time (in minutes) of the AC unit to which they are attached. Data collection from M&V Cannon devices were conducted in June and the end of September. In addition to hourly run-time, the Cannon device scan data includes hourly shed minutes and the contents of many device registers. Information about the AC unit is also recorded, including rated amps for the compressor and fan.

Households in the M&V samples are equipped with load research interval meters, and 15-minute or 30-minute premise interval usage (kWh) was collected for 2012 summer months.

Number of completes and sample disposition for each data collection effort

See "Table 1. M&V Sample Stratification" above.

Expected and achieved precision

The 2012 M&V sample is representative of the PM population and is designed to target at 10% relative precision at 90% confidence level.

Description of baseline assumptions, methods and data sources

The baseline is developed from the duty-cycle of the sampled AC units based upon the observed AC usage during non-holiday, non-weekend, and non-control days.

Description of measures and selection of methods by measure(s) or market(s)

The PM program is an AC cycling program, so the only measure in question is the AC units.

Use of TRM values and explanation if TRM values not used

The analysis provides estimate of the savings that were achieved by participating households, thus there was no need to use TRM values.

Threats to validity, sources of bias and how those were addressed

The approach used in the evaluation relied upon actual measurement of AC usage, and is therefore not subject to any reporting or self-selection bias.

Evaluation Findings

Validation of AC Duty Cycle Data

Hourly air conditioner (AC) run-time collected from Cannon M&V devices is compared to corresponding premise interval kWh to verify that it accurately reflects operation of the attached AC unit. The validation process is accomplished through a sequence of computer programs that: 1) convert the hourly A/C run-time data into hourly duty cycle; 2) display time series plots of premise kWh and duty cycle with control over time resolution enabling visual comparison of plot detail; 3) calculate cross-correlation between hourly kWh and hourly duty cycle and display cross-plots of kWh vs. duty cycle. Each run-time data file collected for an AC in the 2012 M&V sample is reviewed in this fashion, and the AC duty cycle is added to the model database if it passes the validation process.

Duke Energy could not obtain the 2012 data for 8 ACs due to the inability to retrieve scan data (6) or disconnection (2). The run-time data was rejected for 11 ACs through the validation process. These cases appear to be due to equipment sensitivity issues, where the AC is reported to have no run-time or to be always running. Overall, hourly duty cycle data was added to the model database for 151 households with 201 ACs. Table 2 summarizes the 2012 M&V sample.

Table 2. M&V Sample

	Southeast	
	NC	**SC**
Households	123	37
Total AC Units	220	
Missing data	8	
Invalid Data	11	
Final AC Sample	201	
Final Households	151	

AC Duty Cycle Models

Impact estimates during PM load control periods are based upon models developed for the natural duty cycle of M&V AC units. These models are developed from 2012 duty cycle data described above, and similar duty cycle data from the two prior summers (2010, 2011) for AC units that are holdovers from previous M&V samples. Weekends and holidays are not used in the models, and hours during load control and for the remainder of the day are not used. As addressed above, Duke Energy staff was able to develop duty cycle models for AC units at 151 households in the Southeast M&V sample.

Natural duty cycle models are specified and estimated individually for M&V AC units to better capture the unique dependence of duty cycle on the temperature and humidity characteristics of each AC unit. A limited dependent variable model specification is adopted for hourly duty cycle, the dependent variable in the models. Candidate specifications for independent variables in the models include temperature averaged over the prior 2-hour, 4-hour, and 6-hour intervals, and a weighted temperature average with declining weights over the previous six hours. Candidate specifications also include similar sets of averages based on temperature-humidity index (THI) and heat index (16-element polynomial). Models are estimated with the SAS procedure QLIM[2]. The dependent variable specification selected for an AC unit is based on fit diagnostics from hourly model fits over the typical load control hours, 2:00–6:00 PM. For the selected model, distinct parameters are estimated in each hour of interest, resulting in a set of hourly natural duty cycle fits for each M&V AC.

PM Load Control Strategies

The PM program employs two generic types of load control devices which require somewhat different treatment for load impact evaluation. The newer switch types (Cannon LCR 4700) operate with an adaptive control strategy called Target Cycle (TC). For each hour of load control, the Target Cycle switch calculates a unique shed time (or percentage) based on characteristics of the attached AC unit. The older switch types (Comverge) uses traditional fixed cycling control, where all devices on the same program shed the same amount of time during the control period. In addition, another older switch type is referred to as the PLC (Power Line Carrier) device in NC and SC. PLC devices are only used during an emergency event and are only used to turn off the AC unit for the duration of the emergency event.

Cannon devices in NC and SC are configured with a load reduction target of 1.3 kW (TC 1.3) constrained by the maximum shed time of 22.5 minutes per 30-minute control period, and Comverge fixed cycling devices limit the AC run-time to 5 minutes of each 15-minute control period. Equivalently, PM Comverge devices in the Southeast are operated with a fixed cycling percentage of 67% (FC 67%). Another control strategy is full shed of the AC. The AC is completely turned off during the control periods. This strategy is only commonly employed in the Southeast for emergency load shed events. Table 3 summarizes PM load control technology and strategy used the Carolinas.

Table 3. PM Load Control Devices and Strategies

		Strategy	
Device	Period	NC / SC	
	(min)	Cycling	Full Shed
Cannon	30	TC 1.3	FC 100%
Comverge	15	FC 67%	FC 100%
PLC	NA		FC 100%

The Target Cycle control strategy puts more functionality in the switch itself. Rated amps of the attached AC unit is entered into the switch at installation, and used to determine connected load for the unit. The switch also records hourly duty cycle of attached AC unit and builds a profile (historical profile) of the expected hourly duty cycle under weather conditions typical for load control. The historical profile can be scaled (globally) by adjusters included in the commands sent to switches for load control. The connected load and adjusted historical profile are used to

[2] QLIM: qualitative and limited dependent variable model.

calculate hourly cycling percentages for the attached AC unit expected to achieve the appropriate load reduction target. The shed percentage is calculated in the switch for each load control hour as shown below for Target Cycle:

AmpKW = 0.85*DeviceAmp*230/1000
Shedpct = Min(1-scaled_profile/100+Target kW/AmpKW, MaxAllowed_Shed)

Impact analysis for PM in 2011 revealed that shed times for some of the Cannon switches deviated substantially from the expected shed times for the target cycle method. Instead these switches appeared to shed more like an "inverted" pattern, relative to the pattern expected. Further investigation by Cooper Power Systems (Cannon) discovered that the cause of this issue was due to a firmware flaw in these defective switches. An alternate adaptive cycling approach, True Cycle, was developed to solve the inverted shed issue. For the True Cycle approach, a cycling percentage called a gear is estimated using the duty cycle model and is sent to switches for load control. This gear and the scaled historical profile are then used to calculate hourly shed percentages for the attached AC unit expected to achieve the appropriate load reduction target (1.5 kW, 1.3 kW or 1.0 kW). The main difference between target cycle and true cycle is that the latter does not use rated amps to calculate connected load for the attached unit. The shed percentage is calculated in the switch for each load control hour as below for True Cycle:

Shedpct = Min(1-scaled_profile/100+gear, MaxAllowed_Shed)

Factors that determine Target Cycle and True Cycle shed percentages for M&V AC units during control periods are known, except for contents of hourly historical profile registers on those days. Values in these registers change frequently during the summer as they are updated with the AC hourly run-time on "saved" days, which are selected with weather conditions sufficiently close to a typical load control day. Hourly run-time profiles on 2012 control days for M&V AC units are determined from the contents at the end of the 2012 control season (when available), and the unit run-time on 2012 saved days. The impact for both of the cycling strategies are estimated and the proportions of True Cycle switches are used to determine the overall shed per switch attributable to Cannon switches.

AC Connected Load

Connected load is the average power demand (kW) of a running AC unit over a full cycle. It determines the load reduction (kWh) achieved when AC run-time is reduced. Connected load is specified for M&V AC units through the basic engineering formulas:

*Apparent Power (kVA) = (Compressor Amps + Fan Amps) * 230 Volts / 1000*

*Connected Load (kW) = Power Factor * Apparent Power*

Rated amps for the compressor (FLA) and fan (RLA) are typically listed on the AC faceplate.

Power factor in this formula is actually different for different AC units, and even varies somewhat for different cycles of the same unit, increasing at high temperature and humidity. Duke Energy has analyzed synchronous AC run-time and premise interval kWh collected for the

M&V samples to determine an appropriate overall power factor within each sample. The result is 0.82 for the M&V sample. These power factor values are used to calculate connected loads for impact evaluation.

Simulation Method for PM Impact Evaluation

Simulation with M&V natural duty cycle models is used to determine average load reduction per household within high and low M&V strata during each hour of load control and for each PM cycling strategy. These strata results are combined with the population weights given in Table 1 to estimate average load reduction per household in the PM populations in the Carolina System. The potential load impacts estimated in this manner represent the load reduction which would be achieved if all switches controlled as expected. Impact results for PM load control in the Southeast are obtained by simulation with the Southeast M&V sample.

The simulation procedure is very similar for the three basic PM control strategies: Target/True Cycle, Fixed Cycling, and Full Shed. In a fixed cycling or full shed (100% cycling) simulation, the same specified shed percentage is applied to all ACs to evaluate load impact. In a Target/True Cycle simulation for a particular program option, or load reduction target, and during a specified hour (and day) of load control, a customized shed percentage is calculated for each AC unit from information specific to that unit. The resulting unit-specific shed percentages remain fixed in all simulated realizations for that load reduction target and load control hour.

A single realization in the simulation is generated by a random draw of residuals for each of the M&V natural duty cycle model fits, which are evaluated at the temperature and humidity of the control hour (and day). This gives a set of simulated natural duty cycles appropriate for the control hour. Load reduction for each M&V AC is calculated as follows:

Duty cycle reduction = MAX[Duty cycle - (1 – Shed percentage), 0]

*Load reduction = Connected load * Duty cycle reduction*

For households with multiple ACs, realized load reduction is aggregated to the household level by summing load reduction from all household ACs. These realized load reductions are averaged within the strata to produce single realizations of average load reduction per household within high, medium, and low strata. These three sample averages constitute the result from one pass through the simulation corresponding to one draw of model residuals.

Two thousand passes through the simulation are performed to adequately capture the variation in average load reduction within strata that is consistent with our duty cycle models and M&V sample sizes. The results accumulate into distributions of sample averages for all three strata. The grand means of these distributions are the most significant output from a simulation run. They are the estimates of average load reduction per household in each stratum for the specified control hour and cycling strategy. The spread of these distributions (e.g., variance) characterizes the uncertainty in the load reduction estimates, and is inversely related to the M&V sample sizes.

Load Impact Results

Load impacts described in this section are computed with population estimates of load reduction per switch, rather than load reduction per household. Simulation results are converted to load reduction per switch using the factors 1.172 switches per household. Population estimates of load reduction per household are divided by these factors to get corresponding population estimates of load reduction per switch. The estimates of switches per household are determined from the M&V sample.

Power Manager hourly impact results have been computed for all 2012 load control days. These results are adjusted for distribution and transmission line losses. In NC and SC, some older fixed cycling Comverge and PLC (full shed capability only – not applicable to cycling results) switches remain along with newer Cannon devices. Power Manager offers a single program in NC and SC, with fixed cycling at 67% and a Target Cycle load reduction target of 1.3 kW; so the calculations are simplified.

Table 4 shows de-rating factors used for the 2012 impact evaluation. Cannon factors were determined by operability studies conducted in 2011.

Table 4. De-rating Factors for Impact Evaluation

Switch Type	NC / SC
Cannon	0.945
Comverge	0.399
PLC	0.399

Table 5. PM Impact Results for NC and SC

Event Date	Hour	PM Impact (MW)		Southeast Total
		NC	SC	
6/29/2012	16	109.6	41.2	150.8
	17	111.4	42	153.4
7/9/2012	15	86.5	32.3	118.8
	16	84.3	31.7	116
	17	76.5	28.8	105.3
7/17/2012	16	102.2	36.5	138.7
	17	106.2	38	144.2
7/26/2012	16	101.9	37.4	139.3
	17	105	38.6	143.6
	18	106.7	39.2	145.9
7/27/2012	15	108.4	38.8	147.2
	16	115.5	41.5	157

PM cycling events were activated in NC and SC on 5 days during the summer of 2012. Both Cannon and Comverge devices were controlled on all days. Table 5 gives hourly impact results in NC and SC for each control day. The last column of Table 5 gives total PM impact in the Southeast. The highest hourly impact for cycling events in the Southeast was 157 MW in hour 16 (3:00 – 4:00 pm EDT) on July 27.

Table 6 gives estimated load reduction per switch not adjusted for line losses under peak normal weather conditions and load control technologies. **Table 7 shows the summer monthly load reduction adjusted for line losses under peak normal weather conditions.** Table 8 shows the peak normal weather conditions used to calculate the results in Table 6. The system peak in the Southeast is assumed to occur in the hour 4:00 – 5:00 pm EDT (identified as hour 17 in this report).

Table 6. Shed kW/switch with Peak Normal Weather

Switch Type	Control Strategy	Potential Impact	De-rated Impact
Cannon	TC 1.3	1.31	1.24
	Full Shed	2.21	2.09
Comverge	FC 67%	1.29	0.51
	Full Shed	2.21	0.88
PLC	Full Shed	2.21	0.88

Table 7. Monthly Peak Normal Weather Load Reduction De-rated Impact Adjusted for Line Losses for Cycling and Full Shed

State	Control Strategy	June	July	August	September	Summer Capability
Carolinas	Cycling	148.1	148.7	150.9	153.2	149.3
Carolinas	Full Shed	266.5	266.3	269.2	272.8	267.3

Table 8. Peak Normal Weather

Hour	NC / SC	
	Temp	Dewpt
11	89.0	69.0
12	91.0	69.0
13	92.0	68.0
14	94.0	68.0
15	93.0	69.0
16	95.0	67.0
17	95.0	66.0
18	95.0	67.0

The last column of Table 7 shows the weighted average capability of the Power Manager program across the summer months in 2012. These weighted average values are calculated using the summer monthly values and weighting them based on the probability of experiencing an annual peak load in that month. However, for revenue recovery purposes, Duke Energy also calculates a value called a P&L value. The P&L value is calculated from monthly capability values. The P&L value is the value proposed by Duke Energy to be used for revenue recovery since it is consistent with accounting guidelines. The P&L value for 2012 is 268.7 MW for the Carolinas. A further explanation of the P&L value is provided below.

P&L Value (Revenue Recovery Value) – the process can be summarized as follows.

- Using the processes described above and the program participants for a particular month, calculate the monthly capability of those participants using summer peak normal weather. For Power Manager, these values, for the summer months, are the same values as provided above in Table 7.
- The monthly values receive accounting adjustments if applicable.
- The revised monthly values are averaged across the months during which the program is available for curtailment, June through September.

Review Results

The approach used by Duke Energy for estimating the effect of the Power Manager® program is very reasonable and defensible. One particularly noteworthy feature is that they use an extensive history to estimate the model, rather than relying on only a handful of days as is common in many utilities which use less rigorous approaches (i.e., approaches that compare average usages from a pre-event period, for example, rather than conducting a multivariate regression model, as Duke Energy is doing).

Overall, based on our review, Duke Energy's impact evaluation is a very complete and innovative approach, and should result in accurate estimates of event impacts and the summer load reduction capacity under peak normal weather conditions, as summarized in Table 7 on page 13.

Final Report

Impact Evaluation and Review of the 2012 PowerShare® Program in the Carolina System

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

June 11, 2013

Submitted by:

TecMarket Works
165 West Netherwood Road
Oregon, Wisconsin 53575
(608) 835-8855

Subcontractor:

Michael Ozog
Integral Analytics, Inc.

Table of Contents

Executive Summary

Introduction and Purpose of Study

This document presents the evaluation report for Duke Energy's PowerShare® Program as it was administered in the Carolina System. For our use in this report, the PowerShare name is an umbrella term that contains multiple programs including PowerShare Mandatory, PowerShare Generator, PowerShare CallOption, and PowerShare Voluntary. Note that Duke Energy does not claim any capacity credits from the PowerShare Voluntary program and therefore no capacity values are calculated for this program.

For this evaluation, Duke Energy performed the calculations and conducted the impact analysis, and Integral Analytics (a TecMarket Works Subcontractor) conducted the review of the methodology and results.

Summary of the Evaluation

The impact analysis of the PowerShare program was conducted by Duke Energy. The basic approach for determining the impacts, capabilities, and profit and loss (i.e., P&L, the MW values used for revenue recovery under Save-A-Watt, SAW) involves combining actual weather data with hourly load data from all enrolled customers, collected for the previous month(s), as appropriate. A regression model is developed using the combined data to provide an estimate of what the load would have been for the customer, absent an event. This is compared to the actual customer load to determine the impacts from the event.

Evaluation Objectives

The purpose of this evaluation was two-fold. The first objective is to summarize the actual kW and expected peak normal kW impacts determined by Duke Energy for 2012. The second objective is to determine if the approach used by Duke Energy in estimating these impacts (where actual metered data is not used as it is for the Generator program), as well as the capacity values, are consistent with commonly accepted evaluation principles.

Recommendations

Overall, based on our review, Duke Energy's impact evaluation is a very complete and innovative approach, and it should result in accurate estimates of Event impacts (i.e., settlement with customers, M&V results for an event, capability values, and P&L values).
In general, the model specifications in all the processes includes the key determinates of energy usage, so there is little likelihood of any bias in the results from omitted variables. One particularly noteworthy feature is that Duke Energy uses an extensive history to estimate the model, rather than relying on only a handful of days as is common in many utilities which use less rigorous approaches. In addition, using a multivariate regression model in the Capabilities, P&L, and M&V processes is generally preferred over approaches that are based on average loads from a pre-event period.

In addition, the technical approach used by Duke Energy in developing settlement calculations for the customer day-ahead Pro forma load (PFL) and the M&V event impacts are very well thought out and developed. The use of multiple methods and determining the Best of Breed (BoB) in the PFL is noteworthy in that it assures that the most accurate approach will be used in developing the PFL – a step which, to the best of our knowledge, is not used by any other entity.

The one concern we have is that there are multiple processes that essentially measure the same thing. For example, the PFL and M&V processes both measure the impacts for a specific event day (i.e., the effect of the event on load shapes). Likewise, the P&L and Capability processes are essentially both measuring the peak normalized load reduction capability of participants. This appears to be inefficient, as well as confusing.

In addition, for some programs under the PowerShare umbrella, there appears to be no direct link between the customer payments (based on the day-ahead PFL) and the overall program impacts (based on the M&V and Capability process). Since the day-ahead PFL is based on the BoB approach for PowerShare CallOption, Mandatory, and Voluntary, while the other processes are based on regression models, it may be that there is a marked difference between the two estimates of load impacts. Therefore, it is our recommendation that Duke Energy investigate a mechanism that will produce all the required reports for customers, internal use, and regulatory requirements, using a single, unified process for the PFLs and the other reports. An example might be to store the day ahead PFLs associated with an event for developing the Capability and M&V processes for appropriate programs.

Relatedly, it is not clear why different processes must be involved. While there appears to be a specific purpose for each process, there may be efficiencies captured by consolidating the processes. While it is obvious that a distinction be made between actual weather and peak normal weather, it is not clear why that requires two distinct processes. It seems possible to combine the Capability and M&V process into one process, where the regression models are estimated once, and for the weather sensitive customers, estimates of both actual and weather normal impacts are estimated from the same model (just using different weather values). In addition, the difference between the Capability and P&L process is that the P&L includes customers who have enrolled after the summer. Duke Energy clearly wants to capture these post-summer enrollments and start collecting revenues for them during the current year. However, it is our opinion that P&L process may overstate the actual *capability* of the program, if for example you are talking about the *capability* of the program during the summer of 2012, since post-summer enrollments were not enrolled during the summer event period. Therefore, our continued recommendation is that the impacts should be based on the Capability calculations, and Duke Energy should review the need for each process to see if they are truly required. In terms of P&L process results, the use of these results may be appropriate in the revenue recovery process but that is best addressed by Duke Energy and the state regulatory entities. In response to the same recommendations made in previous evaluations, Duke Energy has reviewed each process and believes that the capability, M&V, and P&L underlying calculation processes can be consolidated. Duke Energy will notify TecMarket Works when changes are implemented.

Program Description

PowerShare® is the brand name covering several Duke Energy Carolina's commercial and industrial (C&I) demand response program tariffs. In North Carolina, PowerShare includes NC Rider PS (NC Rider PS) and Rider PowerShare CallOption (NC Rider PSC). In South Carolina, PowerShare includes Rider PowerShare Non-Residential Load Curtailment (SC Rider PS in this document; note that this is only for this document since there exists a separate, unrelated Rider PS in South Carolina) and Rider PowerShare CallOption Non-Residential Load Curtailment (SC Rider PSC) and collectively as the PS Riders. These programs were implemented on or after June 1, 2009. The PowerShare programs are voluntary and offer customers the opportunity to reduce their electric costs by managing their electric usage during the Company's peak load periods. Customers and the Company will enter into a service agreement under the PS Riders under the parameters established in the PS Riders.

There are four product options offered under PowerShare®; Mandatory, Generator, Voluntary, and CallOption®:

- Mandatory
  - A customer served under the Mandatory product agrees, upon notification by the Company, to reduce its demand to a pre-specified firm service level.
  - Each time the Company exercises its option under the agreement, the Company will provide the customer a credit for the energy reduced.
  - PowerShare Mandatory is an emergency only program. Emergency events are implemented due to reliability concerns as determined by the DEC System Operations Center (SOC). Participants are required to reduce load during emergency events.
  - In addition to the energy credit, customers on Mandatory receive a capacity credit.
  - Mandatory is a year around program that permits 100 hours of event time as needed. There are not a defined maximum number of events for this program.
  - Only customers able to provide a minimum of 200 kW load reduction qualify for Mandatory.
- Generator
  - A customer served under the Generator product agrees, upon notification by the Company, to reduce its demand from the Company by starting an on-site generator to supply all or a portion of the customer's electric needs.
  - Each time the Company exercises its option under the agreement, the Company will provide the customer a credit for the energy self-supplied.
  - PowerShare Generator is an emergency only program. Emergency events are implemented due to reliability concerns as determined by the DEC System Operations Center (SOC). Participants are required to start their generators during emergency events.
  - In addition to the energy credit, customers on Generator receive a capacity credit.
  - Generator is a year around program that permits 100 hours of event time as needed. There are not a defined maximum number of events for this program.
  - Only customers able to provide a minimum of 200 kW load response/self-

supply qualify for Generator.
    - The Generator program requires participants to start their generators monthly for a 1-hour test period each month.
- Voluntary
    - Under the Voluntary product, the Company may notify the customer of a Voluntary event and provide a Price Quote to the customer for each event hour.
    - The customer will decide whether to reduce demand during the event period. If they decide to do so, the customer will notify the Company and provide a firm service level for the event hours.
    - Each time the Company exercises the option, the Company will provide the participating customer who reduces load an energy credit.
    - There is no capacity credit for the Voluntary product since customer load reductions are voluntary.
    - Only customers able to provide a minimum of 200 kW load response qualify for Voluntary.
    - Customers may participate in PowerShare Mandatory and Voluntary concurrently.
- CallOption®
    - A customer served under a CallOption® product agrees, upon notification by the Company, to reduce its demand.
    - Each time the Company exercises its option under the agreement, the Company will provide the customer a credit for the energy reduced.
    - There are two types of events.
        - Economic events are primarily implemented to capture savings for customers and not necessarily for reliability concerns. Participants are not required to curtail during economic events. However, if participants do not curtail, they must pay a marginal energy cost based price for the energy not curtailed. This is called "buy through energy."
        - Emergency events are implemented due to reliability concerns. Participants are required to curtail during emergency events.
    - If available, the customer may elect to buy through the event at a marginal energy cost-based price. The buy through option is not always available as specified in the PowerShare® Agreements. During system emergency events, customers are not provided the option to buy through.
    - In addition to the energy credit, customers on the CallOption® will receive a capacity credit.
    - For the 2012/13 PowerShare® CallOption program (note that NC participation years are January – December while SC participation years are June – May), there were four different enrollment choices for customers to select among. All four choices require curtailment availability for up to five emergency events. The number of economic events varies among the choices. Customers can select exposures of zero, five, ten, or fifteen economic events.
    - Only customers able to provide a minimum of 100 kW load response qualify for CallOption®.
- Other

- Note that other large commercial and industrial demand response programs are offered in DEC through Riders IS and SG. These programs are not part of PowerShare and are not included in this report.

Participation Summary

The PowerShare programs have different enrollment periods and participation periods. This report covers the participation year of 2012. However, for some programs (e.g., CallOption in South Carolina), customers enroll for 1 year periods from June through May. Therefore, one set of customers could participate in PowerShare from January through May, 2012, while a different set of customers are enrolled for June through December, 2012. Likewise, with Mandatory, Generator, and Voluntary, customers can enroll for multiple year terms starting in any month of the year. Only PowerShare CallOption in North Carolina has a specified participation period that starts on January 1 and goes through December 31. Duke Energy Carolinas (DEC) is a summer peaking system and therefore, the most relevant participation period is the summer months of June through September and this report concentrates on those months.

The table below compares account participation levels for summer 2011 and summer 2012, as well as MWs enrolled in the program. The MW values are DEC's estimate of the curtailment capability across the summer months. Additional information is presented below on the different calculations performed for the program including summer capability, P&L recovery values, Measurement & Verification (M&V) values, and day-ahead projected load reduction (PFLs).

Carolinas PowerShare® Participation Update by State

Enrolled Customers†

Program	North Carolina 2011	North Carolina 2012	North Carolina Change	South Carolina 2011	South Carolina 2012	South Carolina Change
CallOption®	**0**	**0**	**0**	**0**	**1**	**1**
PS Generator®	**2**	**4**	**2**	**6**	**5**	**-1**
PS Mandatory®β	**82**	**96**	**14**	**63**	**71**	**8**
Total	**84**	**100**	**16**	**69**	**77**	**8**

†Counts coincide with summer month of maximum participation (September for both years)
β Includes Mandatory HP participants

Summer Curtailment Capability (MWs)*

	North Carolina 2011	North Carolina 2012	North Carolina Change	South Carolina 2011	South Carolina 2012	South Carolina Change
CallOption®	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.2**
PS Generator®	**10.0**	**9.4**	**-0.6**	**4.3**	**4.0**	**-0.3**
PS Mandatory®β	**141.7**	**181.3**	**39.6**	**174.3**	**185.1**	**10.8**
Total	**151.7**	**190.7**	**39.0**	**178.6**	**189.3**	**10.7**

*Numbers reported are adjusted for losses
β includes Mandatory HP capabilities

Program Activity

During the winter of 2011/2012, there were no PowerShare® events. During the summer of 2012, there was 1 PowerShare® CallOption economic event. There were no PowerShare® emergency events. The table below summarizes event load reduction.

Date	Hour End-ing	State	Report-ing Time Zone EDT/ EST	PS 0/5	PS 5/5	PS 10/5	PS 15/5	PS Manda-tory (no events)	PS Gener-ator (only test events)	PS Voluntary (no events)	Power-Share (MW)
7/27/2012	14	SC	EDT				0.2				0.2
7/27/2012	15	SC	EDT				0.2				0.2
7/27/2012	16	SC	EDT				0.2				0.2
7/27/2012	17	SC	EDT				0.2				0.2
7/27/2012	18	SC	EDT				0.2				0.2
7/27/2012	19	SC	EDT				0.2				0.2
7/27/2012	20	SC	EDT				0.2				0.2
7/27/2012	21	SC	EDT				0.2				0.2

Overview of the Evaluation Approach

The impact analysis for the PowerShare programs was conducted by Duke Energy staff and evaluated by Integral Analytics staff. The results presented in this report include a review by Integral Analytics of the impact evaluation methodology and results.

There are many different numbers calculated by the DR Analytics group for PowerShare. A large portion of the effort surrounding analytics for PowerShare falls into four different calculation areas. These calculations can be grouped into 2 categories. These categories and calculation areas are listed below and then described in more detail.

a. Hourly Event Day Impact Estimates
    i. Pro-forma Load Estimations (PFLs) – estimates of participant's hourly electric consumption for the next day. These baseline projections are used to determine potential load reduction for a potential event the next day.
    ii. Measurement and Verification Load Reduction Estimates (M&V) – estimates of actual load reduction provided by participants on an event day.
b. Peak Available Load Reduction Estimates
    i. Load Reduction Capability (LRC) – estimates of load reduction under peak normal weather conditions, if applicable, over a specified period of time such as a month or the entire summer for participants during the period of time in question.
    ii. Revenue Recovery Load Reduction Estimates (P&L) – monthly estimates of summer load reduction enrolled in the program under peak normal weather conditions, if applicable, for all participants enrolled in the program during the calendar year. A single value is obtained by averaging the monthly values over the period when the program can be implemented (i.e., all year).

Note that the PFL process and calculations are projected values used in PowerShare operations. These are not the final estimated baselines for customers. The final baselines are calculated in the M&V process and are used to determine the load reductions during events. The PFL process is significant to the PowerShare program since these values are used for customer settlement calculations and we will discuss them in PowerShare Process evaluation reports.

As the categories above imply, the impact evaluation of the PowerShare program must meet a diverse set of goals. Specifically, after each event, the level of load reduction must be calculated for each participant. If the participant is on a firm service level reduction agreement, the determination is made if they reduced load from wherever their load would have been absent the event, a baseline, to their actual load during the event period. Another key feature of a firm service level agreement is to determine if the customer's load is at or below the firm service level during the event hours, regardless of the amount of load reduction provided.

If the customer is on a fixed reduction agreement (CallOption only), the evaluation calculates the difference between the baseline and the actual load during the control period to see if the agreed amount of reduction was achieved.

[Note that PS Generator has a completely different approach from all the other programs. Generators are required to be metered and impacts are derived from the generator output metered during events. Likewise, for other calculations, the 12 test hour metered data is utilized to embed a forced outage rate into the capability of the generators.]

Credits or penalties for events, using PFLs, are calculated within the Energy Profiler Online (EPO) system for PowerShare and recorded on the customer's utility bill. In addition, the results of the various calculations are used to develop reports for the system operator, load reduction projections, summer curtailment projections for state level planning, and event load reduction analysis.

A further complication is that a control event can be called at any time, for either an emergency power or economic condition depending on the program. Therefore, the evaluation must operate under the assumption that each day is a potential control analysis day. An additional requirement related to PFLs is that an event can be called on any day and therefore, the PFL calculation must be available every day. The control season runs all year for emergency events; however, economic events, although possible outside the summer season, tend to be limited to the summer season. Regardless of the date, the evaluation needs to be able to assess the load data of all participants so that Duke Energy can calculate a projected amount of load reduction that is achieved during any hour.

The above requirements have resulted in an extensive impact evaluation procedure as described above. This evaluation procedure consists of the following tasks:

Table 1. PowerShare Evaluation Procedures

Process	Purpose	Frequency
PFLs	Settlement with customers and emergency event load reduction projections	Every weekday
M&V	Reporting actual impacts of events to regulatory bodies.	Monthly if an event occurred in the prior month
LRCs	Internal & external reporting and input into P&L process	Monthly
P&L	Regulatory filings for revenue recovery	Monthly as needed for internal reporting and a year-end true-up for revenue recovery

Other processes which are done on an as-needed or requested basis include event day analysis and generator tests.

A high-level overview of the M&V, Capability, and P&L in Table 1 is given below. [Again, note that these processes are not applicable to PowerShare Generator which uses the metered generator output from events and test events to calculate the values needed.]

Capability, P&L, and M&V

The steps involved in the calculation of the monthly reports of Capability, P&L, and M&V are all similar, but not exactly the same. In addition, for PowerShare Voluntary, the Capability and P&L processes are not performed since they are not relevant to the program. For the M&V process for PowerShare Mandatory, CallOption, and Voluntary, hourly load data from all enrolled customers is collected for a particular month. Data is treated similarly but with a few exceptions such as the modeling of quiet periods. Event days and days where participants have reduced load, due to a maintenance shutdown for example, are excluded. However, if an event occurs during a period when the customer is on a maintenance shutdown, the information used in the analysis concentrates only on the information during their shutdown period and requires special handling. This is a rare event though and the typical procedure is described below.

This data is combined with the actual weather for that month. Regression models (one with and one without weather terms) are developed using the combined data similar to the hourly regression model discussed in the day-ahead PFL calculations discussed above. Specifically, the regression equation relates the customer's hourly electricity load to:

- A Fourier transform of hour of the day
- A Fourier transform of hour of the week
- A Fourier transform of hour of the month
- Temperature Humidity Index
- Binary variables for holidays and quiet periods, if appropriate
- Interactions between the Fourier transforms and the other variables

An F-test is calculated for each customer to determine if weather is a significant explanatory variable (unless weather is explicitly excluded for customers known not to be weather sensitive). If so, then the estimated parameters are used to create predicted loads using actual weather conditions on the event days. Thus, the baselines from the M&V process are representative of the actual load the customer would have consumed absent an event. These baselines from event days are then used with actual load data from the event hours and a load reduction is calculated.

However, note that all results are reviewed by Duke Energy's DR Analytics' staff. If regression results are clearly not representative of a specific participants load absent the event, an adjustment to the baseline may be applied. In addition, small variances around the baseline expected by typical model variance, above and below, are set to zero and therefore not considered load reduction.

M&V results are shown above in the Introduction section. Please note that the PFL event load reduction estimates are used for settlement with customers. However, M&V load reduction estimates are Duke Energy's best estimate of the load reduction impacts and these impacts are used for regulatory reporting purposes where applicable.

Load Reduction Capability (LRC)

Similar to the M&V regression process described above, Load Reduction Capability (LRC) is calculated on a monthly basis for PowerShare Mandatory and CallOption. [Note that for PowerShare Generator, capability is defined by the metered performance during test hours and events.] For the LRC process, hourly load data from all enrolled customers are collected for a particular month. Event day information is eliminated from the analysis. Quiet periods, for example due to a maintenance shutdown, are included and modeled in the analysis.

The data are combined with actual weather. Regression models are developed using the combined data similar to the hourly regression model discussed above. Similar to above, two models are created: one with weather terms and one without. Specifically, the regression equation relates the customer's hourly electricity load to:

- A Fourier transform of hour of the day
- A Fourier transform of hour of the week
- A Fourier transform of hour of the month
- Temperature Humidity Index
- Binary variables for holidays and quiet periods, if appropriate
- Interactions between the Fourier transforms and the other variables

An F-test is calculated for each customer to determine if weather is a significant explanatory variable (unless weather is explicitly excluded for customers known not to be weather sensitive). If so, then the estimated parameters are used to create predicted loads using peak normal weather conditions for all days of the month. Thus, the baselines from the LRC process are representative of the peak normalized load the customer would have consumed throughout the month. The weekday, non-holiday baselines are then used with the customer's specified fixed reduction amount or firm load level to calculate the load reduction available each hour. By hour, these values are averaged across the month.

However, monthly LRC by participant is typically not of interest for most reporting purposes. Of primary interest is the summer LRC given that DEC is a summer peaking utility. Therefore, by hour and by participant, a weighted average of the four monthly LRC values is calculated. Then, the hour ending (HE) Eastern Daylight Time (EDT) 17 is captured to determine the summer LRC of each participant. Summing across all participants provides the Summer LRC of the program.

Revenue Recovery Load Reduction Estimates (P&L)

Similar to the LRC regression process described above, P&L is calculated based on capability calculations for all 4 summer months for PowerShare Mandatory and CallOption. For the P&L process, hourly load data from all enrolled customers are collected for June through September. Event day information is eliminated from the analysis. Quiet periods, for example due to a maintenance shutdown, are included and modeled in the analysis.

The data are combined with actual weather data. Monthly, a regression model is developed using the combined data similar to the hourly regression models discussed above. Specifically, the regression equation relates the customer's hourly electricity load to:

- A Fourier transform of hour of the day
- A Fourier transform of hour of the week
- A Fourier transform of hour of the month

- Temperature Humidity Index
- Binary variables for holidays and quiet periods, if appropriate
- Interactions between the Fourier transforms and the other variables

An F-test is calculated for each customer to determine if weather is a significant explanatory variable (unless weather is explicitly excluded for customers known not to be weather sensitive). If so, then the estimated parameters are used to create predicted loads using peak normal weather conditions for all days of the month. Thus, the baselines from the P&L process are representative of the peak normalized load the customer would have consumed throughout the month for all customers; even if the customer wasn't actually participating in one or more of the summer months. This is where the LRC and P&L processes differ. In LRC, the monthly value for June for a participant who joined the program in July would be 0. However, in P&L, the calculated value would be used for June. The fact that the customer did not participate in June is captured later in the calculation process. Continuing, the weekday, non-holiday baselines are then used with the customer's specified fixed reduction amount or firm load level to calculate the load reduction available each hour. By hour, these values are averaged across the month.

Then, by hour and by participant, a weighted average of the four monthly values is calculated. By participant, the hourly value for hour ending (HE) Eastern Daylight Time (EDT) 17 is captured to determine the summer P&L of each participant. This is where the LRC process would terminate after summing across all participants. However, the P&L process now calculates monthly values by taking the sum of the summer values described above for each month of only the participants in that month. These monthly values are then delivered to Product Analytics for final calculations of the P&L results. Accounting adjustments are made as needed.

Evaluation Findings

Summary

As discussed above, each calculation PFL, M&V, LRC, and P&L has a specific purpose. Primarily, PFLs are used for customer settlements where applicable for event incentives and operational projections of load reduction available the following day. M&V is used for regulatory and internal reporting of load reduction from events. LRC is used for internal and external reporting of load reduction available during each monthly period. P&L is used for revenue recovery requests. For DEC PowerShare Mandatory, Generator, and CallOption, the LRC and P&L values including adjustments for line losses for 2012 are provided in Table 2 below.

Table 2. LRC & P&L Program Summary

Program	Summer LRC (MWs)			P&L (MWs)
	NC	SC	Total	System Total
PS CallOption 0/5	0.0	0.0	0.0	0.0
PS CallOption 5/5	0.0	0.0	0.0	0.0
PS CallOption 10/5	0.0	0.0	0.0	0.0
PS CallOption 15/5	0.0	0.2	0.2	0.1
Total PS CallOption	0.0	0.2	0.2	0.1
PS Generator	9.4	4.0	13.4	13.1
PS Mandatory	181.3	185.1	366.4	363.5
Total PowerShare	190.7	189.3	380.0	376.7

Review of Approach

Overall, the technical approach used by Duke Energy in developing the event impacts are very well thought out and developed.

In general, the model specifications in all the processes includes the key determinates of energy usage, so there is little likelihood of any bias in the results from omitted variables. One particularly noteworthy feature is that they use an extensive history to estimate the model, rather than relying on only a handful of days as is common in many utilities which use less rigorous approaches. In addition, using a multivariate regression model in the Capabilities, P&L, and M&V processes is generally preferred over approaches that are based on average loads from a pre-event period.

The one concern we have is that there are multiple processes that essentially measure the same thing. For example, the P&L and Capability processes are essentially both measuring the peak normalized load reduction capability of participants. This appears to be inefficient, as well as confusing, as it is not clear what the actual estimate of impacts is for the program without considerable explanation. Of note, Duke Energy describes the P&L value as follows:

- The PowerShare programs allow the company to reduce load at any point during the year during an emergency. Because of that, the Company recognizes revenue ratably over a 12 month period based on the current summer capability for that month. (Said another way, the Company multiplies its current kW summer capability times the avoided cost of capacity per kW / 12.) The Company accordingly reports its 12-month average summer capability in regulatory true up proceedings for the PowerShare program.

In addition, for some programs under the PowerShare umbrella, there appears to be no direct link between the customer payments (based on the day-ahead PFL) and the overall program impacts (based on the M&V and Capability process). Since the day-ahead PFL is based on the BoB approach for PowerShare CallOption, Mandatory, and Voluntary, while the other processes are based on regression models, it may be that there is a marked difference between the two estimates of load impacts.

Relatedly, it is not clear why different processes must be involved. While there appears to be a specific purpose for each process, there may be efficiencies captured by consolidating the processes. While it is obvious that a distinction be made between actual weather and peak normal weather, it is not clear why that requires two distinct processes. It seems possible to combine the Capability and M&V process into one process, where the regression models are estimated once, and for the weather sensitive customers, estimates of both actual and weather normal impacts are estimated from the same model (just using different weather values). In addition, a difference between the Capability and P&L process is that the P&L includes customers who have enrolled after the summer or potentially participated during the beginning of the year but terminated their participation prior to the summer. Duke Energy clearly wants to capture these post-summer enrollments and start collecting revenues for them during the current year. However, it is our opinion that the P&L process may overstate or understate the actual capability of the program, if for example you are talking about the capability of the program during the summer of 2011. Therefore, our continued recommendation is that the impacts should be based on the Capability calculations, and Duke Energy should review the need for each process to see if they are truly required. In response to the same recommendations made in previous evaluations, Duke Energy has reviewed each process and believes that the capability, M&V, and P&L underlying calculation processes can be consolidated. Duke Energy will notify TecMarket Works when changes are implemented. Once these implementations are incorporated, we will revise our recommendations based upon the new approach.

Overall, based on our review, Duke Energy's impact evaluation is a very complete and innovative approach, and it should result in accurate estimates of event impacts.

Final Report

Process Evaluation of the Smart Energy Now Program (NC) (Pilot)

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

July 31, 2013

Submitted by

Nick Hall, Dave Ladd,
and Johna Roth

TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

Subcontractor:

Carol Yin
Yinsight, Inc.

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Executive Summary

This document presents the results of the process evaluation of the Smart Energy Now (SEN) Pilot program implemented in Charlotte, North Carolina between October 28, 2011 and the present day, including discussion of program planning events beginning in the fall of 2009, leading up to the October 28, 2011 launch date.

The Smart Energy Now (SEN) pilot is the first-of-its-kind program to be implemented in the world, employing new technologies that are linked with new communications and monitoring strategies to interact with a large population of commercial buildings in a metropolitan area. It is a groundbreaking, state-of-the-art commercial sector behavior-change program that drives changes in energy-related behaviors through a wide range of communication strategies to reach building operators, building managers, building owners, and the tenants and occupants who work in those buildings. The program employs multiple communication and information distribution strategies across a wide variety of approaches, including web-based information and feedback systems, direct e-mails, newsletters, meetings and seminars, training events, and other strategies. A publically visible part of the communication strategies is the use of in-building kiosks that present program-related and behavior-related information to people moving in and out of the participating buildings. The kiosk also displays energy use and comparative energy use information fed by real-time building-specific meter uploads displayed on the kiosk screen. The program also provides software tools to participants that help them find ways to save energy and more efficiently manage their energy use.

Envision Charlotte is a program designed to create a more sustainable urban core in Charlotte's Uptown area through four pillars: energy, air, water, and waste. Smart Energy Now is designed and implemented by Duke Energy and supports the initial "energy pillar" within Envision Charlotte. Smart Energy Now was formally launched prior to the field implementation of all other energy efficiency efforts within Envision Charlotte. All energy behavior initiatives documented by this evaluation that were coordinated or associated with Envision Charlotte were offered by Duke Energy through Smart Energy Now. While Envision Charlotte has an energy savings objective that is greater than and inclusive of those of the SEN program, at the time of this evaluation, Envision Charlotte essentially had no other functioning energy behavior initiatives. Thus, the energy initiatives identified in this report, and the associated energy savings reported in this evaluation and the impact evaluation are those associated with Smart Energy Now.

In order to broaden awareness for the program and influence behavior change in participating buildings, Smart Energy Now includes an Energy Champion component. Energy Champions are individuals who have been trained in one or more aspects of Smart Energy Now, but focusing on the difference occupants can make in reducing wasted energy in commercial office buildings and methods of influencing changes in energy use. Energy Champions can either elect to attend training on their own or are nominated by their company. Once trained, Energy Champions are encouraged to launch energy saving campaigns within their companies, offices, floors or teams. They can choose from campaigns that SEN has developed, or work with the SEN team to create a customized energy saving campaign based on their office energy use and culture.

The program was designed by Duke Energy. In that design process, Duke Energy gathered what they considered to be some of the "best minds in the country" to support the design and operations of this new-concept program. The program was facilitated by technical and financial support contributed by a number of corporate partners and educators who saw market potential in the future development of these types of programs and their associated monitoring and communication strategies. Some of these partners and stakeholders played major roles in providing and developing the technologies and communication systems and operational strategies that made SEN possible, while others provided operational or organizational support in one or more of the design, development and implementation processes.

These partners and key support organizations include, in alphabetical order:

- Charlotte Center City Partners (CCCP)
- Cisco
- City of Charlotte
- Earth Markets
- EMpower Devices
- HR&A
- Intelligent Buildings
- Mecklenburg County
- Massachusetts Institute of Technology (MIT)
- Nexus on Demand
- Performance Systems Development (PSD)
- Pulse
- SmartCore
- StudioBanks
- University of North Carolina Charlotte (UNCC)
- U.S. Green Building Council (USGBC)
- Verizon

It is not possible to judge the success of the SEN pilot program by viewing only the results of the process evaluation. While the process evaluation documents that the program was successful at gaining awareness, interest, engagement, and in inducing energy saving behaviors, the final chapter relating to program effectiveness cannot be written until after the impact evaluation is completed in 2014. From a quantitative perspective, the most important evaluation results will be associated with the results of the energy impact evaluation. This study will be completed after the 2013 cooling season savings can be evaluated. The impact evaluation will allow Duke Energy to understand the program's energy savings impacts and be able to compare the energy saving benefits against the costs associated with the implementation of the SEN pilot program.

However, from a qualitative perspective, this process evaluation study does shed light on the design, development, and implementation process. Because this is the first program of its type in the world, there are no other programs like it by which it can be compared. This program broke new ground in its design and operational approaches. While this evaluation team cannot compare the operational and design success of the program because of the lack of comparable programs, this process evaluation does examine and assess the effectiveness of the approaches used by reviewing the program's progress and accomplishments.

Key Findings and Recommendations
This section of the evaluation report summarizes the key findings and recommendations presented below in the body of the report. A more detailed development of the findings and recommendations can be found in the appropriate sections of the report that deal with each topic.

The key findings include:

1. Almost 97% of the occupant survey respondents from the participating buildings we surveyed are aware of SEN. Most of the survey respondents know that SEN is a program designed to reduce energy use in their building. The program was exceptionally successful at gaining the attention of building occupants in a way that allowed them to know about the program and its purpose. During the official kick-off event, held after the program was operationalized and the kiosks were displaying program information, a pre-campaign survey of people working in the participating buildings found that 54% of workers had heard about SEN. SEN has reached the vast majority of some 60,000 occupants in participating buildings.

2. Building occupants are taking actions to reduce energy use and while 42% say that they are currently doing all they can, 55% of the respondents say that there is still more that they can do to reduce energy at work. Occupants are very interested in saving energy in the workplace and rate that interest at 8.47 on a 10-point scale. The key driver of their interest is the environmental impacts of reducing energy use.

3. Occupants want results-oriented information, not just ways to reduce use. The most common information need expressed by occupants was the need to know how much energy they are saving when they take actions. They want to see proof that what they are doing is working.

4. Almost 60% of occupants we surveyed agree that SEN has provided them with energy saving information that they can use to reduce energy use in their office. However, there remains a potential to influence more occupants if additional ways to reduce energy use (that they do not know about) can be identified and effectively communicated to the occupants. About 40% of occupants indicated that SEN provided them with recommended actions that they were not yet doing, while a similar amount said that SEN provided recommended actions that they were already doing. SEN is reaching a substantial number of occupants and helping them identify new ways to save energy, as well as driving increases in tried-and-true energy-saving actions.

5. Occupants of the buildings are satisfied with SEN, with a mean overall satisfaction rating of 7.68. This rating is moderately high within the field of energy efficiency program evaluation and should be viewed as a good score, with room for improvement.

6. Over 60% of the Energy Champions, volunteers within a company who receive special training from SEN, have conducted the mini-audits of their office to identify ways to save energy in their workplace. The majority of these individuals have conducted these audits more than once.

7. Over 75% of the Energy Champions have obtained ideas from SEN communications for reducing energy that they have recommended to others.

8. Almost 40% of individuals responding to the process surveys do not recall having made a pledge to undertake conservation behavior changes. Program management believes this recall rate is due to the way requests for support evolved over the program's duration. During the first half of the program the focus was on obtaining email addresses and permission to send information about SEN. This effort evolved to a request to pledge support on the SEN website in September of 2012. As a result, many of those having signed up to receive emails in the early phase were never actually asked to "*pledge*" support in general or make a pledge to undertake a specific behavior action.[1]

9. While the majority of respondents (82%) have not used the SEN website within the last 30 days, those who did use it find information that leads to greater participation and increased actions taken. Of the respondents that have used the website, 45% percent have signed up for the SEN newsletter, 42% have pledged support for SEN, 39% looked for Energy Champion information and 27% have found campaign information. The 82% who have not used the website within the last 30 days may be encouraged to visit the website, or visit it more often, if the site can be designed and operationalized to be attractive to them.

10. About 72% of respondents report knowing about or participating in one or more of the SEN campaigns to encourage energy efficient behaviors. The most popular and well-known campaigns are "Crab You're It", "Flipping Out", and "Adopt A Light". Seventy percent of those taking part in these campaigns said that they have increased the frequency of actions they have taken. When asked to rate the effectiveness of these campaigns, respondents scored them at 7.6 on a 10-point effectiveness scale. When asked to score the frequency of the actions taken, respondents reported taking actions an average of 8.9 times a week per respondent. These campaigns are changing behaviors.

11. Smart Energy Now does not track campaign activity details to the level necessary to project energy savings from those campaigns. SEN does know which offices are conducting which behavior-change campaigns, but does not know how many people are participating in these campaigns or exactly which activities are taking place and with what frequency. While SEN has asked the offices to report back on their campaign participation rates, they often do not receive feedback of this nature from the offices.

[1] In fact even pledges of support on the SEN website are accepted without filling in the separate text box for a "pledge statement" where a specific behavior action *can be* recorded. Because the focus of this online form was to garner support for SEN rather than elicit a specific behavior pledge, program management accepted general support pledges not just those with pledges to make a specific behavioral change.

12. The majority of building occupants believe that the ability for each office to create its own campaigns is critical to the success of Smart Energy Now. Half of the respondents (25 out of 50) rated this self-generated component as an important factor, with a rating of eight or more on the importance scale. This is a resounding affirmation of SEN's design, and the fact that these activities are not tracked more closely is the biggest lost opportunity that the evaluation team sees within the Smart Energy Now program.

13. The development of the real-time public access information display represents a significant step forward in energy efficiency behavior change program operations. The use of new technologies and software applications by Duke Energy and their partners provided SEN with a monitoring and communications system that reached the occupants of the SEN participating buildings. This system was set up using substantial levels of contributed resources by key partners, saving substantial amounts of program funds.

14. The kiosks were frequently visited by a subset of the Uptown workers. Half of those surveyed said they had not looked at or read the kiosk within the past 30 days, however, those that did visit the kiosks reported that they did so regularly. Of those who viewed them, one visit every two weeks was the most often expressed visitation schedule. Looking at data captured by the kiosks themselves suggests that visits or "kiosk sessions" declined from a high of about 8,500 visits per month at inception to a low of about 2,500 in April of 2013. This supports an opinion that the novelty of the kiosks may be waning as occupants become accustomed to seeing them. It also suggests that changing the content displayed on the kiosks to capture attention is important for maintaining interest in the content if the kiosks are to continue as a major communication and feedback approach. Both the SEN program managers and the building occupants agree that even if they did not interact with the kiosks, the kiosks served as a method of reminding participants of the program, its objectives, and actions that they could take.

15. Those that did interact with the kiosks were engaged by the information presented and a significant portion of these viewers liked to see the real-time Uptown energy consumption. However, the information most wanted by viewers was not available on the kiosks. Even more than live usage data, the building occupants we surveyed want the kiosks to tell them how much energy their strategies and actions are saving in their buildings, so that program-wide and building-specific progress can be monitored in real-time. The SEN program managers are aware of this desire, and agree that building-specific information may be one of the stronger motivators of behavior change. Since the time of these interviews, building-specific information has become available on the kiosks. However, about half of the management of the buildings in which the kiosks reside does not support real-time displays of their energy use and building-specific performance, in part because of privacy and confidentiality concerns associated with the occupancy and use of their buildings and the performance of their energy systems.

16. Facility managers of the participating buildings who manage the energy systems of those buildings are very much aware of SEN and its objectives and thought that substantial energy-saving potential still existed in retrofits involving lighting and lighting controls, HVAC, chillers, boilers, variable frequency drives (VFDs), and other capital and

behavior-change improvements. The biggest challenge or barrier for achieving the capital improvement savings is finding the funding to implement those improvements.

17. Facility managers who attended the "Town Hall" meetings thought they were beneficial and liked the networking with other managers and the updates they received about SEN and its activities. To a more limited degree, a few of the managers also liked learning about new ways to save energy. Twenty-five percent of the facility managers indicated that they had conducted the SEN recommended audit of their buildings to find ways to reduce energy use.

18. Facility managers need additional training on how to use the Compass Tool. While facility managers generally agree that the Compass Tool can show them the building's energy use, many do not require use of the Compass Tool in order to obtain building energy use information. In many cases, facility managers indicated they did not need live energy usage information. Finally, facility managers do not have the time nor perhaps the interest to use the Compass Tool to help SEN track its progress. From the responses we gathered, it seems to the evaluation team that while the Compass Tool offers cutting-edge technology, it may be offering more than many of the facility managers need.

19. Overall, facility managers report that they are certain that they have reduced their building's energy since the beginning of SEN, and attribute SEN with not only helping them identify ways to save energy, but also helping them with the means by which to achieve those savings.

20. Facility managers are satisfied with SEN and report overall satisfaction at 7.8 on a 10-point satisfaction scale, a number indicating high levels of satisfaction, but with some room for improvement. When managers were asked about the aspects that they disliked, some indicated that they lacked enough time to participate in the program. Some facility managers and some building occupants also said that they would like the kiosks to provide building-specific information (Note: this capability has since been added).

21. SEN had minimal impact on the levels of participation in Duke Energy's other residential and commercial energy efficiency programs. An increase in enrollment that is correlated to the SEN time period was found in only one residential program offered in the Charlotte area: the Personalized Energy Report® (PER) program. However, it is not possible to conclude how much of the increase in enrollment for this program in the Charlotte area was caused by SEN rather than other factors that may affect participation rates, e.g. increased efficiency marketing efforts in those areas. Other energy efficiency programs offered by Duke Energy in the Charlotte area did not have measurably different participation patterns during the SEN time period.

22. SEN's trailblazing efforts are now being used as the foundational model for launching additional Uptown Charlotte sustainability efforts that will address water use, air quality, and waste management. Envision Charlotte board members report they have already used lessons and practices learned by Duke Energy's SEN to design initiatives for Envision

Charlotte's water, air, and waste pillars. SEN's legacy may be long lasting and reach far beyond energy savings.

23. Charlotte area SEN stakeholders report that SEN was the right program at the right time for Charlotte. Stakeholders report that SEN was implemented at a time when the city was ready for it: when key technology firms had newly developed technologies to support it, when software was capable of being used in real-time monitoring, when key business leaders were looking for a place to test their technologies, and when city and county leaders were supporting its objectives. All these conditions came together at the same time making Charlotte an ideal pilot test city. While not all of these capabilities were fully used, especially during the first year of the effort, these capabilities and the availability of their use increased stakeholder interests in being a part of SEN.

24. Smart Energy Now is designed to drive energy savings through behavior changes. While SEN was designed and implemented by Duke Energy, Duke Energy believes that being a part of Envision Charlotte and the Clinton Global Initiative has opened many doors. However, they are in the process of identifying the key elements of success for SEN, and believe they could replicate those elements to achieve equal success within a region that does not have Charlotte's pre-existing close-knit business community.

25. SEN stakeholders who have followed the development and implementation of the program report that they are confident that there will be substantial energy savings from SEN, but are uncertain of the amount of savings.

26. Stakeholders believe that the lessons and educational efforts associated with SEN will provide savings beyond the Uptown area and will achieve savings in the homes of the participants.

27. Most occupants in the participating buildings are equally interested in saving energy at home and in the workplace. Occupants would like for SEN to focus on the workplace and on saving energy at home. However, of those respondents who express a preference for one over the other, more would prefer that SEN be focused on the workplace rather than on the home.

28. Per Commission order, one of the objectives of this report was to differentiate the energy actions and impacts associated with SEN from those that were caused by the greater Envision Charlotte initiative. At the time of this evaluation, Envision Charlotte had no energy-related behavior initiatives other than SEN, therefore the evaluation team concludes that net energy reductions identified in the impact evaluation are due to the efforts associated with SEN and are not due to additional energy-related Envision Charlotte efforts outside of SEN.

Based upon these findings and others in the body of the report, we make the following recommendations:

Campaign Recommendations:

1. Duke Energy should continue to leverage and improve upon the expert input the program has received to develop one or two more campaigns to offer to offices that prefer a less game-oriented approach to campaigns. This will allow participants with both options: to fully customize their own approach, or to use materials that have been developed by behavior-change experts, whether they prefer fun campaigns or more work-oriented campaigns. This would allow Duke Energy to meet the needs of those who prefer more structure, as well as those who prefer more customization.

2. Smart Energy Now should work to ensure that when a company runs a campaign, those campaigns are understood to be a collaboration between Duke Energy and the participating company, and are also seen as part of SEN. These connections do not seem clearly understood, based upon survey responses. While the campaigns do not necessarily need to be branded as SEN campaigns, making the connection to SEN reinforces the overall sustainability context for those participants who are engaged because they genuinely care about the environment. This would also allow participants to credit Duke Energy and others who are responsible for sponsoring these campaigns. Finally, this would allow them to understand that the prevailing social norm in participating companies is to take energy-saving actions such as the ones in their campaign.

3. To support a more rigorous evaluation of the new campaigns (if desired), Duke Energy would need to survey each office and record which campaigns they were running. While this kind of data can be gathered during the evaluation phase, it is less costly to build suitable program data tracking processes into regular program operations. In addition to helping to communicate the successes of Smart Energy Now, regular tracking of this data would be useful in improving the program managers' current understanding of program operations. Duke Energy should also consider the importance for developing a campaign use tracking system to help support a rigorous effectiveness evaluation of new campaigns.

4. Duke Energy should consider the costs and benefits of continuing to encourage participants to create their own campaigns. Several of the participant-developed campaigns were more effective than the campaigns developed by experts. For example, the "Crab You're It" campaign was particularly effective, however not every individually developed campaign was as successful. It may help if Duke Energy considered offering more behavior change campaign development coaching or training to those who are interested in designing new campaigns for their office. This may be accomplished by supporting campaigns with "campaign consultants" or campaign guidance provided by Duke Energy to help train people in companies that are interested in customizing the campaigns. The expert marketing development consultants could provide advice or concept documents to support the self-development efforts of companies who want to develop their own campaigns.

Kiosk Recommendation:

5. If the kiosk component of the program is going to remain as a program design component, Duke Energy should change significant portions of the content on a regular basis. Many of the suggestions provided by the survey respondents have merit, as did many of the original ideas the kiosk designers considered. Duke Energy could consider selecting a subset of these suggestions and rotate their presentation on a weekly or biweekly basis, while keeping other popular elements such as the energy usage counter. This will present passersby with new information, and eventually may encourage them to check the kiosk regularly to see what is new that week. Duke Energy could monitor the usefulness of the changing content by having simple “like” or “dislike” buttons at the bottom of each screen, tallying the number of responses each week. However, it may be that the function of the kiosk is not critical to the program if other forms of engagement can be effective in generating interest and keeping the program visible and engaging to the targeted populations. This recommendation is not to suggest that the kiosks are a necessary part of SEN, but only to note that if they are continued, improvements needs to be considered.

Energy Champion Recommendation:

6. Duke Energy should conduct more detailed research with the Energy Champions about the types of activities that have been successful and not successful within each company. This will allow Duke Energy to find more ways in which Energy Champions could be better used to advance the behavior-change objectives of Smart Energy Now.

Compass Tool Recommendation:

7. Duke Energy should examine the degree of need and the perceived value of the Compass Tool from the users’ perspective. The assessment should focus on identifying the needs and wants of facility managers and on understanding how building usage data is being used (if at all) to support the formulation of actions to reduce energy use or to track savings being achieved. Following this assessment, Duke Energy should determine if the Compass Tool should be: 1) maintained going forward (perhaps supplemented by more training), 2) replaced with something more appropriate for SEN participants based upon their stated needs and wants, or 3) not used at all.

General Smart Energy Now Recommendations:

8. Track and report the cumulative non-energy successes and achievements of Smart Energy Now to the Uptown Charlotte community on a regular basis in order to maintain interest and satisfaction in the program.

9. Smart Energy Now could investigate whether those occupants who were prompted to make a pledge to undertake behavioral actions and went on to do so, are more likely to follow through and become more efficient in their usage compared to early program supporters who were not prompted to make a pledge. This may allow SEN to determine whether additional actions are required to maintain the power of commitment via the use of pledges. It may be that not obtaining a formal pledge to undertake behavior change leads to lower levels of savings.

10. Duke Energy should continue to conduct periodic small surveys (these could be three or four questions long) to track whether Smart Energy Now is using the website and other social media effectively. This will allow Duke Energy to make improvements in a timely manner, if any are warranted.

Description of Program

Smart Energy Now (SEN) is a program from Duke Energy dedicated to helping reduce energy consumption in Charlotte's Uptown office buildings. SEN works with building owners and operators to identify ways in which the buildings' energy systems can be made to operate more efficiently. SEN also focuses significant efforts in educating and motivating building tenants and occupants to use energy wisely within their workspace. SEN accomplishes this by focusing educational efforts and motivational campaigns on office workers within the participating businesses. The goal of SEN is to reduce building energy consumption by 3%-5% over what it would be without the program.

SEN is the first commercial facilities energy efficiency behavior-change program launched in the United States and employs a first-of-its-kind wireless digital display in the participating buildings that shows real-time energy consumption levels of the population of participating buildings and a comparison of that level of consumption with similar periods of weather. This data includes information about real-time usage, load factors, historical trends, and information about what those numbers actually mean. Through SEN and the Envision Charlotte initiative, the goal is to reduce energy usage in Uptown by 20% overall in five years.

Background

Smart Energy Now is a program developed by Duke Energy as a result of the company's experience offering energy efficiency program services to their commercial customers. Duke Energy had "experimented" with behavior-based energy service programs over the past several years by offering customers advice and recommendations to help them save energy in their buildings. These recommendations had been offered in conjunction with other standard technology programs. The experience from these behavior-based efforts had demonstrated to Duke Energy that there are additional energy savings that can be achieved when energy technologies are linked with behavior-based actions that go beyond what standard technologies can save. However, Duke Energy had not yet designed and launched a program specifically targeted at changing behaviors within the commercial sector as a stand-alone concept. They needed a place to pilot the idea.

At the same time that Duke Energy had realized that there are potential savings to be captured by changing behaviors within the commercial sector, key community leaders within the Charlotte area were looking to create a sustainable urban core in Uptown Charlotte that was called Envision Charlotte. Envision Charlotte was conceived in 2010 in collaboration with Charlotte Center City Partners (CCCP), when CCCP was developing its 10 year sustainability plan for Charlotte. As a member of CCCP's board of directors, Duke Energy wanted to demonstrate its support and commitment by developing a new behavior-based program that could be tied back to Duke Energy's energy efficiency offerings. This new program became Smart Energy Now. Intelligent Buildings was brought in to leverage their expertise in smart buildings, and together they developed the idea to connect commercial office buildings together through the Digital Grid to promote energy efficiency and sustainability. As the Duke Energy program manager reports, "It was a big idea, a grand idea. It quickly got traction within Duke Energy." Through Duke Energy's support of the Clinton Global Initiative (CGI), former President Bill Clinton learned of this effort and wanted to include Envision Charlotte as part of their initiatives.

The essence of Smart Energy Now lies in the measurement of behavior change. As one of the original designers of SEN says, “Whatever we do in this program, we've got to measure, and we've got to show people we're measuring. You can't change what you can't measure.” Although Envision Charlotte is the umbrella program for SEN, for all intents and purposes, Duke Energy was the primary entity driving Envision Charlotte in the early days through its implementation of Smart Energy Now. At this time Envision Charlotte’s other sustainability pillars[2] were not yet developed at more than the idea level. Envision Charlotte was only represented by Smart Energy Now and effectively SEN and Envision Charlotte were one and the same. That confusion can still be found today as some people use the two names interchangeably. As the SEN program manager reported, “When people talk about Envision Charlotte, they still mean Smart Energy Now.” Thus, the efforts by Duke Energy were focused on Smart Energy Now and not to any significant degree on the other pillars of sustainability.

Duke Energy's success in launching SEN required that they overcome challenges on both the technological and political fronts. As one of the original designers put it, “A lot of what is going on here is innovative because this never really had been done, not necessarily on the technical side but on the political side.”

On the technological front, SEN required the establishment of the cutting edge 4G LTE wireless network, and the integration of smart meters, real-time data normalization, and 24/7 live data displayed on over 60 kiosks. On the political front, SEN required the buy-in of Uptown Charlotte's building owners, tenants, and facility managers. This required that two different populations sign legal contracts. In order to install the smart meters, SEN had to obtain the agreement and signatures of the customers. In order to install the kiosks in the building lobbies, they had to obtain the agreement and signatures of the building owners. SEN's objective was to sign up 80% of eligible buildings in Uptown Charlotte; they achieved 97%.

Based upon SEN's market analysis and using the input of subject matter experts on behavior change, SEN established the objective of a 3% - 5% reduction in energy use solely through behavior change. Based upon their research, SEN expected a 3% energy reduction through behavior change in smaller buildings (<100,000 square feet), and a 5% energy reduction in larger buildings that had more energy savings potential due to their size (100,000 square feet and over).

In order to affect this change, Duke Energy developed a plan that targeted different populations within the Uptown Charlotte office buildings, including the building owners, the building occupants (office workers), and the facility managers or property managers. The remainder of this process evaluation report will contain a discussion of Smart Energy Now's efforts to date in affecting behavior change.

The Smart Energy Now pilot resided within Duke Energy's Grid Modernization Division until Q4 of 2012, when it became a part of the Customer Services organization. Through the efforts of Duke Energy, Smart Energy Now and Envision Charlotte have garnered a number of awards.

- Vincent Davis, the director of the SEN program, was awarded USGBC Charlotte's 2012 Individual Leadership Award.

[2] Water, Air, and Waste, as discussed in the section “SEN and the Four Pillars of Sustainability” on page 23.

- Envision Charlotte won USGBC's 2012 Leadership Award for Non Profits.
- Vincent Davis won the North Carolina Sustainable Energy Association's 2012 Individual Leadership Award.
- Smart Energy Now won POWERGRID International magazine's "2012 Energy Efficiency/Demand Response Project of the Year Award".

Non-Energy Successes

# Participating Buildings	59
# Signed Declarations by Tenant Leadership	50
# Energy Champions	1000
# Pledges made on Website	890
Approximate # of Email Messages Promoting Efficient Behavior to Uptown Charlotte[3]	36,000
% Facility Managers participating in Town Hall Sessions	97% of Uptown Charlotte Managers

Methodology

Overview of the Evaluation Approach

The process evaluation had four components:

1. Interviews with SEN Designers and Developers
2. Interviews with Envision Charlotte Stakeholders and Board Members
3. Online Surveys with Occupants of SEN Buildings
4. Online and Telephone Surveys with Property Managers and Facility Managers

Study Methodology

Interviews with SEN Designers and Developers

These interviews were conducted in April and May of 2013 with all available contacts provided by Duke Energy. Interviews followed the interview protocol provided in "Appendix A: Program Development Partners Interview Guide" and were conducted with the following eight SEN Designers and Developers:

1. Charles Pfeiler, Intelligent Buildings
2. Brandon Miles, Nexus on Demand
3. Greg Thomas, PSD
4. Bill Ribarsky, UNCC
5. Kat Donnelly, EMpower Devices
6. Kerry O'Neill, Earth Markets
7. Will Winn, SmartCore
8. Emily Scofield, USGBC

Interviews with Envision Charlotte Stakeholders and Board Members

These interviews were conducted in February of 2013 with all available contacts provided by Duke Energy. Interviews were conducted with the following six Envision Charlotte stakeholders and board members:

1. Darlene Heater, Vice President of Sustainability and Neighborhood Development, Charlotte Center City Partners, Envision Charlotte Board Member
2. Greg Johnson, Executive Director, Envision Charlotte
3. Rob Phocas, Envision Charlotte Board Member and Charlotte City Manager
4. Heidi Pruess, Environmental Policy Administrator, Mecklenburg County, Envision Charlotte Board Member
5. Tom Shircliff, Intelligent Buildings and Chairman of the Board, Envision Charlotte
6. Michael Smith, President and CEO, Charlotte Center City Partners and Envision Charlotte Executive Advisory Board member

Online Surveys with Occupants of SEN Buildings

Surveys were conducted in April 2013 with 153 occupants of SEN buildings, seven of which were Tenant Leaders that were asked to complete a set of nine questions specifically for Tenant Leaders, some of which continued on to complete the full survey (as part of the 153 completes). An additional 21 occupants partially completed the online survey. The survey protocol can be found in “Appendix B: Occupant Survey Instrument – Phase 1”. Email invitations were sent out by Duke Energy to their email lists of people who were part of the Smart Energy Now community through various channels: Invitations were sent out through Twitter, and emailed directly to Energy Champions, tenants, people who had signed up on Duke Energy’s website pledging their support, people who had provided their business cards at SEN events, and to property managers. In addition, the Energy Champions, tenants and property managers were asked to forward the email invitation to others in their offices, because Duke Energy did not have contact information for all building occupants or tenants. The following sources were used in the distribution of the email invitation to take the survey:

- Newsletter contacts: 1,700 contacts were on this list provided by Duke Energy
- Website registrations: 615 contacts were on this list provided by Duke Energy
- LinkedIn: 412 signed on, 60% were registered “Energy Champions”
- Campaign contacts:850 of which 25 have been appointed by tenant management

The survey instrument contained a section of general questions on attitudes and behaviors that was administered to all survey respondents. Respondents were then randomly assigned to answer one of three sets of questions on 1) Web, social media use, and questions about Energy Champions (if they themselves were not Energy Champions), 2) SEN Campaigns, and 3) SEN kiosks. Energy Champions were identified during the general questions and asked to answer survey questions that were specific to the Energy Champion experience, such as taking the Energy Champion training and running campaigns.

Online and Telephone Surveys with Property Managers and Facility Managers

Online and telephone surveys were conducted from April 25, 2013 through May 10, 2013 with 38 facility managers; one additional manager partially completed the survey. Approximately 55 properties with contact information were provided to TecMarket Works. The final number of contacts is indeterminable, as a particular contact would be responsible for and responding to the survey about one or more buildings (and may have been a different contact than what was provided in the list of contacts).

Facility managers and property managers of the SEN buildings were sent an email asking them to participate in the online survey. The TecMarket Works survey staff followed up the emails with a phone call offering the tenants the option of taking the survey via telephone. Telephone surveys were entered into the online survey instrument for data collection purposes and followed the same survey protocol, found in “Appendix C: Property Manager and Facility Manager Interview Instrument”.

Expected and achieved precision

Online Surveys with Occupants of SEN Buildings

The survey sample methodology had an expected precision of 90% +/- 9.1% and an achieved precision of 90% +/- 6.5%.

Online and Telephone Surveys with Property Managers and Facility Managers

The survey sample methodology had an expected precision of 90% +/- 10.2% and an achieved precision of 90% +/- 7.5%.

Threats to validity, sources of bias and how those were addressed

For all these interviews and surveys, the questions may have triggered a social desirability bias. This was anticipated and questions were worded to refer to a neutral "reduce energy usage" rather than referring to "energy efficiency" which may be a term associated with environmentalists. Also, multiple-choice responses allowed respondents to indicate they did not take socially desirable actions, or that they did not hold socially desirable beliefs. This acknowledges that not everyone holds these beliefs. Questions that had multiple-choice responses also may be subject to a response order bias. Specifically, research[4] has showed that when options are presented visually, there is a primacy effect, or a tendency to select the first option. We used the response order bias to counter the social desirability bias, by ordering multiple choice responses with the least-socially desirable option first, to allow respondents to easily indicate they did not take an action, or did not hold a belief. Finally, we assume a certain level of social desirability bias that cannot be avoided, but that the bias would be a constant factor across all responses.

Evaluation Date Ranges

Evaluation Component	Dates of Analysis
Interviews with SEN Designers and Developers	April 2013 – May 2013
Interviews with Envision Charlotte stakeholders and board members	February 2013
Online Surveys with Occupants of SEN Buildings	April, 2013
Online and Telephone Surveys with Property Managers and Facility Managers	April 25, 2013 – May 10, 2013

[4] Krosnick, J. A., & Alwin, D. F. (1987). An evaluation of a cognitive theory of response order effects in survey measurement. Public Opinion Quarterly, 51, 201-219

Evaluation Findings

Envision Charlotte Stakeholder Interviews

The process evaluation included in-depth, on-site interviews with the Charlotte's key community leaders who were active advisors in SEN and who remain active implementers in the development of the Envision Charlotte initiative. Because SEN was developed in conjunction with Envision Charlotte and was considered a key component of Envision Charlotte's sustainability efforts, and because these stakeholders were substantially involved with both of these developmental efforts, the perspectives and opinions of these community leaders were considered a critical part of the process evaluation so that the study's conclusions could be informed by these key players.

Interviews were held in February of 2013 with the following individuals listed in alphabetical order:

1. Darlene Heater, Vice President of Sustainability and Neighborhood Development, Charlotte Center City Partners
2. Greg Johnson, Executive Director, Envision Charlotte
3. Rob Phocas, Envision Charlotte Board Member and Charlotte City Manager
4. Heidi Pruess, Environmental Policy Administrator, Mecklenburg County
5. Tom Shircliff, Intelligent Buildings and Chairman of the Board, Envision Charlotte
6. Michael Smith, President and CEO, Charlotte Center City Partners and Envision Charlotte advisor
7. Charles Pfeiler, Intelligence Buildings Consultant and former SEN Program Manager for Duke Energy

TecMarket Works and the SEN Evaluation Team wish to express their appreciation to these individuals who met with the evaluation interview team and devoted substantial time in order to take part in these in-depth interviews.

The above individuals were selected for in-depth interviews because of their roles with SEN and Envision Charlotte and their positions within their respective organizations associated with these efforts. In summary, there were five primary organizations initially involved in the development of SEN as a component of Envision Charlotte's sustainability efforts for Uptown Charlotte. While there were numerous others who took part and supported the development of SEN and Envision Charlotte, the coordination of SEN within the larger Envision Charlotte platform was substantially impacted by these organizations in the early development period. These organizations were all in some way associated with the development, launch, and implementation of SEN and the use of SEN as one of the sustainability pillars within Envision Charlotte's sustainability objectives.

Background

Duke Energy is the utility company providing electric power to the Charlotte area; Charlotte City Center Partners is a non-profit community leadership focused organization that works to make Charlotte an extraordinary viable and livable community with a focus on maintaining the city as a healthy and sustainable community; the city of Charlotte is the incorporated public body responsible for the governmental operations of the city; Mecklenburg County is the public body responsible for the governmental operations of the county in which Charlotte is located; Intelligent Buildings is a Charlotte-based "smart real estate professional service company" that focuses on helping clients build, own, and operate energy efficient, smart, sustainable buildings.

While there were several other organizations and individuals who also supported a sustainability initiative, it was these organizations that took on the objective of organizing, launching, and supporting the initiative that was to be called "Envision Charlotte". It was these organizations who had mutually supporting sustainability objectives for Charlotte and who were able to organize these objectives into a working initiative that attracted the attention, cooperation, and participation of Uptown Charlotte's commercial sector. While the interviewees could point to the specific organizations and key stakeholders that were able to successfully launch the SEN and Envision Charlotte initiatives, they also noted that these efforts would not have been near as successful without the support and cooperation of many key businesses, business owners, organizations, and individuals who helped design and launch these initiatives. For example, interviewees noted that bank officials (including Bank of America and Wells Fargo), UNCC staff, MIT staff, and others were part of the "launch platform". Without their support the program would not have come together successfully. The individuals interviewed noted that Jim Rogers, President and CEO of Duke Energy, was critical to not only launching SEN but in helping to support Envision Charlotte's sustainability mission. They also noted that Cisco Systems, Verizon, and others donated supporting equipment, resources, and expertise that made it possible to set up and operate the communication and energy monitoring systems and the implementation support systems. It was also noted that the MIT brainstorming sessions and efforts that brought the behavior-change scientists and the technology people together was a big step in the right direction. However, to limit the cost and time required within the evaluation effort, the in-depth interviews were limited to the individuals noted above.

Interview Results

While several of the commercial businesses operating in the Uptown Charlotte area had their own energy efficiency, environmental and sustainable-building policies and practices, Envision Charlotte, and specifically the Duke Energy-developed SEN component, served as the seed that was to grow into an organized focus on saving energy and enhancing Charlotte's sustainability objectives. While Duke Energy was the leading force behind the development of SEN, this force had impacts beyond SEN and led to a broader focus on sustainability efforts over time. It was these mutually supportive energy and sustainability objectives held by these six organizations that successfully engaged others, which led to the first community-focused commercially-targeted behavior-change energy efficiency program in the United States, Smart Energy Now.

There was no single generator that can be credited for the SEN idea. Several organizations had been working on the idea of a sustainability initiative at the same time and the Charlotte City Center Partner's 10-year plan included it. These ideas came together in Charlotte when each of the organizations was receptive to doing something in Charlotte. However, as one stakeholder put it, "We have been doing great things in Charlotte for a long time, we got our pro-basketball team and our pro-football team here and we have a good set of positive, focused business leaders who have a history of working together and have strong corporate citizenship ethics. We can help get things done in Charlotte and Duke Energy is one of these leaders."

It was noted in the interviews with the different stakeholders that different people working with Intelligent Buildings or with Charlotte City Center Partners brought the idea for an SEN-type program to Duke Energy. But in reality, Duke Energy had been investigating the idea for at least two years prior to SEN with its field-testing of the concepts via its SmartBuilding Advantage® marketing approach and within Duke Energy's smart meter initiatives and the future-directed advanced communications systems associated with Duke Energy's Innovation Center. In these efforts, Duke Energy experimented with new technologies and communications approaches and in offering a broader mix of energy service initiatives that included both technologies and behavior-change ideas. In this same period, as part of the Charlotte City Center Partner's 2020 economic plan there, was a recognized need to economically grow the city in a way that recognized sustainability. As a part of this 10-year economic plan, Charlotte City Center Partners were looking to design and launch a sustainability initiative. Likewise, others within the Charlotte area, such as Intelligent Buildings, were already providing sustainable building and energy efficiency services and had considerable expertise in designing and operating sustainable buildings. These three sets of interests were present at the same time that Intelligent Buildings and the Charlotte City Center Partners approached Duke Energy with the concept of doing an SEN type of program in Charlotte, at the same time that Duke Energy was considering the potential for developing an SEN type of service if it could be designed in a cost-effective way. These primary forces were all looking in the same direction at the same time when the idea of doing something specifically in Charlotte was proposed to Duke Energy. The idea that Charlotte would be a good place to design and launch the country's first SEN-type (commercial behavior-change) pilot program landed on Duke Energy's soil that was already prepared to receive that seed and had been considering efforts to see if communities in their territory were interested in that concept.

These organizations came together and worked to direct the focus of their efforts on the "first-step" of their sustainability objectives: energy savings. While there were other sustainability aspects of varying levels of interest to these key organizations, including clean water and air initiatives and a waste reduction effort, the lens of the sustainability initiative focused first on energy savings through SEN to achieve a part of the energy savings objective. According to interviewed stakeholders, Envision Charlotte wanted to achieve a 20% energy use reduction within the Charlotte area, with 5% of that reduction coming from the SEN commercial behavior change program.

Following the early discussions among these organizations in 2009 and 2010, Duke Energy proposed the implementation of the SEN Pilot Program to the North Carolina Utilities Commission. In February of 2011 the Commission approved the pilot testing of SEN and authorized recovery for a part of the cost of the pilot program. As a result of the Commission's approval of the pilot test, Duke Energy began to work with the other key organizations on the developmental efforts to design, build, and offer the country's first large-scale commercial behavior-change energy efficiency program. According to the stakeholder interviewees, it was because of Duke Energy and the Commission's approval of the pilot program that led to not only the first commercial behavior change program in the United States, but also to the launching of the expanded efforts of Envision Charlotte on other sustainability objectives. According to the interviewees, "Duke Energy and SEN served as the kick-off structure for our larger focus on sustainability within Envision Charlotte." This is not to suggest that Duke Energy or the Commission's decision was the spark for SEN or the Envision Charlotte concept, but only to suggest that according to several key stakeholders, it was Duke Energy's SEN program approved by the Commission which enabled the boots-on-the-ground launching of not only the SEN initiative, but also for Charlotte's sustainability initiative. While Duke Energy's focus was on the SEN component within the sustainability initiatives, it was Duke Energy's ability to develop and deploy SEN that enabled the City of Charlotte to more aggressively go after the broader Envision Charlotte sustainability objectives that occur outside of the SEN framework.

These efforts led to the teaming arrangements between Duke Energy and Intelligent Buildings of Charlotte, to "scope out" a potential program and to work with the various organizations and trade allies to test a behavior-change concept that later would be called Smart Energy Now.

Charlotte was an ideal pilot test community, primed to be supportive of the SEN initiative led by Duke Energy and positioned within Charlotte's Envision Charlotte sustainability initiatives. These efforts led to discussions with key trade allies such as Cisco and Verizon about the types of technologies and communications systems could be developed or brought together to offer a real-time, information-based program that allowed participants to monitor their daily progress in real-time. The idea of real-time energy-based communications as part of a downtown business community pilot program was supported by the firms who were to become the pilot program's key trade allies. These allies were able to bring new technologies, new software, and new communication strategies together in a way that allowed the smart building energy meters to work as shadow meters providing the information needed for the real-time streaming for the kiosks. The approach downloaded data to newly designed aggregating data systems that streamed performance information to wireless 4G networks. Within SEN, new technologies merged with new software and communication systems for the first time, allowing real-time monitoring of the energy use of an entire downtown area of participating buildings linked to messages about energy use and a comparison to historic energy use for those buildings. It is important to note that in the accomplishments associated with this initiative, SEN achieved a series of national firsts, in many ways setting the stage for all commercial behavior-change programs to follow. The combined efforts of Duke Energy, Charlotte City Center Partners, and the many important supportive trade allies and participating organizations and businesses, working within the SEN structure, essentially moved energy-use-related behavior-change messaging from the status of monthly residential customer messaging of comparative energy use status, to real-time, open-access public monitoring and instantaneous messaging for an entire city.

SEN and the Four Pillars of Sustainability

During the pilot development period, the Charlotte community leaders and stakeholders were planning their energy and sustainability efforts. As SEN and the sustainability pillars began to be formed, there was at least some degree of confusion within the stakeholder group over what aspects of what initiatives were being planned for which parts of the sustainability efforts. While SEN focused only on energy, some stakeholders reported that some of the people they were working with were not always sure if the planning efforts applied to SEN, one of the other three sustainability pillars (air, water, and waste), or if they applied to all four. Because of this confusion, and because SEN was only to focus on energy efficiency actions approved in the pilot program, there was a need to more clearly separate each of the pillars into separate planning and implementation functions - not only so the community could understand the individual aspects, but also so that the developmental functions could more effectively separate the initiatives for the purposes of both planning and community exposure. SEN needed to stand alone, and not be affiliated with other objectives. At this time, Duke Energy was already committed to SEN and to launching these efforts with the help and support of the community leadership associated with Envision Charlotte's sustainability efforts. However, there needed to be a clearer and more concentrated focus on SEN and the development of a more rapid timeline for the energy program component. SEN was approved by the Commission with a specific timeline established under their regulatory function. Because SEN was the first of the sustainability efforts within Envision Charlotte, and because of the Commission's regulatory oversight and timeline, SEN is where the Duke Energy and SEN planning and leadership teams focused their efforts. This restructuring of the planning for the four sustainability pillars was beneficial to the development of SEN because it more formally structured a wider community focused on SEN as a standalone energy efficiency pilot program outside of and disconnected from any other objectives.

Subsequent to the planning and development of SEN, the larger Charlotte's community sustainability efforts focused on the other three pillars of air, water, and waste. While this evaluation does not focus on these three pillars, stakeholders do give substantial credit to Duke Energy and the SEN development efforts for not only leading the way in the energy program planning efforts, but for providing examples of the planning platforms that have led to the approaches now being used in the implementation of the efforts associated with the other three pillars. Stakeholders also provide substantial credit to Duke Energy and the SEN planning efforts for helping the key planners understand the importance of establishing a measurement baseline and the need to be able to measure improvements in order to document accomplishments as those initiatives move forward, regardless of which pillar was being developed.

SEN Energy Champions Help Envision Charlotte

Stakeholders indicated that Duke Energy's focus on recruiting and enrolling Energy Champions supported a decision to develop the larger Envision Charlotte sustainability efforts. The Energy Champions are a group of approximately 1,000 individuals from the participating buildings who have volunteered to be the key energy efficiency expeditors for their offices. Duke Energy supported the development of the SEN Energy Champions by providing training and materials. However, the stakeholders associated with the non-SEN aspects of the Envision Charlotte efforts expressed hopes that these SEN Champions would also evolve to be the sustainability ambassadors for their businesses. It was hoped that because these Champions would bring the majority of the occupant-focused SEN campaigns to the individuals within their business who could take the actions needed to reduce energy, they would also have the skills to apply that ability to other areas.

It was these Champions who, on their own, developed several of the campaigns that were shared with Duke Energy and the other participating buildings. The Envision Charlotte stakeholders expressed hope that Energy Champions may evolve beyond SEN and become the Sustainability Champions helping to make progress on the other three pillars (water, air, and waste). It was noted by several of the Envision Charlotte stakeholders that the SEN program is largely responsible for the development of the army of SEN Energy Champions that are thought to now (outside of SEN) be an instrumental part of the ability to gain support and make progress on the other sustainability objectives. Not only have the Energy Champions helped Duke Energy make progress on the SEN energy savings efforts, but they may choose to become key components of the Envision Charlotte sustainability initiatives beyond energy.

SEN Participating Buildings are becoming Envision Charlotte Sustainability Partners

In the early months of the planning for the SEN initiative, Duke Energy, working with the key community stakeholders and business partners, with support of the leading members of the business community, as well as leaders within the city's professional and social networks, were able to gain the participation of over 60 of the Uptown commercial properties. This alone was a significant accomplishment. According to stakeholders, this participation was a result of the right people coming together at the right time, with strong community and business leadership support. Duke Energy was able to utilize this support and gain participation commitments from over 60 of the largest buildings in the Uptown area that have continued to work toward the energy saving objective of the energy pillar of the sustainability objectives. Stakeholders noted that with SEN maturing as a pilot program, these same buildings are moving towards becoming participants in the other three sustainability objectives. Stakeholders noted that it was SEN and the ability to make the interactions with the participants work to the degree that Envision Charlotte can, moving forward after SEN, have a higher degree of participation with the other sustainability efforts in the pillars of water, air, and waste. The interviewed stakeholders provided significant compliments to Duke Energy and their SEN approach for helping to make the entire Envision Charlotte sustainability initiative more successful by increasing the level of engagement across the Uptown community. According to one stakeholder, "Duke Energy achieved the primary accomplishment [with SEN] that has led to the ability to launch the three other pillars." Or, as noted by another, "Without Duke Energy we would have had a hard time going forward with Envision Charlotte. SEN left us in a good position to design and launch the other three pillars."

Every stakeholder interviewed noted that SEN had the support of the Chairman, President & CEO of Duke Energy (Jim Rogers), the support of President Clinton, and the support of area community and business leaders, and that it was this upper-level support that made a difference to not only SEN, but to the very organizational and development efforts associated with Envision Charlotte. According to multiple stakeholders, the support provided by Duke Energy led to the design and implementation of a system of organizational developmental frameworks that carried over into the planning and organizational design associated with the other Envision Charlotte pillars. As multiple stakeholders reported:

- "We took what we learned from SEN and used that for planning and developing the launch efforts of the other pillars."
- "We learned from SEN."
- "SEN was our launch platform for the other pillars."
- "SEN was our Envision Charlotte highway."

One stakeholder also pointed out the importance of establishing a "trust" factor. "SEN has performed well and Duke Energy has carried through on its commitments. SEN has established a trust factor in our community." This stakeholder noted that without a platform of trust, as established by and for SEN, the business and professional networks would not be supportive of moving forward on the other pillars. This individual noted that it was because "SEN enabled a trusting relationship relative to the energy initiatives that the other efforts can move forward with an anticipation of success."

Can SEN be replicated?

One of the key questions to be addressed in this study is if an SEN type program can be successfully implemented in other cities which may not have the same supportive organizational infrastructures in place to help design, promote, and launch an SEN-type program.

All of the interviewed stakeholders agreed that an SEN-type program could be successful beyond Charlotte if the target city/community/organization is already interested in sustainability or energy efficiency and if the key business and community decision makers within that entity would actively support the initiative to help make it successful. All interviewees noted that Charlotte was the perfect launch platform for SEN because many of the key decision and motivational organizations were already on board. "SEN did not have to be sold in Charlotte; the key stakeholders were asking for SEN before SEN was designed."

Other interviewees noted that Charlotte is a collaborative community and that the city is the social leadership center of the state. One interviewee noted, "What happens in North Carolina happens here first." They noted that Charlotte has a close-knit social community within the business sector with strong social networks compared to other cities. Another noted that Charlotte would like to become the "energy capital of the United States" and noted that the city now has 220 energy related businesses in the area. Stakeholders also noted that the objectives of an SEN-type program are consistent with the 2020 planning goals of Charlotte City Center Partners, which are supported by the business community. It is clear from the interviews that Charlotte is a city focused on their energy future and that focus was already in place as SEN and Envision Charlotte was developing. The convergence of many factors helped establish a receptive and supportive platform on which SEN could be launched and supported.

Interviewees also noted that SEN was groundbreaking in the use of technologies and in bringing different technologies together. "We had technology, software, and communication challenges each step of the way and in some ways we were out in front of the technology." These interviewees noted that, "The next time it [SEN] is done, Duke Energy can be much more efficient in terms of getting the right equipment, the right software, the right meters, and the right messages, and in bringing these all together in a seamless, tested way." Interviewees noted that other utilities have jumped on the SEN approach and noted that both Minneapolis and Chicago have looked at SEN and adjusted their approaches based on the SEN experience. Interviewees noted that it is always difficult to be the first because it is the early programs that have to identify and overcome expected and unexpected barriers. However, none of the interviewees suggested that SEN could not be replicated and that if the right city can be identified, with a good supportive social structure in the business community, SEN could be successful and more easily implemented.

One of the stakeholders noted, "We have set this up in a way that it could be replicated. The agreements, the messaging, the campaigns, the way we worked with the business community, the web site, the kiosks, the newsletter, the champions, etc., this is all transferable." However, as with the other interviewees, this person also noted the importance of selecting a city or community that wants to do this and has the communications and organizational infrastructure that is required.

TecMarket Works agrees with the interviewees in that if other cities/communities can be found that are or can be supportive of the SEN mission, and if that program can engage with and obtain the active support of the business and community leaders and can ride their social and professional communication channels or establish operable communication strategies, services and objectives, we see good reason to think they could be successful from an operational perspective. While it may take some effort to develop cohesiveness within the key stakeholders of a different target area (if it is not already there), SEN provided the lessons to know how to use that cohesiveness. It would, of course, be better to identify target communities that are already on board with the sustainability vision or are already pro-energy efficiency. As one interviewee put it, "SEN can be successful on its own, but it is much more attractive as a sustainability package".

One stakeholder cautioned about how the program is brought to other communities. This individual indicated that the program cannot be seen as being associated with "tree-huggers or polar-bear-huggers", and noted that the effort needs to be linked to a vision about the quality of life or the quality of the city environment. This person noted that "coal burning means increased illness and higher levels of mercury contamination" and indicated that a program can gain better traction if it is seen as an effort to improve the quality of life as well as helping to reduce current energy bills and future energy supply costs.

Stakeholders also indicated that it will be important to pick the next SEN target cities or communities with care and noted that the social and professional networks that will talk about SEN and Envision Charlotte as well as the efforts in the next cities, will need to be "positive and upbeat". They noted that negative social interaction or negative press will directly impact the success of future efforts. One stakeholder noted that the next target community will need to be "a city where Duke Energy is well received, where relationships are good – this will be key because it all starts with social relationships." It was also noted that the next target community will need to be one where the community decision makers will want to do something. A stakeholder also indicated that SEN is largely a volunteer effort and that some communities have a volunteer ethic, while others do not. This individual indicated that finding a location in which those community and business stakeholders will support an initiative that requires the use of volunteers from those businesses will be important.

Having a desire to reduce the environmental footprint was suggested as being critical to the success of an SEN initiative. They noted that Charlotte already had a footprint reduction objective that was supported by key community decision makers and organizations. SEN was able to use that preexisting condition in Charlotte. This person noted that Charlotte's business leaders are also active community leaders and that they want Charlotte to be seen as an energy-efficient, sustainable city. SEN fits well into this perspective and it will be important for the next city to have a similar perspective. This person also noted that Charlotte was one of the state's more socially active cities, and noted that there were other socially active cities in Duke Energy's territory that also have sustainability objectives. Raleigh and Cincinnati were floated as possible communities to target next. This individual also noted that it would be important for the next communities to have a preexisting organization that has high levels of community trust with functioning networks across the community's business and social leadership that can be used to launch the program.

All of the stakeholders suggested that they need to wait for the evaluation to decide if SEN should be brought to other communities and to try to learn what works and what does not. All stakeholders noted that if cost-effective energy savings are not there, then there may not be enough of a result to take to the other areas. They noted that while they think there will be significant savings, they are not sure which components of SEN will provide the most savings or if those savings will be worth the financial, organizational, and implementation costs. Stakeholders noted that there was a lot of volunteer time and effort as well as development dollars and in-kind contributions placed into SEN. Some of those development dollars were in the form of direct or indirect financial resources and others were in the form of contributions of hardware and software and professional support. As one key stakeholder put it, "If the evaluation indicates that the savings are there, then a decision can be made about the risks for implementing this in a different city that is ready and receptive."

One of the key stakeholders provided the following points for replication consideration:

1. Manage the scope of the effort well and limit drift in that scope, keep it focused.
2. Provide clear roles for the organizations and people involved.
3. Get donor support and commitment and know what resources you will have and when you will have it.
4. Let the people in the buildings decide what they want to do, don't force them.
5. Don't set up must-comply parameters or requirements.

According to one of the interviewed stakeholders, "We have tested the concept and put the technology pieces together into a workable model." This individual noted that the success of the next program will depend a lot on the strength of the building owner and manager networks and if the program can successfully use those networks via an SEN-type program. He added; "You have to get the owners, managers, and occupants to want to do this."

Another stakeholder noted that Charlotte is different than other large cities; "While we are a large city, we operate like a small community. Everyone here knows each other; we have a long history of working together. This is not mission-critical for the next city, but it sure makes it easier." This individual was pointing out that there was a pre-existing cooperative network of business and community leaders who have a history of making things work for Charlotte and that SEN was able to take advantage of that level of cooperation.

When we posed the same question to the SEN program managers, they credited Envision Charlotte with paving the way for making a lot of the relationships that were necessary to ensure the success of Smart Energy Now. However, Duke Energy believes that a program such as SEN does not require that there be an umbrella organization such as Envision Charlotte. As the program manager explains, "The key elements of Smart Energy Now are about the partnerships and collaboration and community efforts. I think it's easier if there is an entity in place that embodies that [such as Envision Charlotte]. If it's not already there, we don't need to re-create an Envision Charlotte. We can just go in, offer Smart Energy Now, and see if people react…we introduce Smart Energy Now as that collaboration." Duke Energy explains that if there is an existing effort in a community that is being well-received, they would like to "plug into that, and leverage a lot of the assets that are already in place. That makes a lot of sense to me." However, if there is no existing collaborative spirit or effort, "We'd get there either way."

Linking with the Clinton Global Initiative

While the Clinton Global Initiative (CGI) provided Envision Charlotte with an unparalleled publicity opportunity, several of the stakeholders cautioned Duke Energy on the liabilities associated with linking the program to an organization with political ties or agendas that can be alienating to key community stakeholders within a city whose support would be critical to the success of the program. They also noted that a few of the community and business leaders were "less than fully supportive" of the link to the Global Initiative and to some degree disliked being "upstaged" by making it appear that Envision Charlotte or SEN were components of CGI or in some way developed as a result of CGI. Others noted that while the link to CGI provided some beneficial exposure for the program, that exposure was provided before key stakeholders were ready for it or had been convinced of its need. However, stakeholders also noted that Charlotte is different than other communities because, according to one stakeholder, "We are able to leave our egos at the door and look at the community benefit associated with these efforts."

However, from another perspective, the link to CGI kick-started the planning and put the efforts into a higher development speed. Stakeholders noted that the world learned about SEN and as a result, Duke Energy and the Envision Charlotte team associated with SEN needed to move into a more rapid and focused development approach. This high-speed approach served the regulatory purpose well in that it is harder for regulators to support an initiative that has unspecified or extended performance timelines. Speeding up the effort, as a result of President Clinton's CGI kick-off event, helped move the project forward at a faster pace than what might have occurred. This higher speed effort served to bring key forces together and move the planning efforts forward in what may have become a more effective design and development approach than what would have occurred if the link was not established. And, according to one key stakeholder, "It certainly brought a lot of exposure to our city and that exposure proved to be a benefit to our efforts."

When asked about the response to CGI, the SEN program managers seemed to agree with the pros and cons described by the Envision Charlotte interviewees, and describe this as another instance where the Charlotte business community rallied together. The program manager reported, "It's a challenge when someone says [Charlotte's] major employers agreed, when we were still in preliminary discussions with them. They [the major employers] clearly understood and supported the goals, but the type of dialog we normally would like to have with major partners like that…we weren't able to have [before their commitment was announced]." Furthermore, the program manager said, "I understand why there was hesitation and frustration from the larger employers, and they understand how this thing got out there like that and why we couldn't talk about it." The program manager clarifies that while the CEOs of these major employers had indeed made the agreements with CGI and SEN about the early announcement, "We didn't have the opportunity to talk with the people who would actually be executing the program. We didn't really didn't have the chance to have the round table [we wanted] and say, how do we want to do this?"

In the end, the program manager says, "There was never any hesitation from the [major employers] in terms of their commitment. To this day, it's a huge asset for us. [CGI] was the right partnership to make."

The SEN program manager reports that Smart Energy Now still has the active support of the Clinton Global Initiative. SEN still provides regular updates to CGI, and the program manager reports, "They are still huge supporters. I can tell you the moment we are ready to announce a number [for energy savings], CGI will probably make an announcement. They're waiting for a number."

Building SEN is an Unprecedented Effort

Multiple stakeholders noted that the development of SEN was an unprecedented coordination effort. "There were many parts and pieces that we were developing that needed to come together for this to work." At the same time stakeholders noted that they were "breaking new ground with the use of new technologies and software in a way that had never been done. This takes time and it does not always go as planned." Stakeholders noted that they were focused on a wide range of efforts, each of which was essential to the success of the program. A number of these were identified, including:

- Gaining the cooperation and support of contributors and partners who had the financial and technical ability to help make the program work.
- Getting real-time technologies and technology-based communication systems to talk to each other in a way that can be used to stream data to real-time displays in the buildings.
- Working with allies on messaging and behavior change concepts.
- Getting the support of various Charlotte businesses and organizations that were essential to the success of the effort.
- Identifying building owners and operators and their operational trade allies with whom we need to work and gain their support and participation.
- Identifying occupants and tenants that would be supportive and receptive and actively participate.
- Working with experts who could help build the key program components and systems that needed to come together at the right time.
- Keeping track of all the developmental efforts to focus attention on the things that were not working or going too slow to be of use, and making directional adjustments in order to stay on track.

All of the interviewed stakeholders noted that SEN took a lot of work by a lot of dedicated people, businesses, and organizations who had committed to the project and who stuck with it, keeping it on track and moving forward. Several of the stakeholders noted that the program had to adjust to the cultures of the business community and partnering organizations. "Getting the big banks on board was a very big deal for us, once others saw the banks were on board, it was easier to get support and participation." However, it was noted that each of the businesses and organizations had business cultures that need to be considered during the developmental period.

"Charlotte is a mix of cultures, ranging from 'the suits' associated with the banks to 'the polo shirts and loafer shoes' of some of the other businesses and organizations. You have to be sensitive to the business culture of the key people that it takes to make this work." This individual was noting that SEN needed to work with the community in a way that gained the support of the business leaders who operated under significantly different types of business cultures.

One key stakeholder summed it up by saying: "This is not RFP-able; you have to have the right foundations and support to do this. Charlotte had the right foundations."

Will there be Energy Savings from SEN?

All of the interviewed stakeholders agreed that SEN will produce energy savings. Most of the interviewed stakeholders said that from what they have seen so far, they expect that there will be significant savings both within the building operations components, and in the tenants and occupant workspace component. However, none of the stakeholders were able to predict if there would be high enough savings to cover the costs of the program so that it can be demonstrated to be cost-effective, especially if the costs of acquiring and maintaining the kiosks in each participating building is required. The stakeholders noted that they are anxiously awaiting the results of the energy impact evaluation to be completed after this summer's air conditioning season is over. One stakeholder noted that if there are not enough energy savings to cover the costs of the initiative it would be a setback for not only the energy pillar of the sustainability mission, but for the other pillars as well. "If we are not successful in communicating that there is a reduction, we will not be successful with the other [sustainability] pillars. We will have to be able to demonstrate that there are savings."

What do Stakeholders think are the Key Benefits of the SEN Approach?

We asked the stakeholders what they considered to be the value of SEN to the participants. Several key benefits were identified and included here in the words of those providing the benefit topic. These include:

1. **Participants make decisions:** In the opinion of the interviewed stakeholders, "It is a program that lets the participants decide what worked for them. It was not prescriptive or forced. Participants could develop their own campaign, use the ones Duke Energy developed, or use the ones developed by the other participants. It was a self-developed effort in many ways and allowed people to be the designers of their own success, or they could use what SEN had, or borrow from others." One stakeholder indicated that they thought it was "the ability of participants to tailor their own efforts that were then supported by Duke Energy that drove the success of the participation decision." This person noted that the success of doing this in other cities may depend on a self-directed approach: "You can't force these things on people; they have to want to do it."
2. **Provided real-time information**: "It demonstrated to building tenants what is happening with energy use today. It gave them proven ideas as well as cutting edge ideas and let them see what energy they were using in real time. It provided tangible results with real information about what is going on in their buildings. Few before have had this kind of information on which to act." According to one stakeholder, "This information is empowering."

3. **Worked from the inside out:** "It provided advice, ideas, and shared ideas from the building managements' point of view rather than the view of an outsider. It provided information and services without judgment of what they should be doing. Participants could be their own energy program directors for their facility supported by SEN."

Will SEN Lead to Higher Participation in other Duke Energy Programs?

Interviewees were also asked if they thought SEN would lead to higher levels of participation in the other energy efficiency programs offered by Duke Energy. This was a difficult question for the stakeholders who understood that participation in SEN meant that they would have some level of direct contact with Duke Energy, but they were unsure of the level of interaction with Duke Energy prior to SEN or the level of promotion of the other programs prior to or during the operations of SEN. Stakeholders reported that they didn't think that there was a significant degree of direct promotion of the other Duke Energy programs to the SEN building owners and managers, but also indicated that this was not an item on which they focused. (Note: the assessment of participation in other Duke Energy programs conducted as part of this evaluation showed no significant change in participation rates within the Charlotte area during the pilot program period. See the section titled "Analysis of Participation in Comparable Cities" for more information.)

Will SEN Ideas be used at Home?

We asked the stakeholders if they thought the energy saving ideas from SEN would be taken home by tenants and occupants and used to help make their homes more efficient. Most of the stakeholders suggested that when someone gets used to the practices of saving energy and understands the importance of the benefits, they will tend to replicate those actions at home. However, none of the stakeholders interviewed indicated that there was any part of SEN that was designed to reduce energy use in the home. It was noted by several interviewees that the benefits of SEN are more than a reduction in an energy bill in the workplace. Several stakeholders noted that Envision Charlotte was about building a better, more healthy life and lifestyle for the residents of the Charlotte area, with a focus on the job site. Others noted the importance of reducing carbon emissions and pollution from coal-fired power plants. Others noted how the new social network platforms reach far and wide and how ideas today are spread and shared beyond the workplace much more easily than just a few years earlier. However, it was also noted by several stakeholders that the focus of the program was saving energy at the workplace, especially via building operators who modify how their buildings operate, but also by the tenants who joined in and took an active part in the campaigns and events or who modified the way they use energy at their workstations. It was noted that buildings operate very differently than homes, but that the ideas shared with and between the tenants and occupants were ideas that worked just as well at home. Most of the stakeholders thought that there would be some level of savings achieved in the homes of those impacted by SEN, but few thought this was a major focus of the behavior initiatives, and none could predict the level of impact beyond a general agreement that there would be some level of savings in participant's homes. As one stakeholder noted: "We are an inside The Loop[5] initiative."

[5] "The Loop" refers to Uptown Charlotte.

When stakeholders were asked what kinds of things people would do at home as a result of SEN, they tended to focus on the typical behaviors associated with low-cost, no-cost actions. The primary response to these questions centered on turning things off when not in use, including TVs, computers, and lights. Stakeholders noted that it was the efforts of the Energy Champions and the program's campaigns that would most impact the workstations and the homes, with several stakeholders noting that it was the Energy Champions who brought the program into the workplace for the tenants and occupants. The campaigns noted by the stakeholders as being especially effective at work, and could also impact the home were "Flipping Out", "Adopt A Light" and "Crab You're It". In several cases, the stakeholders noted that it was the social interaction that made these campaigns successful, and that social interaction cannot be confined to a specific building, but rather has an impact on the individual, regardless of their location.

Another stakeholder noted that it is important to not dilute the message of a behavior-change campaign and that to be effective, a message has to have a defined focus. This individual suggested that it is important that SEN focus on the workplace and that if there are added benefits that is great, but suggested the SEN message and focus needs to stay on the workplace. They noted that when a message tries to do too many things, it can end up doing too little. Another stakeholder indicated that SEN and Envision Charlotte are in "generation one development mode" and that it was very important for SEN to not get distracted into addressing objectives that are beyond the purpose of the pilot program or the broader Envision Charlotte objective. He suggested that the SEN and greater Envision Charlotte approach stay focused on the Uptown area. One stakeholder noted; "We had a Charlotte area neighborhood organization come to us who wanted to build a residential component, but we elected to not go in that direction. We needed to keep the program Uptown, business-focused, and housed within our sustainability mission." This person also thought there would be some level of impact within the residential sector as a result of the SEN educational aspects, but could not speculate on how much of this would occur, and noted that SEN needed to stay focused on the core objective – the Uptown business sector.

What Changes do Stakeholders Suggest?[6]

During the interviews we asked the stakeholders what changes they would make to SEN. We received several responses provided below that are paraphrased for presentation purposes. These include:

1. **Include LEDs**: Have an aggressive LED lighting package for the Uptown area. These provide better lighting, create a more active atmosphere, promote safety, are innovative, capture attention, and save energy.
2. **Reward good behavior:** Bring a positive enforcement campaign into the program that is the opposite of the "Crab You're It" negative enforcement approach. Something like a "Wise-Owl" campaign or a "Hoot-Out-A-Success" type of campaign, where there is a sticker or something that says they were found doing something that saved energy.
3. **Plan well:** We learned that it is important to think things through carefully. What works well for some is not the same thing that works for others. You have to think beyond one's own perception and carefully consider the impacts and effects on others. We learned it is

[6] Suggestions provided by the interviewed stakeholders. TecMarket Works does not agree or disagree with these suggestions, but reports them as an evaluation finding.

better to go a bit slower and to think through things well. We learned to spend more time, especially in the early days, thinking things through a bit more than we did when we first launched. While we took advantage of the Clinton Global Initiative, it made us jump the gun and launch before we were ready. Do not launch until you are ready to launch. One city who tried to do something like we were doing contacted us and indicated that they launched before they had the support and infrastructure and said that they tried to do too much too fast with too little support. Don't launch too soon or dive too deep.

4. **Focus on the doable:** Have the technologies set up and working well at the start. We spent a lot of time trying to figure out what the technologies and software could do and then trying to figure out how to get them to do what we wanted them to do. Sometimes the technology or software people over-promised what they can get done or how much money or time it would take. While we were setting up the first program of this type, using real-time data, we had a number of barriers to overcome and people who were overly optimistic about what could be achieved. Plan with what your hardware and software can do, not what you think it may be capable of doing. Then, if the new technology or software allows you to do things differently, incorporate those ideas after they have been well tested so that they are low maintenance.
5. **Get the best minds involved:** Be careful about who you structure into the program as your key development allies. Get firms and partners who are experienced and practiced in the areas that they will need to perform. Business partners who think they have the experience and skills to do something, does not mean that they have those skills or experience. We had to go through a few firms and people to find the right firms and people who had the skills and knowledge we needed.
6. **Bottom-up and top-down structures:** Structure the planning efforts to employ both top-down and bottom-up perspectives and functions. At first we planned this using a top-down approach with a more central planning function, a "here is what we will do" approach. Though in the end for key components, we found that we needed more of a bottom-up, "let people do what they think is best" approach. In reality both are needed. You need a central planning function to get the ball rolling and accomplish the technology, software, and organization approaches to start, but to engage people today, a central-control approach does not work. You have to be ready to reach the goal by the roads that can be built, not by the roads you plan to build. In a volunteer program like SEN, it is the action-takers who need to get there in the best way for them. The real-time information of today's virtual world means that central planning by a few is not necessarily going to be the best planning approach. Yet for some things that need clearly focused or specific approaches, you have to be ready to move forward with the people who have the resources to complete the task. With SEN you have to be able to shift and move in a way that best reaches the goal, and that may be different than what you think it will be or should be. You need to be ready to let people run with their own ideas for their buildings and operations. Do not close the fence in too tight or there will be no one left in the corral.
7. **Coordinated outreach:** Marketing became a bit of a challenge for us from time to time because there were two different organizations responsible for marketing. Envision Charlotte had a marketing and development role that is more than just energy savings. Duke Energy had a marketing and development role that was more focused on Duke

Energy's energy efficiency goals. Sometimes these two meshed well and other times they did not. Sometimes there was good coordination and other times it needed a bit of attention. This can be an issue in a different city that may have different objectives than only those of SEN. Marketing coordination may need to be structured into the process.

8. **Do not over-push businesses:** We learned that if we pushed the communications and the messaging too hard, we could drive some businesses away. We learned how to keep SEN messaging within the limits of receptivity and tolerance of key business owners and leaders. SEN is not the primary goal of the business community; it is important to them as a good citizen, but you cannot over-push. If you over-push, you will drive away your support. We learned that the type and frequency of messaging is critical to the success of the initiative. Future efforts need to clearly understand this important lesson.
9. **Less is more:** Limit your focus on what you can do well, do not over-reach. For a while we were starting to take on too much and we had to limit what we were going to do. We had a lot of great ideas for what could be done, but we learned to limit that focus to those things that we thought we could do well. If you over-reach you may not accomplish much in any given area. At the same time, you have to let people do what they want to do within their buildings. The key is to understand what is part of the mission and also helps, and what is reaching too far. You also have to limit and focus without pushing people away.
10. **Track progress and accomplishments:** It is important to measure and track progress toward the program's goals. We knew that measurement was important. We incorporated measurement into each of our sustainability efforts. The importance of measurement became clearer as we moved forward with each of our sustainability pillars and as we learned a good deal about baselines and measurement approaches while working with SEN. Everything on which you want to document performance and progress needs to start with measurement and end with measurement.

SEN Building Occupants

Behavior Change

Duke Energy hired several subject matter experts to join SEN's community outreach and implementation strategy team in 2011. One of the key experts was HR&A Advisors. Assisting HR&A were subcontractors Earth Markets and EMpower Devices and Associates, consulting companies whose areas of expertise are in behavior-change and community marketing programs. The community engagement plan laid out the steps necessary to achieve the 5% energy reduction via behavior changes. HR&A led the portions on engaging facility managers and executive decision-makers, while the two behavioral experts led the portions on engaging the building occupants and Energy Champions. After the development of the engagement plan, Earth Markets and EMpower Devices were engaged in 2012 to implement the community engagement plans. The HR&A plan consists of a multi-stage document that detailed all the steps of engaging facility managers, Duke Energy customers, and the executive decision-makers. The behavioral expert contractors collaborated closely in their scope of work. One of their early tasks was to solicit input from the behavior-change community on how Smart Energy Now might be implemented, and what best practices in behavior-change to include in the kiosks.

In the section below, we will provide survey results from a set of general questions asking about SEN building occupants' attitudes and behaviors. We then discuss each of the components of Smart Energy Now's design, followed by survey findings on the effectiveness of each component.

Findings from the General Survey

We invited occupants working in Smart Energy Now (SEN) buildings to respond to an online survey and received responses from 174 people (153 completes and 21 partials). Of these, 67 were occupants in buildings owned by Duke Energy, and 108 were occupants in non-Duke Energy buildings.

Most respondents have been working in their respective buildings for over two years (N=124 or 71%). Of the others, 16% (N=28) have been working for 1-2 years, and 13% (N=23) have been working for less than one year. Taking the conservative assumption that those who have been working in their buildings were not working at another Uptown building, we still can conclude from this that the majority of the respondents had experience with energy efficiency efforts prior to the start of the SEN campaign in order to attribute any behavior changes to SEN.

The majority of respondents reported they were familiar with a program called Smart Energy Now (N=152, or 86.9%). After an additional prompt, "Smart Energy Now is a program from Duke Energy dedicated to helping reduce electric energy consumption in Charlotte's Uptown office buildings", all but six (out of 175) reported they knew of SEN.

The survey participants were asked to describe Smart Energy Now's objective in their own words. Most respondents correctly described the basic objective of Smart Energy Now to save energy but differed in their specificity. A word frequency analysis showed that of the 155 responses, 88 (57%) specifically mentioned energy savings in "Uptown Charlotte", "in the office", "in buildings" or "at work". Another 62 (40%) mentioned energy savings in general without further specification, and five (3%) mentioned energy savings in Charlotte without specifying whether they meant commercial or residential energy savings. We can conclude from this that most respondents had a clear understanding that Smart Energy Now is dedicated to energy savings in the workplace. In addition, 20 of the respondents (13%) further specified (incorrectly) a quantitative goal for SEN of 20%[7] (with one respondent mentioning 60 buildings). Although SEN does not focus on reducing energy use in the home, seven respondents (5%) included an SEN objective of reducing residential energy use.

Perception of Current Efforts in Reducing Energy

Over half (55%) of the respondents (N=93) reported they thought they could still do more to save energy in the workplace; 42% (N=71) thought that they were already doing all that they could. In the minority, 3% (N=4) thought they were doing "more than is really necessary". (Additional analyses revealed there was no significant difference between respondents working in Duke Energy owned buildings versus other buildings, p>.05.)

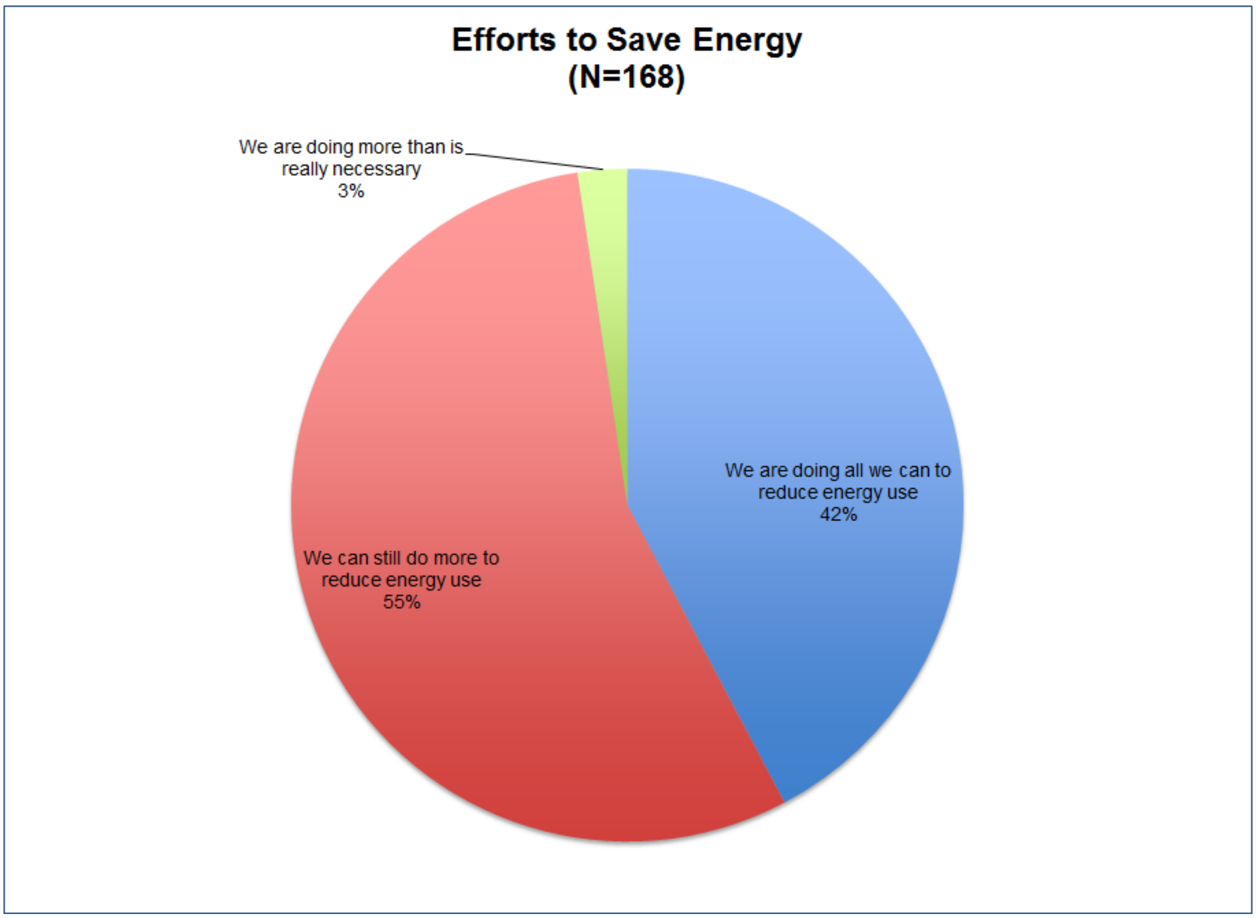

Figure 1. Perception of Current Efforts in Reducing Energy

[7] The Smart Energy Now goal is 5%, while the overall Envision Charlotte energy reduction goal is 20%.

Those respondents who thought more could be done were given the opportunity to provide open-ended suggestions as to what specific actions could be taken. Their most frequent responses called for more communication and education about energy efficiency as the means by which to drive more actions.

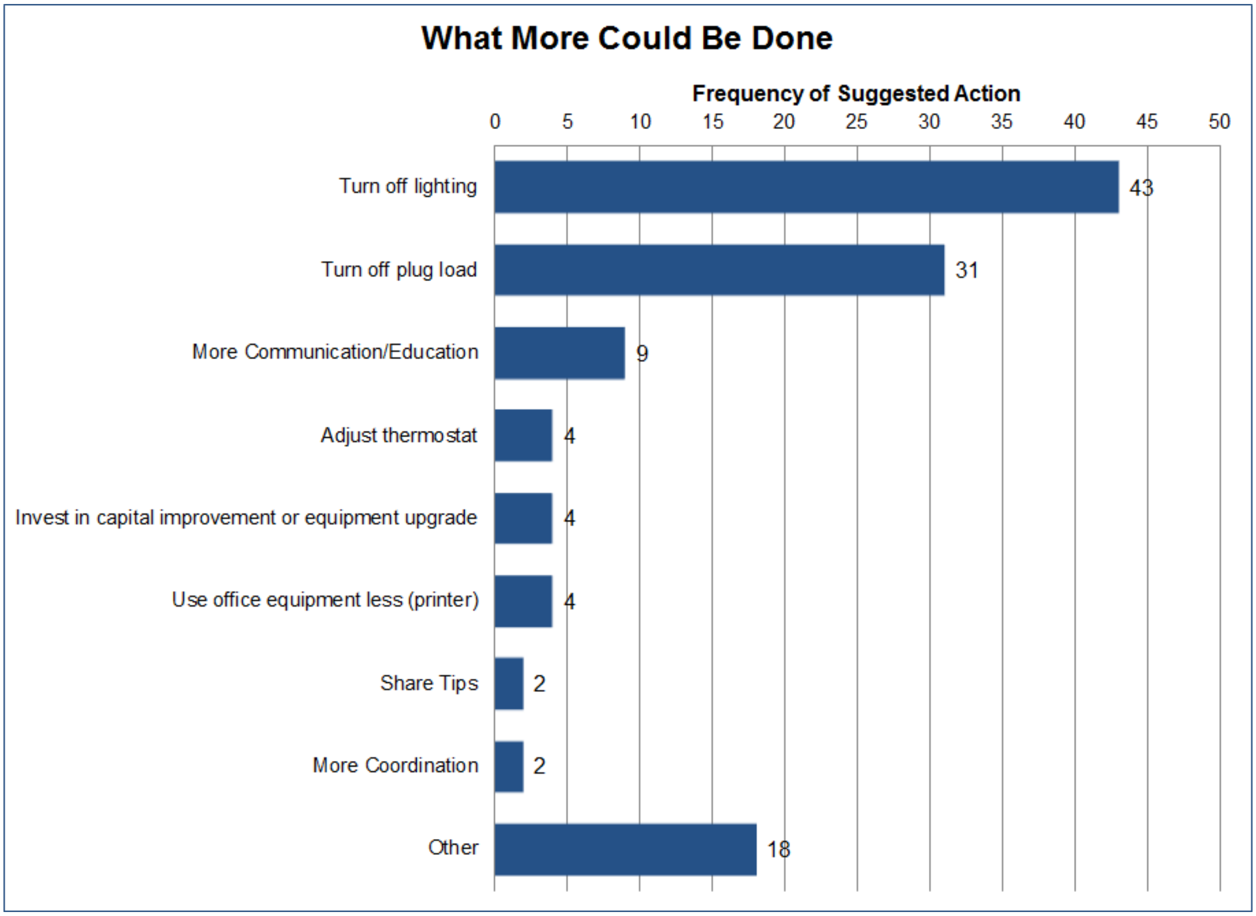

Figure 2. Suggested Actions for What More Could Be Done

Responding to the question on what additional actions they could take, respondents provided suggestions for personal actions that they could do on their own, while a few others provided suggestions that the office could undertake. Most suggestions involved turning off lighting or reducing or managing plug loads. Some respondents also provided “other” non-electric energy suggestions, including transportation related ideas (carpooling, using public transportation), and suggestions for SEN to use incentives to motivate actions.

The respondents who thought more was being done than necessary were also asked what they thought were unnecessary actions. There were only two responses:

- “The copier shutting down during idle periods and having to [wait for it to] warm up to run.”
- “Keeping office lights off during the work day, when it’s gloomy outside is a bit of overkill in my opinion.”

Perceived Interest in Reducing Energy

Respondents were asked to rate their level of interest in reducing energy use in the workplace. On a scale of 1 (very uninterested) to 10 (very interested), they rated their level of interest at 8.47 (N=175, SE=.12). When asked what they thought about the interest level of their co-workers and their management, their ratings were 6.31 (N=175, SE=.15), and 7.33 (N=175, SE=.16). Paired T-tests shows that all these differences were significant.

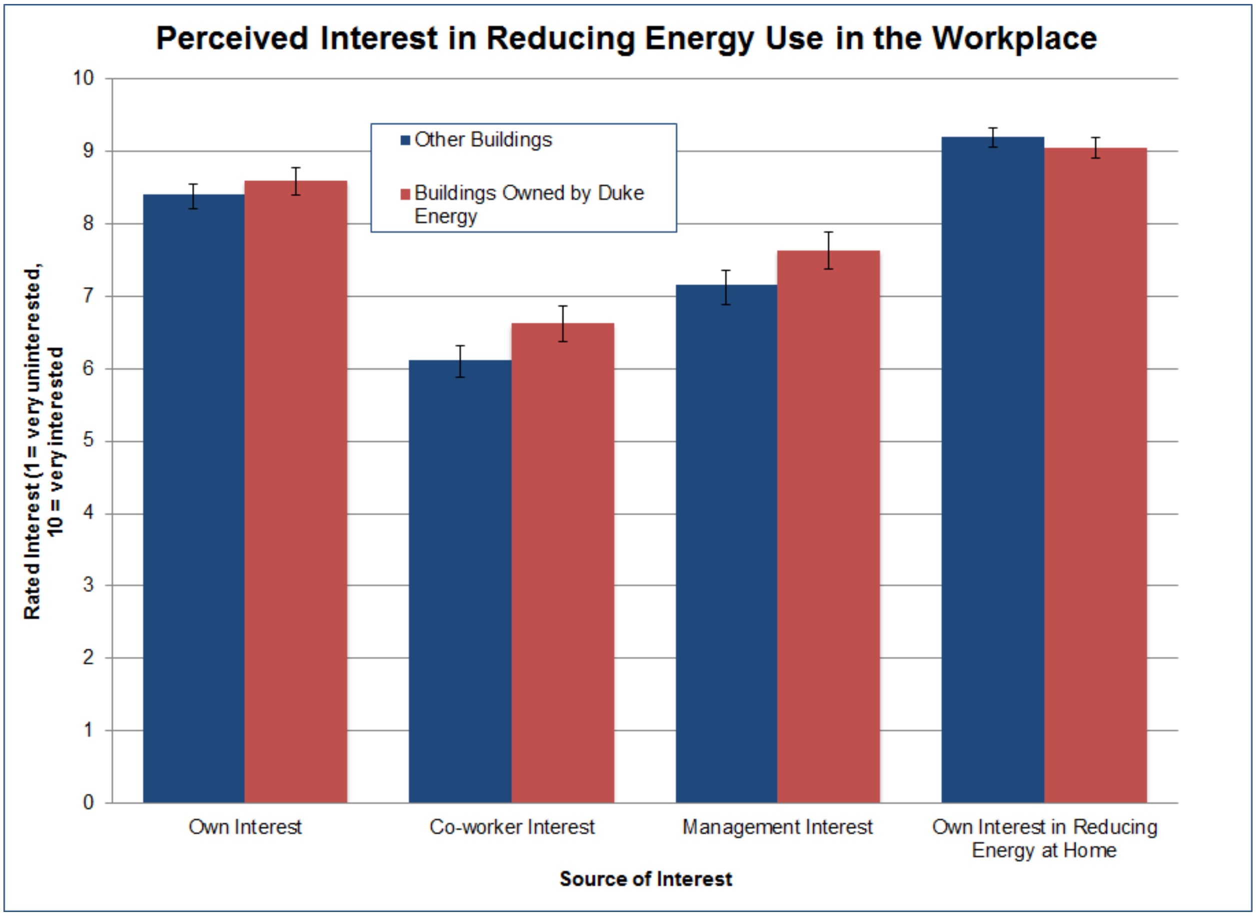

Figure 3. Perceived Interest in Reducing Energy Use in the Workplace

Respondents were also asked about their interest in reducing energy use at home, which they rated at 9.14 (N=175, SE=.089), significantly higher than their interest in reducing energy use at the workplace. This is not surprising, since people usually see the cost of energy use at home but not at the workplace. The difference between ratings of one's own interest versus ratings of others' interest may be an indication of the social desirability bias. There was no significant difference ($p<.05$) between the ratings by occupants in buildings owned by Duke Energy (N=67) compared to the other buildings (N=108).

Communication Networks of SEN Participants

Participants indicated that they talked about reducing energy only occasionally, if that. They were asked to rate the frequency with which they discussed reducing energy on a Likert scale (1 = Never; 2 = Infrequently; 3 = Occasionally; 4 = Frequently; 5 = At almost every possible chance). Participants tended to talk about reducing energy at home with both co-workers and friends/neighbors, but they tended to restrict conversations about saving energy at work within the work context. Participants also tended to restrict these conversations to their co-workers (those who worked in the same office), and spoke less frequently ($p<.05$) to business associates (from other offices) about reducing energy at work, with a mean rating of 1.82 (infrequently).

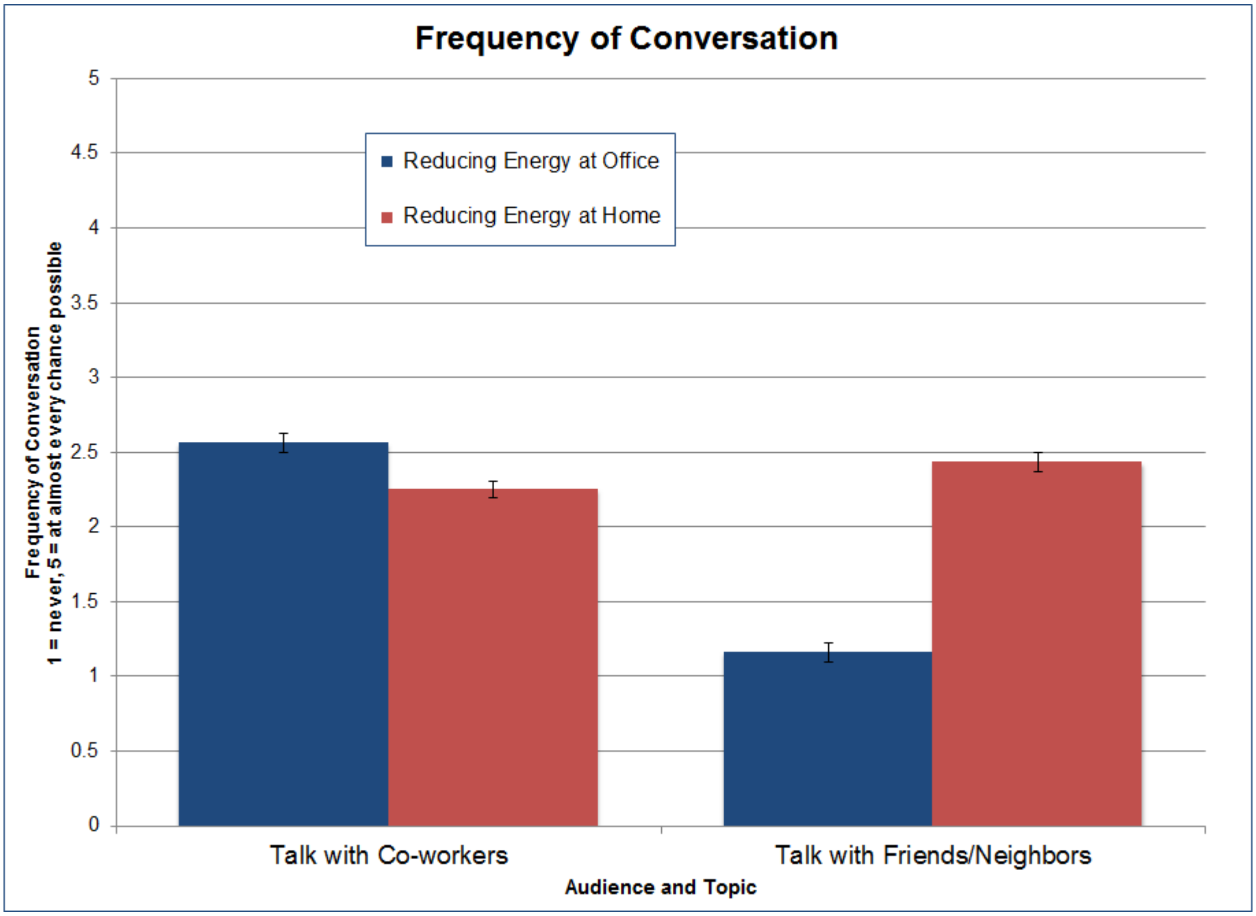

Figure 4. Frequency of Conversation

The 97 respondents who did speak to business associates (from other offices) were asked whether those associates “worked in the greater Charlotte area, but outside the 277 loop”. Half (N=48) reported their associates were not in that region, another third (N=36) reported they were, and 13% (N=13) did not know.

Given that overall there was “infrequent” communication between SEN building occupants with their business associates in the greater Charlotte area, there seems unlikely to be SEN spillover occurring to the wider Charlotte business metro area. There might be some spillover with regards to SEN participants’ residences. However, there is only a small difference between the frequency with which participants discussed reducing energy use with co-workers versus friends/neighbors. This may indicate a pre-existing tendency to talk about energy use at home that cannot be attributed to SEN activities (though this tendency might be attributable to Duke Energy’s other efforts in the residential energy efficiency sector). This data suggests that any spillover effect of

SEN to the home would likely be a small effect, and likely be too costly to quantify with future evaluation activities. Statistical tests showed that all differences shown in the chart were significant ($p<.05$).

Usefulness of Information

The respondents seemed to agree with the statement that "Smart Energy Now has given them information that could be used to reduce energy use in the home", with a mean rating of 3.52 on the same scale (SE=.087). Of the 168 respondents, 26% neither agreed nor disagreed with the statement, 18% strongly or moderately disagreed, and 56% moderately or strongly agreed (see Figure 5). The Energy Champions within this group were particularly adamant about this, with 41 out of 46 (89%) agreeing that "Smart Energy Now promotes actions and activities that can also be done at home."

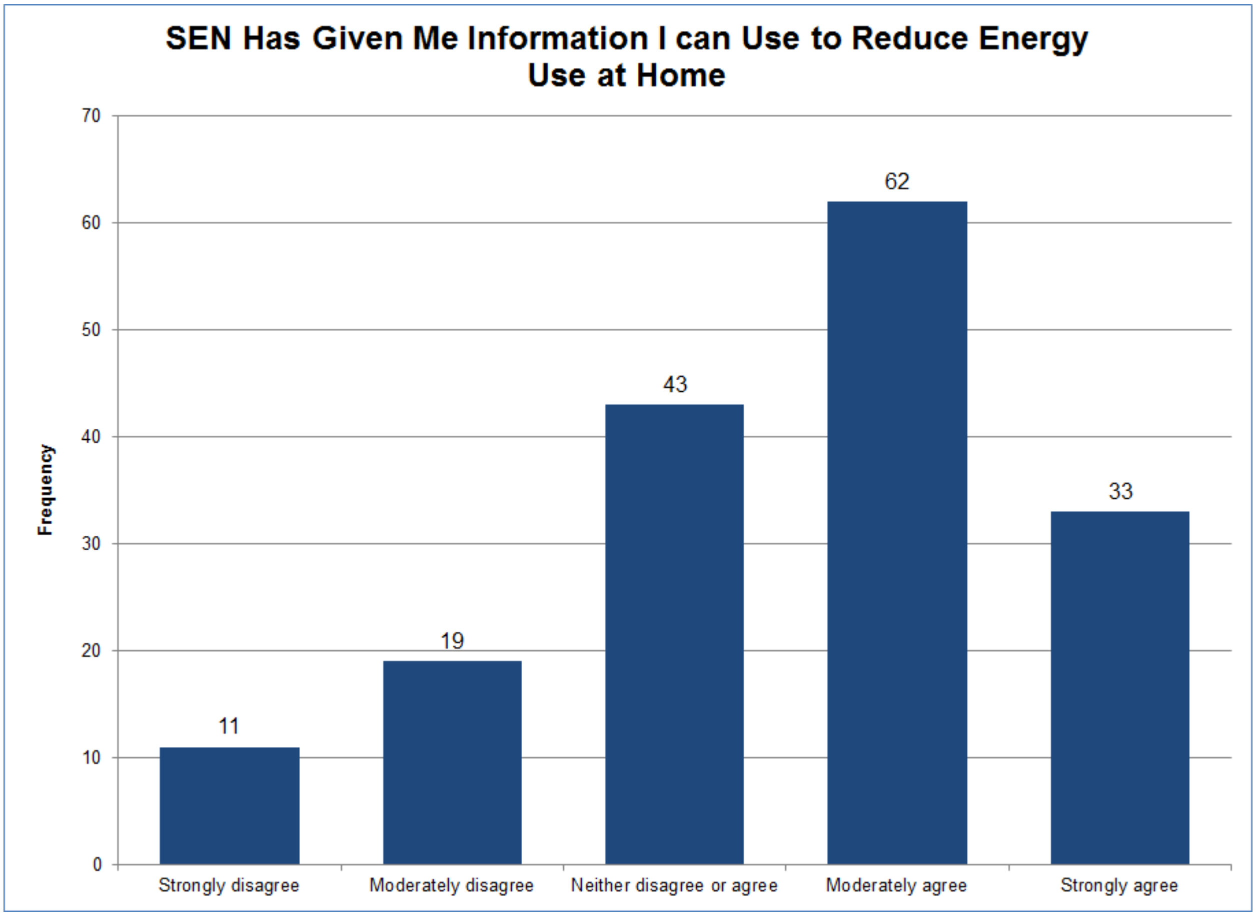

Figure 5. SEN has Given Me Information I can Use to Reduce Energy Use at Home

Keep in mind, however, that the predominant behavior-change activities promoted by Smart Energy Now involve turning off lights and turning off equipment to reduce workplace plug load. It is not particularly surprising that the respondents would feel these actions could apply to the home, and 100% attribution of these popular recommendations to SEN, if taken at home would be hard to justify. Rather than interpreting this data to indicate that spillover from SEN is occurring to the home, the evaluation team recommends a more conservative interpretation: information from SEN provides reinforcement of popular energy efficiency recommendations that may be leading to behavior changes at home by reinforcing known energy efficiency behaviors.

Duke Energy program managers should consider it a promising sign that so many respondents already see a link between energy savings at work and at home. The last link that needs to be forged is a specific action that Smart Energy Now suggests to its participants that is implemented at home. Currently, SEN does not have any activities around energy savings at home and leaves it up to the participants to transfer actions. Given that SEN has limited resources, and given that many residential energy efficiency programs promote the same actions (making attribution of energy savings difficult), the evaluation team recommends that SEN program managers consider including residential behavior-change actions if they are distinctive activities and if that information does not distract from SEN's core mission. SEN should consider which aspects of SEN are both unique and suitable as an explicit recommendation to carry out at home. We suggest that some of the campaign activities such as "Crab You're It" and "Adopt a Light" might be distinctive activities that are worth suggesting for use at home. However, the other side of this coin is our recommendation that if SEN cannot find a distinctive action or technique suitable for transfer to the home, it should not diffuse program resources in duplicating interventions from other successful energy efficiency programs in Duke Energy's portfolio.

In future evaluations, we suggest asking respondents whether they have used any techniques from SEN campaigns in their homes, such as "Adopt a Light" or "Crab You're It". Those are distinctive techniques that would be more easily attributed to SEN than general suggestions to turn off lights or unplug equipment.

Because of the general interest in spillover from Smart Energy Now, respondents were also asked what percentage of Smart Energy Now activities should be focused on the home versus the workplace.

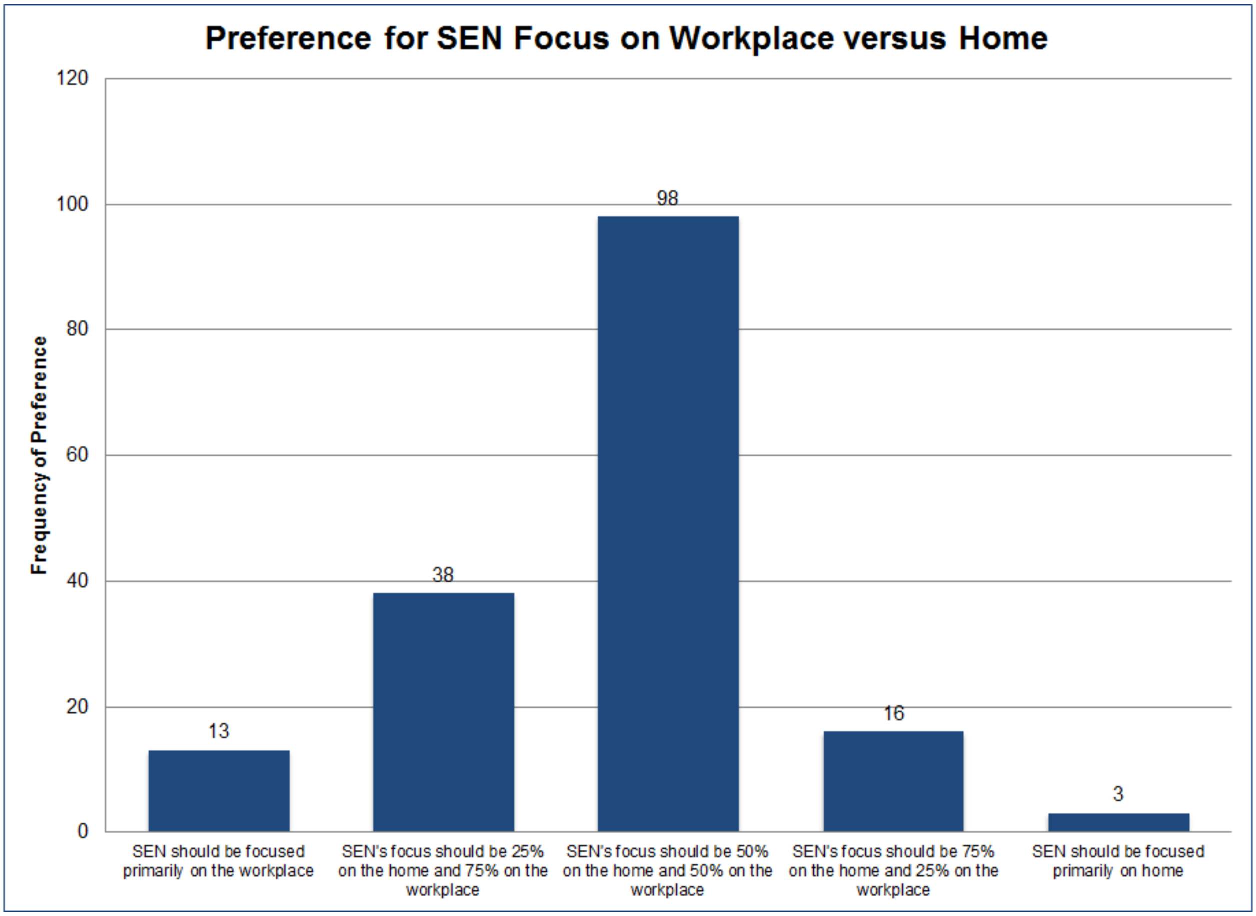

Figure 6. Preference for SEN's Focus on Workplace versus Home

Ignoring the neutral option of "50% focus on home and 50% focus on workplace", we can see more respondents prefer a greater focus on the workplace than on the home (51 to 19). This pattern is particularly interesting given the fact that participants would financially benefit from reduced energy use at home, but not at work. The classic "split incentive" problem has stymied many energy efficiency interventions across the nation, but does not seem to be apparent in these ratings.

The evaluation team sees this as an indication that SEN should continue to focus on reducing energy use in the workplace. There are multiple reasons for this. In addition to the occupant interest expressed in these ratings, several Envision Charlotte stakeholders have pointed to the fact that SEN's focus is a factor in its success to date. Resources can be directed to the successful achievement of targeted objectives rather than diffused across a multitude of desirable goals. Within the Duke Energy portfolio, there are several successful residential energy efficiency programs addressing behavior change whereas Smart Energy Now stands out as the sole effort addressing behavior in the workplace. This focus of Smart Energy Now, by itself, makes this an innovative program.

Suggestions for Improving SEN

All respondents were asked the open-ended question: "If there was just one thing you could do to improve the Smart Energy Now program, what would it be?"

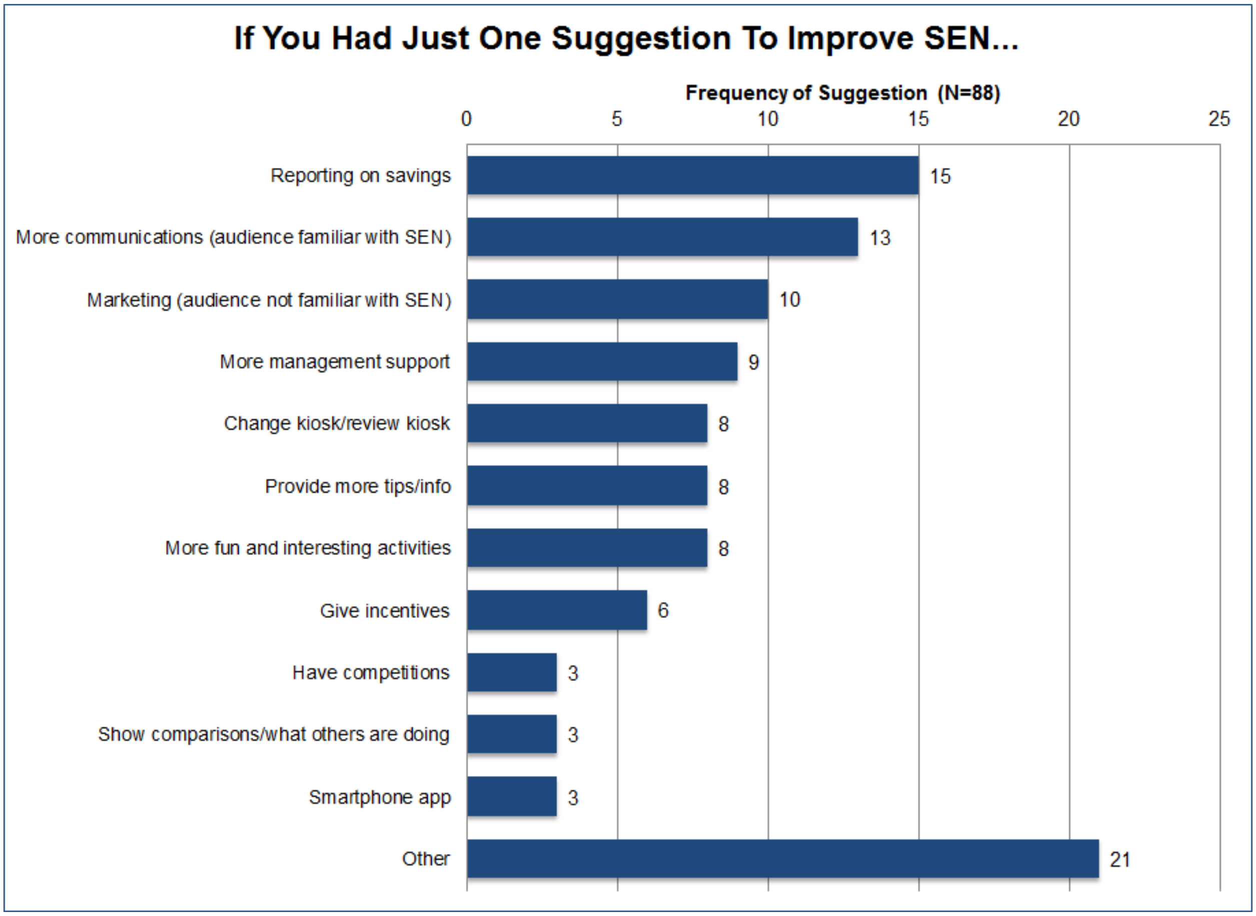

Figure 7. Suggestions for SEN Improvements

The most frequent suggestion was to report on energy savings from Smart Energy Now (N=15 or 17%). Specifically, the respondents offered:

- "If the goal is really to [influence] employees to take actions, the program needs to set achievable and measurable goals that the organization and its employees can take action on."
- "More feedback on results."
- "Our building is old and so is the HVAC system. I wish we could impact that energy hog. Not seeing that data (or incentive to our building owner to upgrade) is frustrating."
- "Share actual numerical results instead of reiterating years-old goal figures."
- "Update us on how we are doing [in our efforts to save] energy in this building."
- "I would love to see actual data about my building's energy use year to year to help me feel motivated to beat previous years."
- "Need to provide updates as to how Charlotte is doing quarterly."
- "Consider a summary of the past week's results with comparisons. Keep it short and sweet though."
- "Provide additional communication about the impacts of Smart Energy Now."

- “Publicize participating major tenants'/employers' individual accomplishments on the website.”
- “Publish your progress.”
- “Report progress and explain how it was achieved.”
- “Reporting the progress toward goals on a regular basis.”

Other top suggestions involved more communications to those already participating in SEN (N=13, or 15%), for marketing to those not participating in SEN (N=10 or 11%), and for more tips and information (N=8 or 9%).

There were also a number of suggestions regarding the kiosk, some negative and some positive. Altogether, these comments indicate that as currently implemented, the kiosks may not be having the desired effect. However, the evaluation team notes that the kiosks do not seem to be implemented as originally planned (see the Section titled “Kiosk” later in the report).

- “I'm not in a position to know all the details on what the SEN program has pursued or accomplished, so I'm operating on speculation. That said, my suggestion generally would be to be careful that what you're spending money on is value-add. It seems unlikely to me that the numerous lobby kiosks would provide a net benefit. Anecdotally, I've only observed anyone using these screens twice ever.”
- “[Develop a] Smartphone App so that information is handy to everyone and there would be no need to stop at the kiosk.”
- “Tell us what other people in the city are doing to save energy. The people [showcased] on the kiosk have never changed and I figure other people are doing things.”
- “Find ways to involve people. The kiosk in our building is overlooked by 90% of those passing by.”
- “Have a screen that allows users to enter their name indicating that they are still committed to SEN.”
- “Have occupants sign in to the kiosk each week to commit to save energy. Names could be drawn to win a tablet, Kindle, iPad, etc.”
- “I do not see many people stopping to look at the kiosk in the lobby, not sure if these are really accomplishing anything.”
- “Put a kiosk in the elevator banks, or put information from the kiosk on the elevator TVs (rather than random trivia) - people in elevators (and elevator banks) are a captive audience.”

Almost one third (N=28) had no suggestions for improving SEN.

Overall Satisfaction Ratings

The respondents reported that their overall satisfaction with SEN is moderately high with a rating of 7.41 (SE=.16) where 1 = very dissatisfied and 10 = very satisfied. The respondents’ overall satisfaction with Duke Energy is also moderately high with a rating of 7.68 (SE=.18). These satisfaction ratings are good, but cannot be considered to be high ratings. While there is no single factor that drives this satisfaction rating, the evaluation team notes that across various questions in these surveys, participants have been asking about the results of SEN. This is not surprising:

SEN was designed as a program based upon measurement, and indeed the presence of the kiosks reinforces the premise that all energy savings can be measured. Smart Energy Now has been careful not to make early claims about energy savings. Rather, they have waited until this evaluation effort to provide official energy savings claims. However, there are other ways to measure progress that do not rely upon official impact evaluations. We suggest that the program managers consider other ways of providing feedback across all communication channels on the cumulative success of the Smart Energy Now Program. The successes of Smart Energy Now could be measured in number of campaigns launched, how many people are participating in campaigns, number of companies where over 50% of workers participate in campaigns, number of Energy Champions trained, number of participating companies, or in weather-adjusted changes in energy use. But this requires a more detailed knowledge about the Smart Energy Now campaign activities within the companies than the program managers are currently tracking.

> RECOMMENDATION: Track and report the cumulative non-energy successes and achievements of Smart Energy Now to the Uptown Charlotte community on a regular basis across all communication channels in order to maintain interest and satisfaction in the program.

Familiarity with Envision Charlotte

In the final portion of the survey, respondents were provided with an optional question, "Are you familiar with a program called Envision Charlotte?"

Without any prompt, 52% (N=76) reported they were familiar with Envision Charlotte, 27.8% (N=40) said they had heard of it but were not familiar with it, and 19.4% (N=28) said "No". Respondents in the latter two categories were then provided with a prompt: "Envision Charlotte is a public-private collaboration that will try to make Uptown Charlotte the most environmentally sustainable urban core in the nation. Does this sound familiar to you?" With this prompt, 36 respondents (or 25%) of SEN respondents were still not familiar with Envision Charlotte.

Energy Champions

Design

Energy Champions (ECs) were designed to be the SEN advocates within their workplace. Earth Markets and EMpower Devices were the two behavioral experts that worked with Duke Energy to develop the Energy Champion training program by creating a "train the trainer" program. This was intended to allow SEN to rapidly disseminate the training throughout the network of Energy Champions. As EMpower Devices put it, "Our first deliverable was Sustainability Corps training, to develop an army of on-the-ground Duke Energy Sustainability Corps Energy Champions." These early trainings were targeted at Duke Energy's pre-existing Sustainability Corps, a group of employee volunteers. After this initial training by the two consulting companies, Duke Energy then took over the training. A Duke Energy program manager reports that over the first few months, the SEN staff trained almost 600 Energy Champions.

Earth Markets believes there are a number of big successes with Smart Energy Now. These include the number of Energy Champions that were trained, the fact that SEN "got kiosks in as many of the buildings as they did", and by the engagement the SEN got with top-level managers and with the commercial real estate companies. However, Earth Markets believes even more momentum could be built with the Energy Champions, but acknowledges that may need greater staffing resources than SEN currently has. EMpower Devices agrees, reporting that even the behavioral experts didn't anticipate the success Smart Energy Now would have in encouraging interest from the Energy Champions. "People would get excited, email and contact SEN; they just didn't have the resources to go out and manage that." One of the behavioral experts reports, "For us, that's a major lesson learned. It takes a lot of resources to deploy large scale engagement." The evaluation team notes that the HR&A plan was designed with the assumption that there would be three full-time staff at Duke Energy devoted to implementing Smart Energy Now, which was exactly the staffing that Duke Energy had. When asked how SEN responded to the unexpectedly high interest, Empower Devices reports that Duke Energy was able to prioritize interest based upon the potential impact that the individual Energy Champions would have, and addressed that interest first.

Survey

Our Energy Champions survey sample included 53 Energy Champions who were participating based upon the fact that they were nominated by their management to act as an Energy Champion, or by the fact that they had volunteered to act as an Energy Champion. The Energy Champions in our sample were asked to describe in their own words the role of an Energy Champion. Of the 43 descriptions, 39 (or 91%) specifically mentioned Energy Champions having a leadership role within their company. Figure 8 presents a visual depiction of the frequency with which specific words were used in their descriptions.

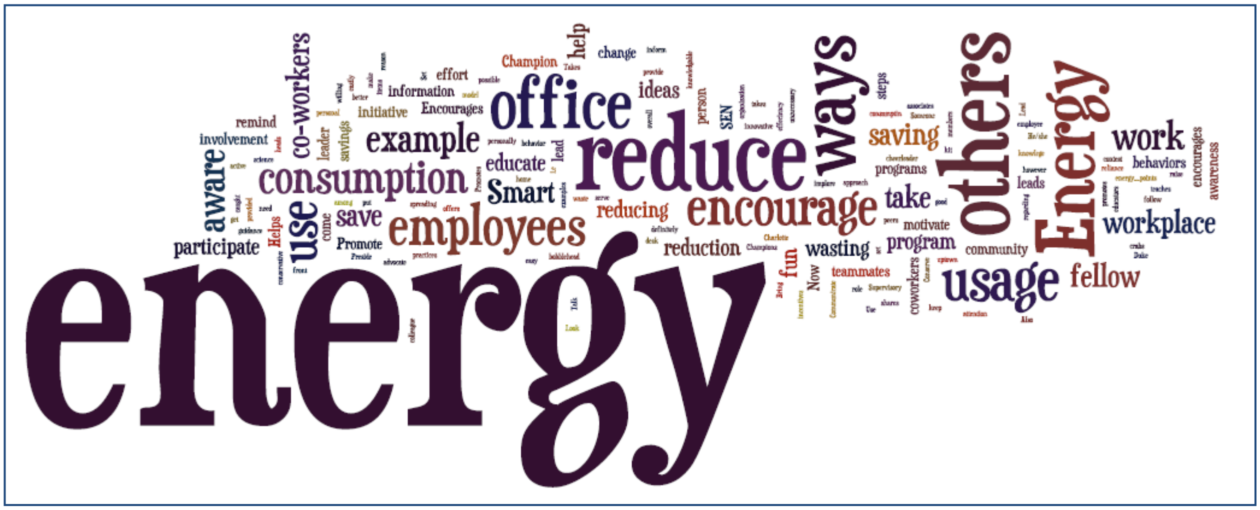

Figure 8. Energy Champion Word Diagram

Energy Champion Training

Energy Champion training has varied in its degree of formality throughout the initial phase of Smart Energy Now. During this phase, the Energy Champion training consisted of a 90 minute session that included a luncheon. Energy Champions were trained on the facts of Uptown Charlotte's existing energy footprint, on the types of actions that could be taken in the office workplace, ways to encourage co-workers to take those actions, and concluded with training on campaign implementation and a brainstorming session on campaign ideas. The Energy Champions would then refine the campaign and launch it at a later date. The Energy Champion training has evolved since then. Duke Energy program managers reported that they had a disappointing response from the Energy Champions. Since then, SEN's efforts have shifted away from using Energy Champions as the main advocate within an office, and toward asking tenants to become the main advocates. Once the tenants have made a commitment, they were then asked to designate an Energy Champion for their office. Under this new model, SEN program managers would be able to hold a "lunch and learn" meeting with the tenants, the employees, and the designated Energy Champions, and provide the same training materials with the exception of the brainstorming portion. The SEN program managers report that this approach has been much more successful: "Now we're training the whole company up front and launching a campaign at the same time. It's far more actionable."

Survey Findings

In our survey, we included both the original self-volunteered Energy Champions as well as the tenant-designated Energy Champions.

We asked the Energy Champion respondents whether they have had training and about their satisfaction with the training. Of the 46 respondents, 12 (or 26%) reported they had not had any training as of the date of the survey. Those who did have training reported that on average it had been 11 months since they were first trained.

The Energy Champion respondents who received training (N=33) rated their satisfaction with the training at 7.70 (SE=.327). When asked to suggest improvements for future trainings, 4 (of 16) respondents suggested greater involvement from upper management was needed. However, the most frequent suggestion (from seven respondents) was for more follow up meetings:

- "Never really hear anything from [Duke Energy] other than through email after our training session in our building that introduced the concept."
- "More follow-up [from the program] with Energy Champions to make them feel more responsible for energy savings."
- "More follow-up... seems the initiative has somewhat taken a back seat."
- "Needs continual reinforcement.... keep the ideas and goals on people's minds."

These Energy Champions were also asked how much support management has given to the SEN campaigns. Most Energy Champions agreed that management gave "enough support" (31 of 46, or 67%), 14 thought management support was "not enough" (30%), and only one thought management provided "more support than necessary" (but he or she did not specify what actions were unnecessary).

When asked to specify what Energy Champions thought management should be doing more of, 13 provided a range of responses. Six suggested that management should spread awareness of energy efficiency, including two who suggested that energy should have the same priority as safety. This last idea expressed was one of incorporating discussion of energy efficiency into regular work events. Many companies have a corporate policy to start every meeting with a brief discussion about safety. If management could be persuaded to support energy efficiency in the same way, they could institute policies to start every meeting with a brief tip on workplace energy efficiency.

Three Energy Champions reported their management was unaware of SEN, or never mentioned it. Three other Energy Champions suggested that their management should be taking more energy efficient actions across the company:

- "Doing a bit more to shut down when not in use."
- "More frequent communication about actions the company is taking to reduce energy use through new initiatives on how the buildings operate as well as setting employee goals for participation."
- "Talk more about it; do more of it; install/enforce more energy-efficient building features."

Other suggestions include recognition programs for taking actions, and that management should require SEN participation.

Communications with SEN Program Managers

Most of the Energy Champions who responded said they received special emails sent to Energy Champions (N=32 or 70%), and the newsletter sent out to those who pledged support on the SEN website (N=22 or 48%). Fewer than five Energy Champions each said they were on the SEN-affiliated LinkedIn group or Twitter feed, or spoke to an SEN program manager in person.

The respondents were asked to report how frequently these communications were used on a five point scale where: 1=almost never; 2=infrequently; 3=occasionally; 4=frequently; and 5=almost always.

The few Energy Champions who shared the content of these communications with their co-workers only did so on an "infrequent" basis (Mode=3, Mean=2.41, SE=.17), and only saw limited evidence that their co-workers had implemented or shown interest in these communications. See Figure 9.

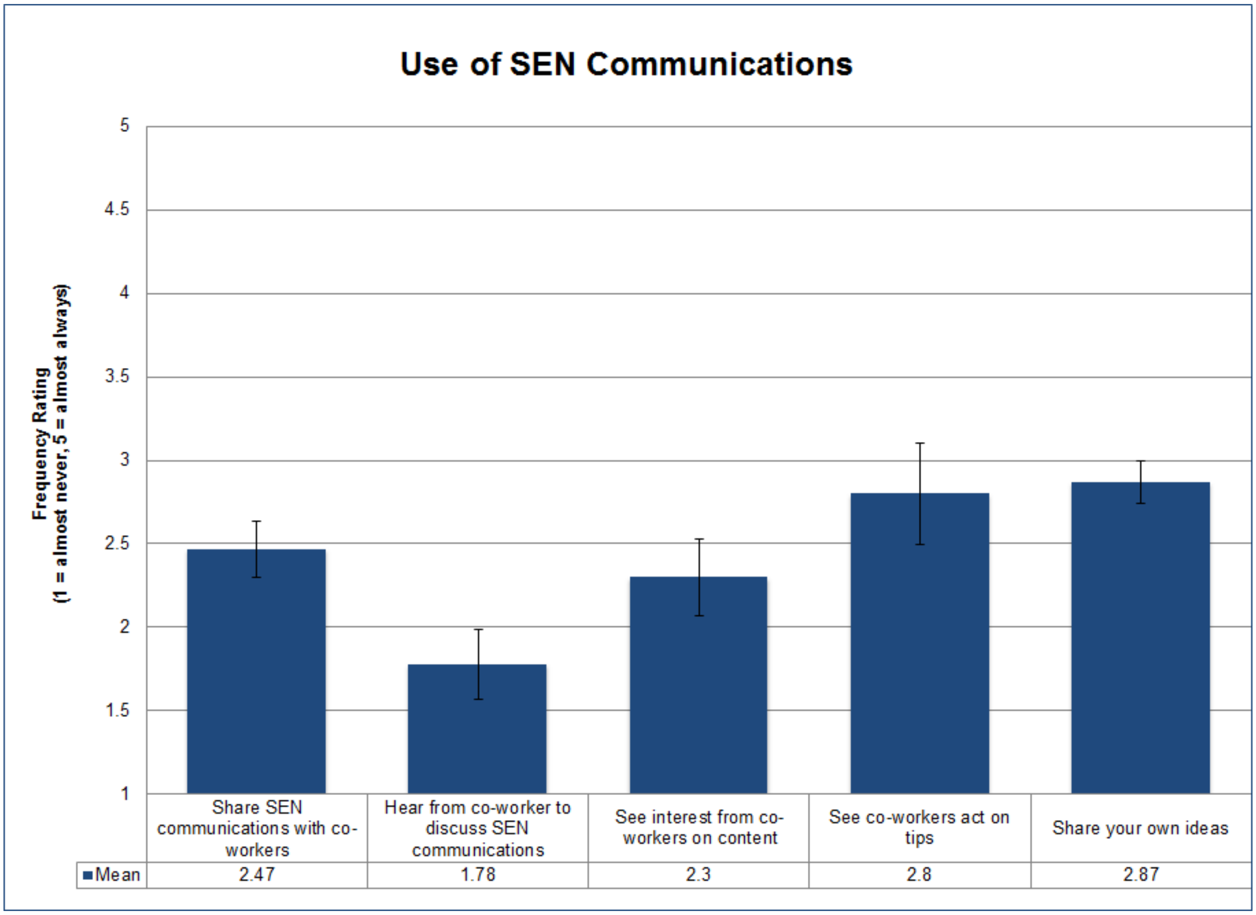

Figure 9. Use of SEN Communications

However, the Energy Champions also seem to be taking the initiative to share their own ideas with their co-workers.

The Energy Champions were also asked to provide suggestions for improving the communications from the Duke Energy program managers. Six respondents (19%) suggested more tips, five (16%) reported a need for more communications from SEN in general. In the suggestions for more communications, some respondents expressed a need for materials that could be directly shared with their co-workers.

- "Need more focused communications that can be shared – we do not have time to create our own communications."

- "Offer tips to use in team/staff meetings, similar to safety tips that are used on a regular basis. Make it an expectation of management that energy savings is encouraged and a priority."
- "Provide smaller promotional pieces for inclusion in company and divisional newsletters."

Three respondents (10%) directly requested sharing of SEN results, and four respondents (13%) said that current efforts were sufficient. Seven respondents (23%) volunteered that they thought using email for communications was the best channel.

Energy champions were asked whether they agreed with the statement "The Smart Energy Now outreach materials promote energy saving actions that my office co-workers were already doing."

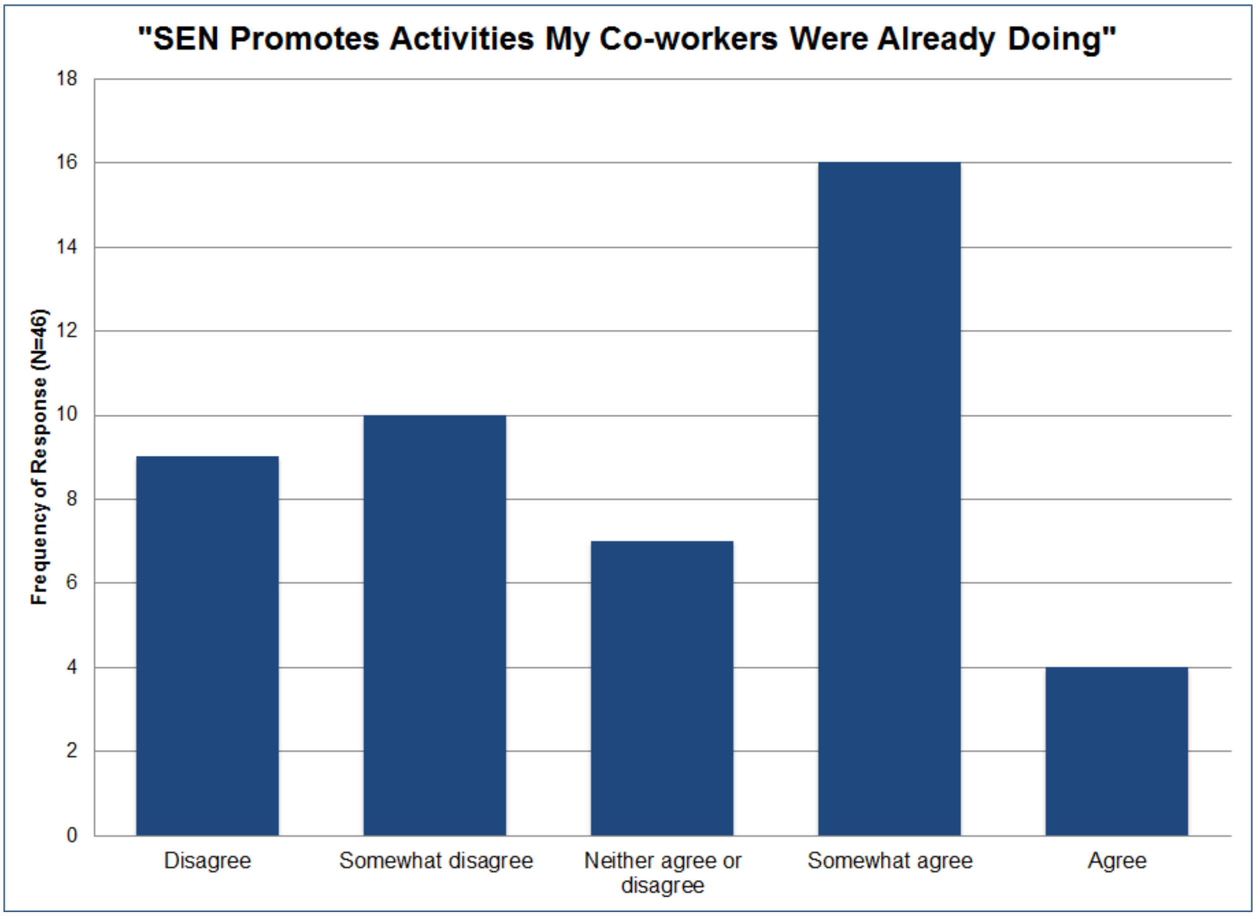

Figure 10. "SEN Promotes Activities My Co-workers were Already Doing"

The Energy Champions were almost evenly split on whether they agreed (N=20) or disagreed (N=19) with that statement. This suggests that there is room for improvement on the content of SEN communications from the program managers. In truth, there are likely only a limited number of actions that can be taken by occupants in office buildings, and the SEN program managers are aware that their communications should not be repetitive.

Energy Champions were asked to report the motivational factors explaining why they became Champions. These self-reported motivations were rated on a five-point scale where: 1=disagree; 3=neither agree nor disagree; and 5=agree.

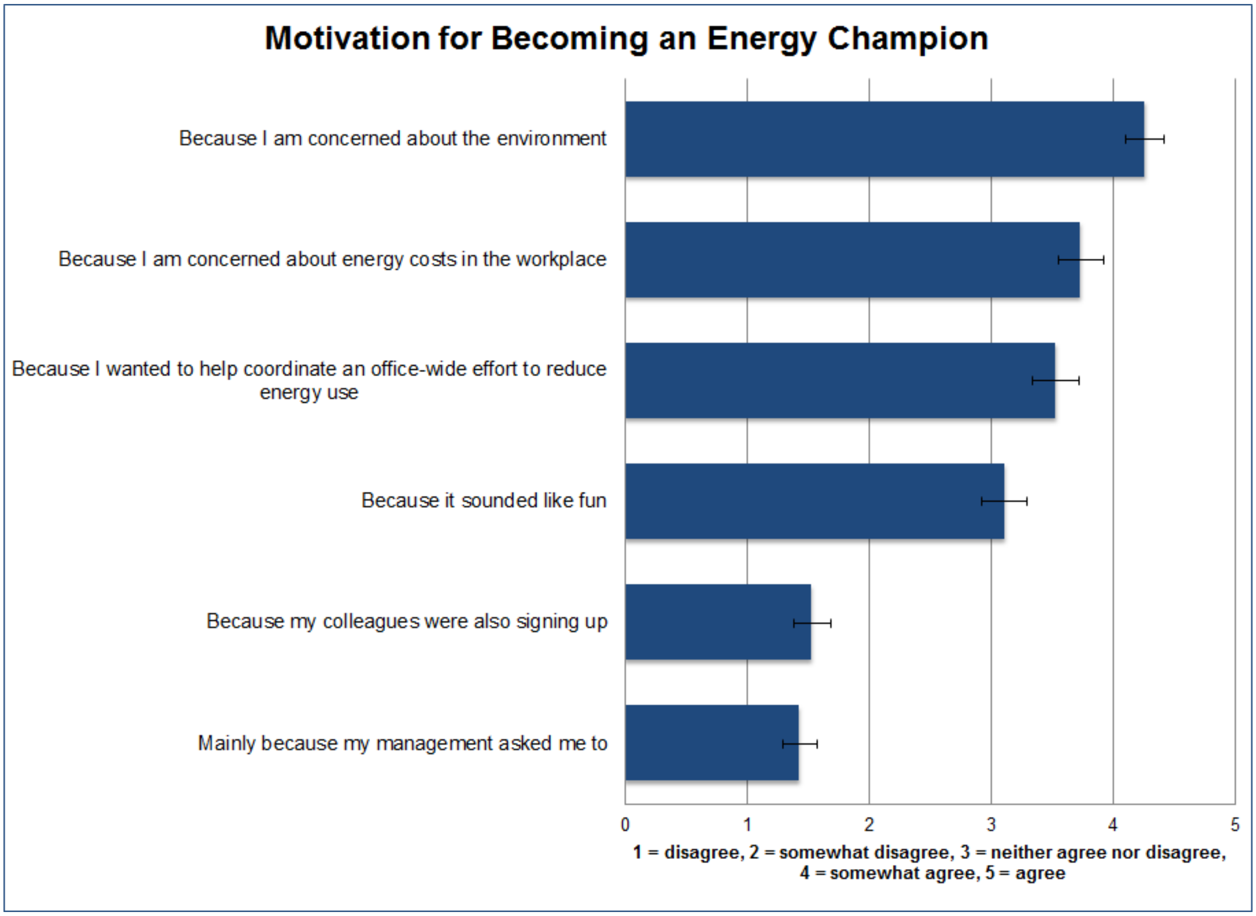

Figure 11. Motivation for Becoming an Energy Champion

Energy Champions are motivated out of environmental concerns. Respondents were most in agreement that they were motivated by a concern for the environment (Mean agreement = 4.26), and secondarily by a concern for reducing energy costs in the workplace (Mean agreement = 3.65). They were neutral on whether or not they signed up because they thought it would be fun (Mean = 3.04). Statistical tests showed that these agreement levels were significantly different from one another. Although these ratings may be subject to the social desirability bias, the fact that the Energy Champions in our survey were neutral on the “fun” motivation suggests that they would have been amenable to the prospect of putting in some effort in order to achieve energy savings in the workplace. The fact that they did not sign up primarily because of management or peer influence (mean agreement of 1.43, somewhere between “disagree” and “somewhat disagree”) suggests that they were internally motivated rather than directed. The low response rate means more research will be needed to determine whether these patterns do or do not reflect the attitudes of the rest of the Energy Champions. If these results can be generalized to the rest of the 700+ Energy Champions, this means that SEN has a lot of human resources that could be mobilized to achieve change if they think there are environmental or other benefits in doing so, and they know what to do. The question is: is this resource being taken advantage of by SEN? If not, might the lack of mobilization efforts lead to decreasing interest among the Energy Champions? The use it or lose it effect can take hold. The findings suggest that more research is needed: Duke Energy may wish to track the attitudes of the Energy Champions on a regular basis as part of their program management activities, to determine whether interest is decreasing.

Energy Champions' Activities in the Workplace

Mini-audit. Conducting a workplace "mini-audit" is one of the main recommendations of the Smart Energy Now program at each office. (See "Appendix D: Mini-Audit".)

More than half of the Energy Champions we surveyed had conducted a mini-audit of their workplace (N=29 or 63%) at least once, with some conducting mini-audits multiple times (see Figure 12).

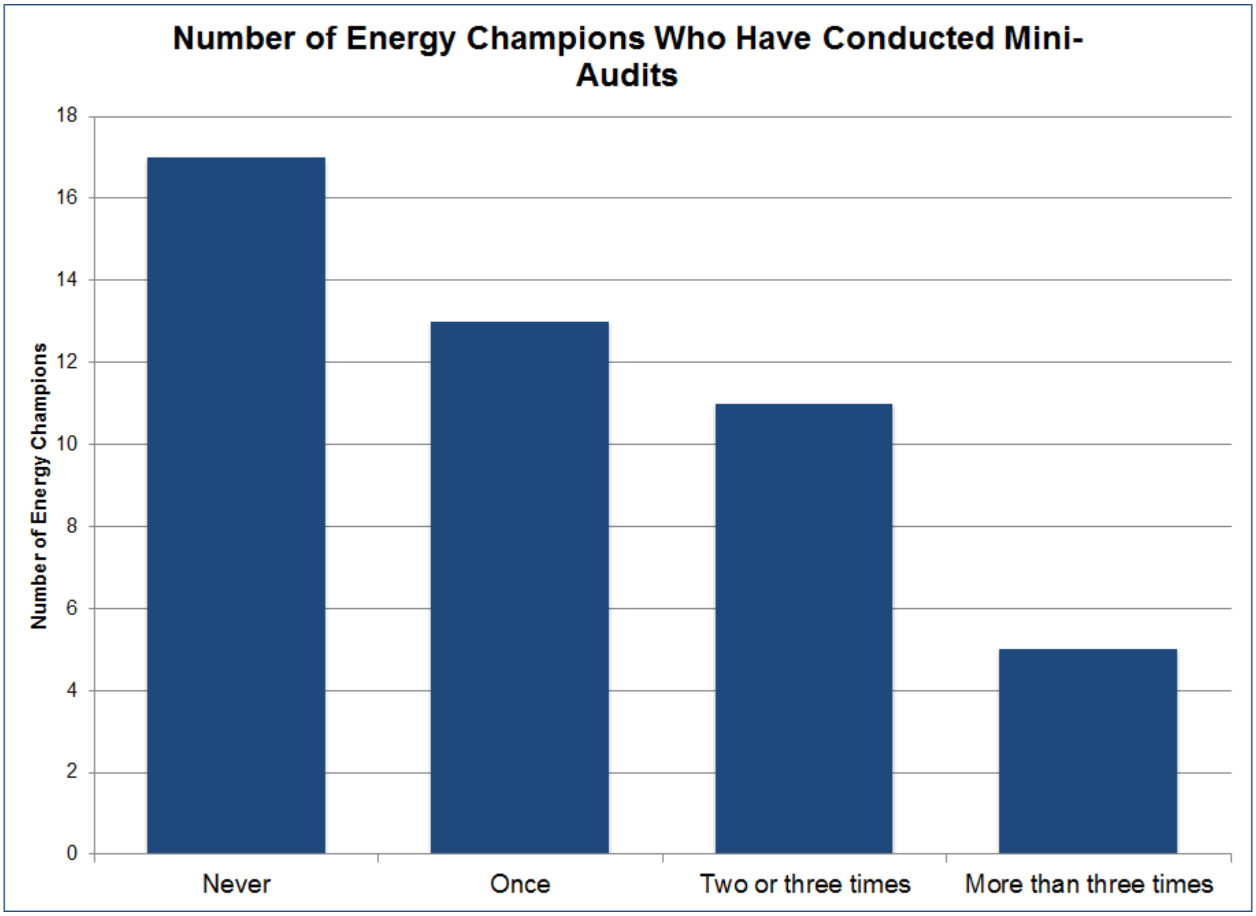

Figure 12. Number of Energy Champions Conducting Mini-Audits

These Energy Champions were asked if any of the audit recommendations were adopted at their workplace. Twenty-six responded, with lighting-related actions constituting over half of the adoptions (N=15 or 58%) and plug load-related actions constituting over a third (N=10 or 38%). This indicates that actions that save energy are being taken. The plug-load related actions included three cases where the office started using power strips, which requires a small investment by the company. Two Energy Champions reported the audit did not provide any recommendations due to characteristics of the building (one building was LEED Platinum). Two reported that they did not have the support needed to implement any recommendations and could therefore not take the actions. Only four Energy Champions reported on the method by which the audit recommendations were implemented, with two workplaces using signs and one appointing “volunteer captains” to monitor lighting in common areas. The remaining audit recommendations that were implemented by only one or two workplaces included using revolving doors, using natural day lighting, closing blinds, changing printer settings, and recycling.

Other activities. Figure 13 shows the frequency with which each Energy Champion respondent said they took certain actions. The Energy Champions’ other activities in the workplace were more frequently directed toward other individuals than the office as a whole. This is not surprising, because activities directed towards individuals often occurs spontaneously, while activities directed toward a group requires advance planning. While over half of the Energy Champion respondents ran at least one campaign designed by someone else (N = 24 or 52%) (See Figure 13), more said they shared information (N=36 or 78%), gave reminders (N=38 or 84%), and assumed leadership for energy saving actions in common areas (N=32 or 70%). Some Energy Champions even ran a campaign they designed themselves (N=12 or 26%) or held meetings about ways to save energy (N=19 or 41%). The level of effort required for these last two types of activities are considerable, particularly to design and launch a campaign. The fact that these Energy Champions have conducted these efforts in more than one company is a testament to their motivation to help save energy in the workplace and indicates that actions are being taken to save energy.

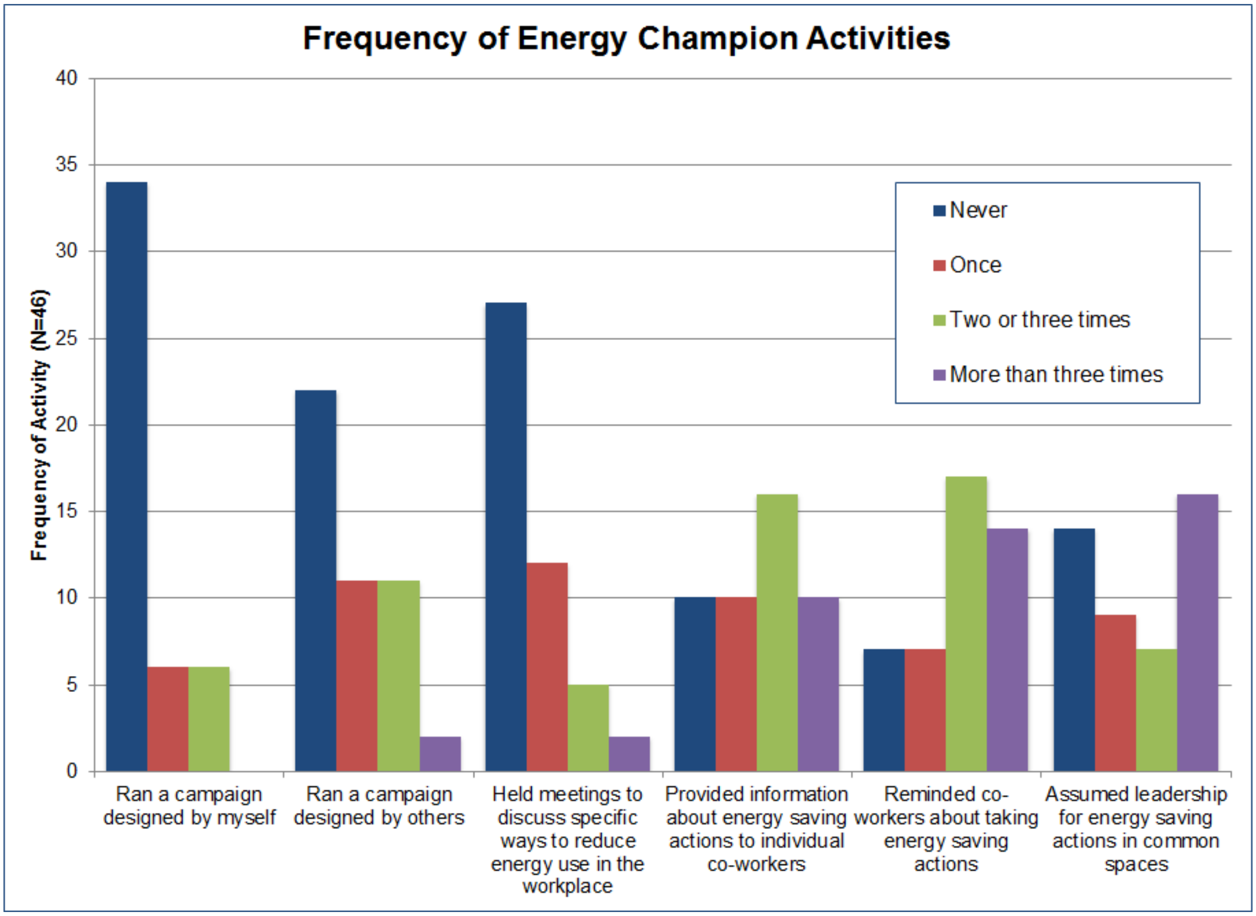

Figure 13. Frequency of Energy Champion Activities

Perceived Success of Activities

Figure 14 shows that there were certain activities that over 75% of the Energy Champions consider successful and would recommend to other ECs.

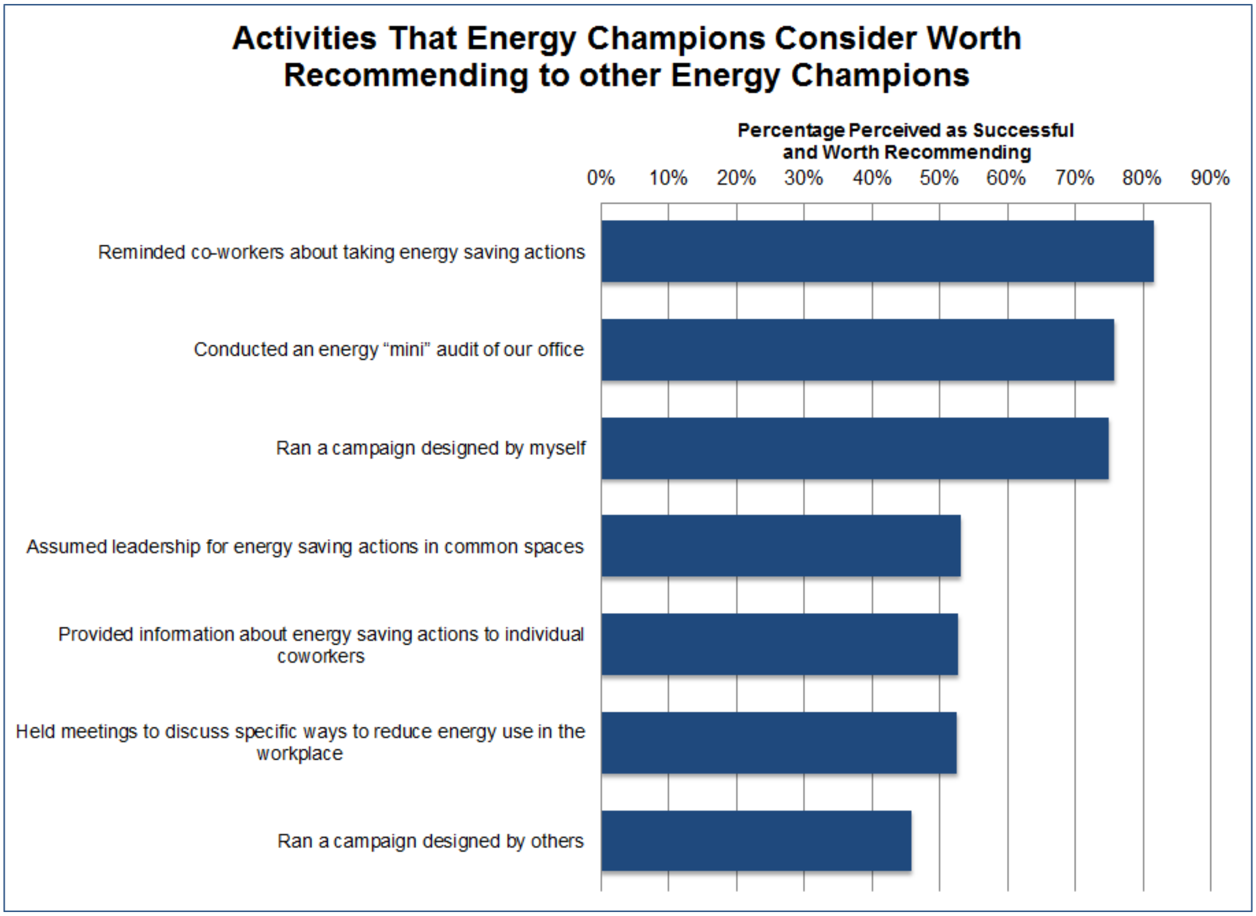

Figure 14. Activities that Energy Champions Consider Worth Recommending

1. Reminding co-workers about taking energy saving actions (31 out of 38 who took this action)
2. Conducting an energy "mini" audit of our office (22 of 29)
3. Running a campaign designed by myself (9 of 12)

The remaining activities were only considered worth recommending by half of those Energy Champions who had tried them at their workplace. One notable finding that can be seen is that Energy Champions were mixed on the perceived success of running campaigns designed by others versus the perceived success of running campaigns they designed themselves. One natural role of an Energy Champion would be to run campaigns. According to the SEN program managers, the two most popular campaigns (and the two that are usually presented during visits to offices) are "Crab You're It" and "Adopt a Light".

"Crab You're It" is a game based upon the behavior of fiddler crabs in nature. Fiddler crabs are drawn to light. In the game, co-workers place plastic fiddler crab toys on the desks of those who left their task lighting on. "Adopt a Light" is a campaign where office workers can "adopt" a light by placing a sticker with their name on it by a light switch. They are then taking responsibility for making sure the light is off when the office space is not being used.

It is not clear from our limited number of responses what might be the reason that these campaigns may not be considered successful. In addition, Energy Champions should be encouraged to share their successful campaigns with others as well as share their process for developing campaigns. This may encourage others in the Smart Energy Now community to design more campaigns that are uniquely suited for their business culture. The SEN program managers report that some law firms did not seem interested in playing the types of games associated with the campaign and behavior-change encouragement efforts, while others did. Likewise, they reported that some businesses such as some of the participating banks have a different business culture than office buildings or other types of service organizations and noted that the program needs to be sensitive to these differences. It also reinforces Duke Energy's notion that participants need to be allowed to develop their own ideas and campaigns.

The behavioral experts also noted that Duke Energy's policy has been to not send too many emails and to "stay hands off" with regards to workplace activities and campaigns. However, the behavioral experts cautioned that based upon lessons-learned in other contexts, "if you don't engage them right away and give them a specific task, they go away. A fair number [may have gone cold], and you won't get them back in, based on past experience." As the customer surveys will also show, there may be a number of participants who have limited time to develop their own approach. A laissez-faire approach may not be the best approach for all SEN participants.

> RECOMMENDATION: Duke Energy should continue to leverage and improve upon the expert input received to develop one or two more campaigns to offer to offices that prefer a less game-oriented approach to campaigns. This will allow participants with both options: to fully customize their own approach, or to use materials that have been developed by behavior-change experts, marketing experts or others that provide effective campaign ideas, whether they prefer fun campaigns or more work-oriented campaigns. This would allow Duke Energy to meet the needs of those who prefer more structure, as well as those who prefer more customization.

Perception and Effectiveness of Energy Champions

The existence of Energy Champions may not be widely publicized at participating buildings and the SEN program manager reports that not every company may have referred to them as "Energy Champions." When occupants in participating buildings were asked, "Do you know someone who is an Energy Champion?", only 11 of 34 respondents knew an Energy Champion, with the remaining respondents reporting they were either unsure or they did not know an Energy Champion. After prompting the remaining occupants with a description about the function of an Energy Champion, "An Energy Champion is someone who has volunteered to receive Smart Energy Now training on how to lead their co-workers to get excited about reducing their individual energy waste around the office", only an additional two more occupants (for a total of 13) said they knew someone who was an Energy Champion, either by name or by function.

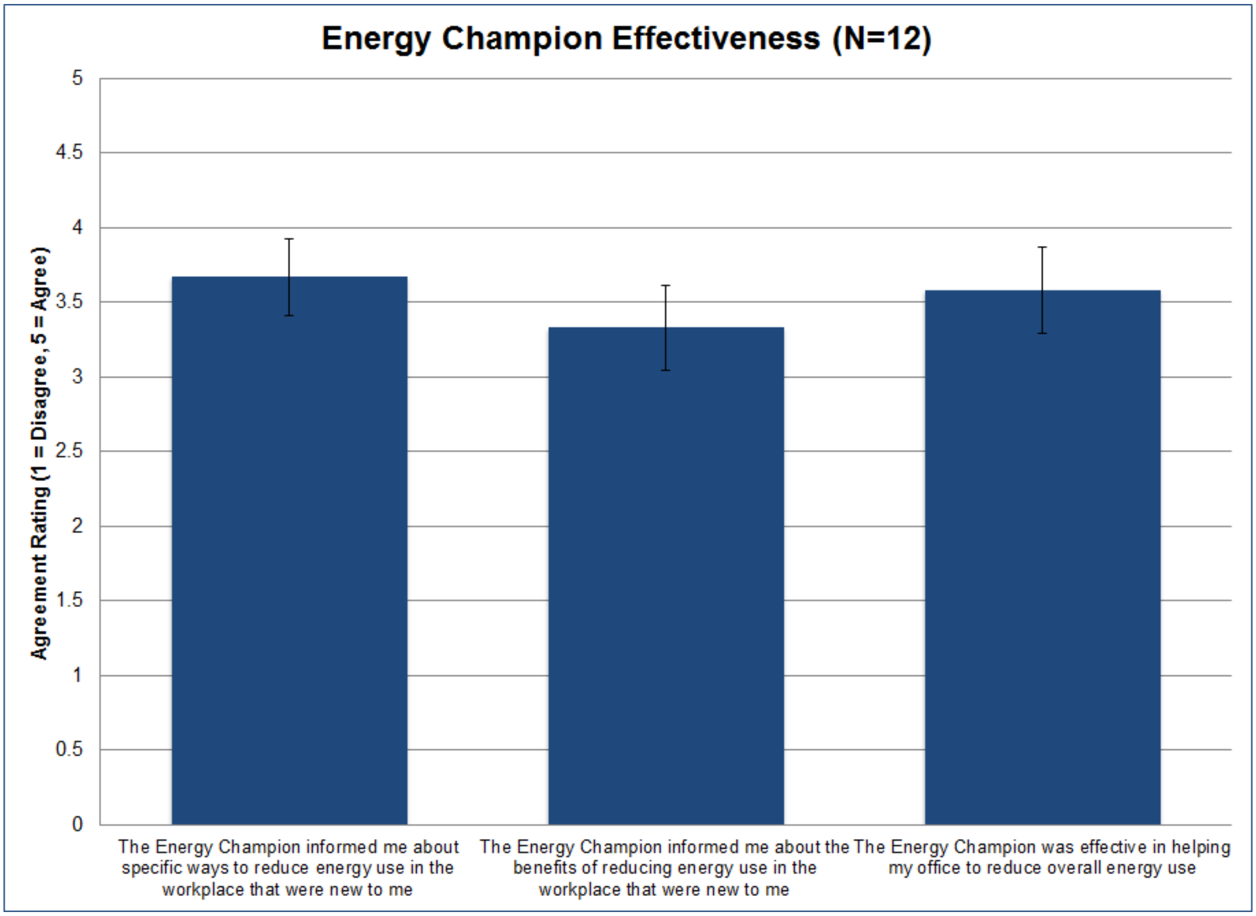

Figure 15. Energy Champion Effectiveness

Those occupants who knew an Energy Champion were also neutral on whether those Energy Champions have been effective, with average ratings between “neither agree nor disagree” and “somewhat agree” (see Figure 15). However, when asked “What is the best thing about having an Energy Champion?”, occupants responded with statements that suggest they were effective:

- “Access to communication - knowledge.”
- “Having another resource in the office who's committed to conserving energy.”
- “Having someone you can relate to close to the activities of Smart Energy Now.”
- “He is trained in valuable energy saving methods.”
- “It makes people more aware of how they use energy.”
- “Keeping the program awareness high and visible.”
- “Having someone accountable.”
- “They help encourage others.”
- “To know more about saving energy.”

When asked “What is the worst thing about having an Energy Champion?”, only two respondents had comments:

- “He doesn't always share his information.”

- "Single point of contact..."

Based upon the occupants we surveyed, there seems to be a generally positive perception of the Energy Champions as well as expectations for the Energy Champions to play a role as a knowledgeable leader. It is important for SEN to provide Energy Champions with the resources they may need to play this role within their companies. While SEN currently sends out regular communications to the Energy Champions, according to these respondents, there doesn't seem to be a clear call to action, or a suggestion as to how to use the content of these communications. This may be a missed opportunity.

Summary: Energy Champions - An Underutilized Potential

In the absence of explicit direction from the Smart Energy Now program managers, Energy Champions seem to be defining their own roles within their companies. The benefit of this approach is that the Energy Champions are free to take on only those activities with which they feel more comfortable: If they prefer to act spontaneously on a one-to-one level with other co-workers, they can do that and feel they have contributed something useful. If they prefer to design their own campaigns and organize office activities around them, they are free to do that as well. There are many benefits to having Energy Champions define their own role, including increased ownership of the role's responsibilities.

However, there may be opportunities lost as well. There seems to be a call from the Energy Champions in the results from our survey for more communication, more actionable advice, and more assistance from the Smart Energy Now program managers. Some of the Energy Champions have identified a need for more coordination, as well as more sharing and learning from others. The fact that there are some Energy Champions who have been designing and implementing campaigns that they believe are successful suggests that there is much that can be shared by those Energy Champions with their peer Champions in other buildings.

Currently, Energy Champions seem to be operating more or less in anonymity, by name or by function. While this might be more comfortable for some, there is also the risk that their efforts are underappreciated or under recognized. There is also the likelihood that more co-workers might be able to benefit from the Energy Champions' knowledge if their presence were better known. We recommend that SEN explore ways in which the Energy Champions are given more support if they wish to organize office-wide activities, rather than working on their own. While we were not able to delve into more detail about the Energy Champion's needs and wants, as the front line advocates of SEN within the companies, they are likely to have specific insights about what would be most successful for their company.

> RECOMMENDATION: Duke Energy should conduct more detailed research with the Energy Champions about the types of activities that have been successful and not successful within each company. This will allow Duke Energy to find more ways in which Energy Champions could be better used to advance the behavior-change objectives of Smart Energy Now.

Web and Social Media

Design

Duke Energy has a marketing plan for Smart Energy Now outreach efforts which regularly utilizes Twitter, LinkedIn, direct emails to the participants and to the Energy Champions, and their blog on the SmartEnergyCharlotte.com website. This marketing plan is organized thematically each time it is deployed, with the messages complementing one another across the different media channels. Blogs on the website were posted every other week, with topics such as “Trends for Commercial Office Space”, “1 Easy Way to Reduce Your Energy Waste and Get Fit for 2013”, and news on recent activities from other energy and sustainability activities around the country. These blogs are also posted on the Duke Energy “Smart Energy Now” group on LinkedIn.

Their Twitter following has steadily grown throughout the pilot. Currently, they have 872 followers, and they tweet three times every week.

The SEN LinkedIn group started in March of 2012. Since that time, they have gathered 480 members, of which 85% are in Charlotte, and 26% in the energy utility industry, some of which are Duke Energy employees. The groups are used as a program content information feed, with most of the content provided by Duke Energy. There have been 12 unique posters, with SEN staff and consultants providing approximately 85% of the 75 posts.

Emails are sent out every other week, the same week that the blog posts are published, with separate emails to the SEN participants and the Energy Champions. The SEN participant emails include suggestions for actions to take at the workplace, and the Energy Champion emails include suggestions on how the Energy Champions could encourage others to take these actions in the workplace. That is, they are energy action oriented and focused on actions that can be taken.

A review of the blog website web traffic analysis which Duke Energy provided to the evaluation team showed that website traffic increased 21% from November 2012 to December of 2012 with 494 visits (an average of 2.01 pages visited each, 1:24 minutes per visit). In February 2013, there were 690 visits (average of 2.01 pages each visit, at a visit duration of 1:28). In addition, the kiosk web analytics data provided by Duke Energy showed that the kiosk’s website usage has remained fairly constant since the inception of the program, indicating that usage ramped up at the beginning of the program and has remained fairly constant over the pilot period. Interest, as reflected by use statistics, has not slowed.

Survey Results

Respondents seem to be using the website in order to accomplish tasks, but do not visit it as a regular destination. When asked for the number of times in the past week they looked at the info on the SEN website (N=28), most respondents had not looked at all (N=23 or 82%). One respondent reported they looked five times, but the other three only looked once or twice.

Respondents who visit the site are using it as intended. Approximately 40% of respondents have used the web to sign up for the newsletter (N=15 or 45.5%), pledge support for SEN (N=14 or

42.4%), and looked for information on campaigns (N=13 or 39.4%). Of the 12 who looked for campaigns, nine reported they did find a campaign that they had already launched or are planning to launch. Unfortunately, Duke Energy does not track the number of visits to its blog on the website so they do not know how many people are reading the blog.

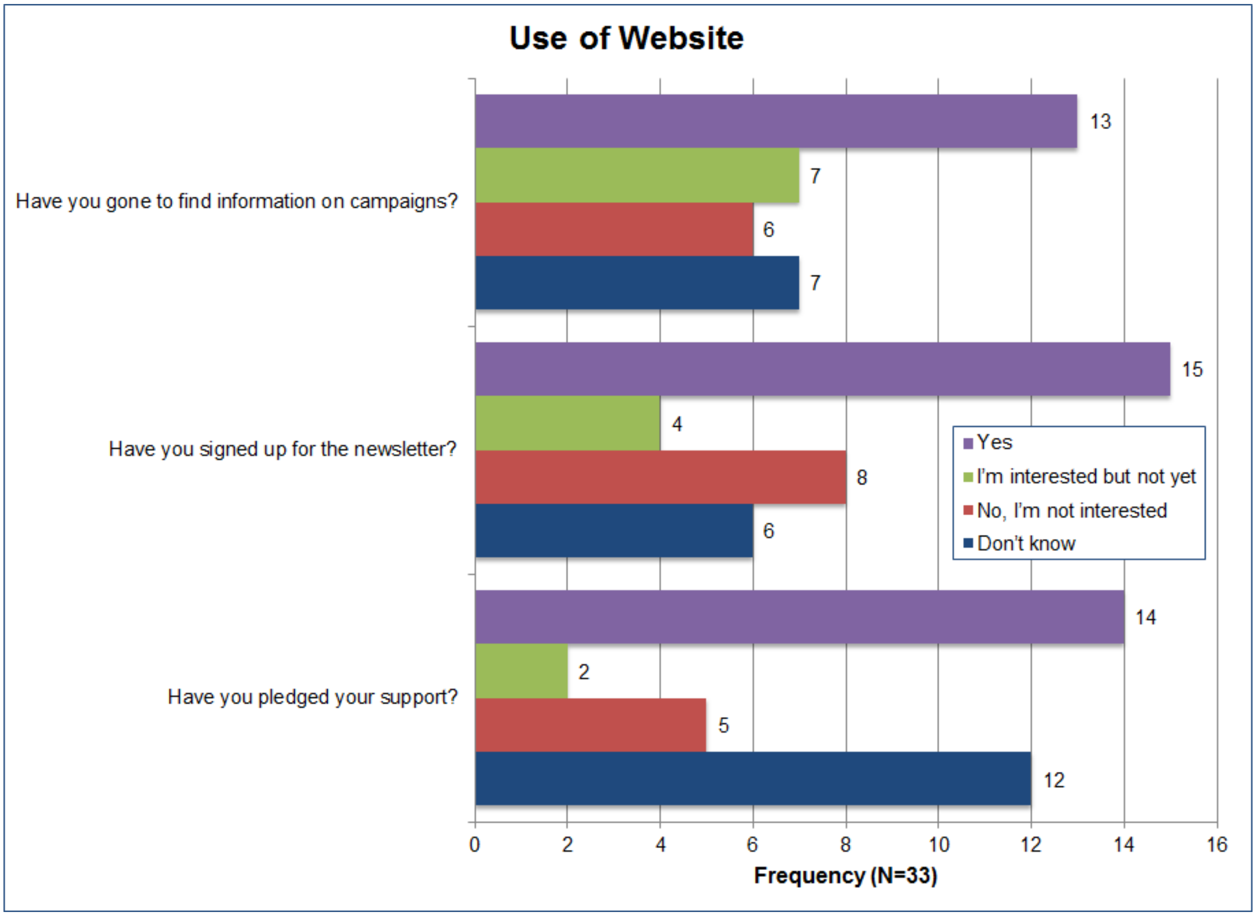

Figure 16. Use of Website

Currently on the SEN website, participants can click to pledge support to SEN.[8] They are then provided a screen where they can provide a name, email address, and check a radio button if they also wish to sign up for the newsletter. They are also presented with an optional text box to capture a "pledge statement". Pledges of general support are accepted whether or not website visitors make specific action-based "pledge statements". SEN program staff members report that the word "pledge" was not used until September of 2012, though the SEN website does list individuals who agreed to pledge support for SEN objectives up to two years ago. Despite the fact that the newsletter signup is secondary to and separate from a pledge sign up, there were more "Don't know" responses from "pledging" occupants when they were asked whether or not they recall making a pledge (N=12 or 36.4%) than when asked whether they had signed up for the newsletter (N=6 or 18.2%). One possible explanation is that providing an email address prior to 2012 was not interpreted by the occupant as a pledge for making a behavior change,

[8] http://smartenergycharlotte.com/

particularly since the word (pledge) was not used during the earlier period. In the future, SEN may find that regular newsletters provide an easy reminder that someone has signed up for the newsletter, as well as to provide support for SEN by taking a "pledged" action. This could reinforce continued focus on the pledged action, compared to a one-time pledge that may be more easily forgotten.

> RECOMMENDATION: Smart Energy Now could try to determine what fraction of participants made formal pledges to change behavior and whether more specific actions are related to the pledge recall in survey response as well as to additional actions taken. This will allow SEN to determine whether they need to take more focus on maintaining the power of commitment and pledges for achieved behavior change.

There were 31 of 33 occupants who said they followed the SEN Twitter feed. However, when asked if they have "ever read the Smart Energy Now blog", only a small minority reported they ever read the blog (N=4 or 12%), while 28 (85%) of the respondents reported they have never read the blog at all. Similarly, only a minority of respondents (N=4 or 12%) report that they have joined the Smart Energy Now group on LinkedIn.

Because the sample for this survey is not large, we do not interpret these results as representative of the actions of the entire SEN participant population. However, we recommend that Smart Energy Now continue to conduct periodic customer satisfaction surveys to see whether their use of the website and social media is effective. The current results suggest that the website may be underutilized.

> RECOMMENDATION: Duke Energy should continue to conduct periodic small surveys (these could be three or four questions long) to track whether Smart Energy Now is using the website and other social media effectively. This will allow Duke Energy to make improvements in a timely manner, if any are warranted.

When interviewed, one challenge that the behavioral experts identified was the need to coordinate publicity about Smart Energy Now with Duke Energy's corporate communications department. Earth Markets explained that it was critical for community-based marketing campaigns to have "earned media PR", or free marketing that is provided by others in the community that were also speaking to SEN's mission. However, in some cases, the timing of Duke Energy's marketing campaigns that targeted their multi-state service territory meant that local earned media PR could not be showcased by SEN.

Campaigns

Design

EMPower Devices and Earth Markets, two behavioral change consulting firms hired by Duke Energy, teamed to help design SEN behavior-change campaigns that started with a focus on strategies aimed at reducing wasted lighting in office buildings. These experts contributed some ideas to the development of campaigns but also solicited ideas from the Energy Champions for any "great project ideas and models". The program campaigns were then constructed around these ideas. EMpower Devices reports that they designed two campaigns.

The first campaign had multiple components and was developed for turning off lights when not in use called "Flipping Out". EMpower Devices and Duke Energy also supplemented the "Flipping Out" campaign with a component called "Adopt A Light" which encouraged people to take responsibility for specific lights in their office. Added to these efforts was a game developed by the county called "Crab You're It". "Crab You're It" had been successful at the county's offices to increase energy savings by reducing lighting use. In nature, fiddler crabs are drawn to light. The game asked co-workers to place plastic crabs on the desks of those who left their office or task lighting on when they were away. The behavioral experts took the "Crab You're It" idea and developed toolkits which included props that could be used to identify undesirable behavior and included these props with written instructions for how to play the game.

The second campaign was designed around reducing plug loads ("Powering Down"). For these campaigns, the behavioral experts provided a calendar along with detailed communications on the approach that was to be distributed during the process of rolling out the campaign throughout the participation community.

The behavioral experts also supported the SEN campaigns behind the scenes on a weekly basis, providing materials for e-mail blasts and keeping offices supplied with campaign materials and props such as crabs and stickers.

The behavioral experts reported that their usual program implementation model uses regular measurement of the response from the target audience to determine how well current activities were working and whether they needed to modify the program. To support this, they developed a set of tracking protocols for Duke Energy's use, to see how many ideas were submitted via the web, to monitor the traffic on the website and the use of the LinkedIn site. These metrics were similar to those that were used to track user engagement of the kiosk. The behavioral experts reported that they unfortunately had little access to the monitoring data. This made it difficult for them to determine if the current campaigns were working well or if they needed to be adjusted. "We were unable to close the loop. It's critical to close the action-research loop. Community social marketing can be effective if you have that feedback loop. Without it, you don't know if you're over-resourcing things that aren't effective." The behavioral experts also intended these campaigns to be run for short periods of time and then conclude with a celebration and recognition of each office's achievements. Duke Energy chose to allow the campaigns to run as long as each office wanted, and did not ask the offices to track or report on the campaign activities to avoid over-burdening them. Duke Energy's perspective was to let the users of the campaigns take full responsibility.

Survey Results

In our evaluation survey, respondents were asked if their office had participated in any of Smart Energy Now's campaigns. Of the 71 respondents, about half (N=31 or 44%) said yes, but the rest either did not know (N=22 or 31%) or said their office did not participate (N=14 or 20%). Those in the last two categories were given an additional prompt, "Some examples of Smart Energy Now campaigns are "Crab You're It" and "Adopt A Light", which are games that co-workers play to motivate each other to turn off unused lights," and then were asked if either of those campaigns sounded familiar. With that prompt, an additional 20 participants said "yes", for a total of 51 of 71 (72%) who had some familiarity with SEN campaigns. These numbers indicate that the majority of respondents remember and took part in the campaigns; however they do not always know that they are SEN campaigns. This finding suggests that many may be seeing the campaign as a workplace-only campaign, or perhaps an Envision Charlotte campaign. While it is true that there may be some building occupants who are more likely to take actions for a campaign run by their own company over an SEN, Envision Charlotte, or Duke Energy campaign, the intent behind SEN is collaboration. While there is no guarantee that properly branding a campaign as an SEN campaign would increase energy-saving actions, the evaluation team sees an opportunity to reinforce the larger, collaborative nature of these campaigns. Many behavioral programs also leverage social norms to change behavior. Knowing that they are part of a larger effort in which many other offices are changing behavior would serve to reinforce that social norm.

> RECOMMENDATION: Smart Energy Now should work to ensure that when a company runs a campaign, those campaigns are clearly understood as a collaboration between Duke Energy and the participating company, and are also seen as part of SEN. These connections do not seem clearly understood, based upon survey responses. While the campaigns do not necessarily need to be branded as SEN campaigns, making the connection to SEN reinforces the overall sustainability context for those participants who are engaged because they genuinely care about the environment. This would also allow participants to credit Duke Energy and others who are responsible for sponsoring these campaigns. Finally, this would allow them to understand that the prevailing social norm in participating companies is to take energy-saving actions such as the ones in their campaign.

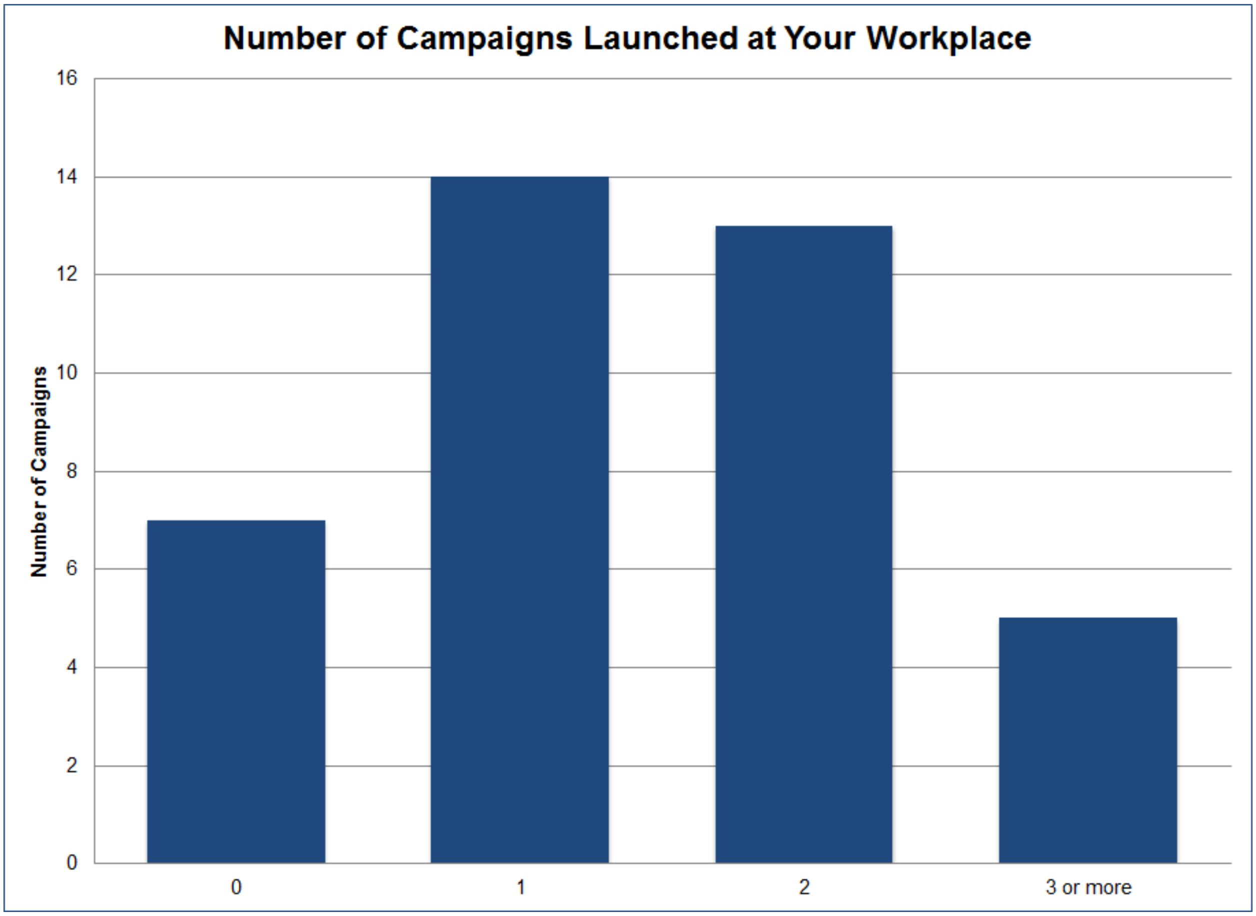

Figure 17. Number of Campaigns Launched at Workplaces

Of those responding, 29 (57%) were able to provide the name of their office campaign. Almost half of these were some form of "Crab You're It", and three were some form of "Flipping Out" or "Adopt a Light". The remaining campaigns included "Energy Elves, Energy Vampire Bobblehead, Hines Green Office, Kill-A-Watt Program, Office Light Monitor, Pulse Energy Challenge, You are an Energy Star, All Stars, Smart Commute Challenge, and Weekly Reminders". When asked to describe what behavior change was being promoted, of the 33 responses, 23 involved lighting and plug load actions (70%). Seven respondents (21%) simply described generic energy efficiency behaviors, such as "cut wasteful use of energy" and "energy conservation reminders". The two distinctive descriptions included one in which a positive incentive ($10 coffee cart card) was raffled off each month to those who reported the energy saving actions they had taken, and one in which participants measured the energy consumption of various devices.

Given that most of these campaigns were promoting common but effective energy saving actions, it is noteworthy to find that 70% of the respondents reported that these campaigns were effective in causing them to increase the frequency of actions they had already been taking (23 of 33). In addition, six (18%) reported that the SEN campaigns motivated them to start taking a particular action for the first time. Only four (12%) reported that the campaigns did not change their behavior at all. This means that the campaigns are reaching their intended targets and the campaigns are causing behaviors to be changed, even for commonly-known behaviors.

For those who did report a change in their behavior, they attributed moderate influence for the change to Smart Energy Now's campaigns: On a scale of 0 to 10, with 0 indicating no influence from SEN and 10 indicating "Smart Energy Now was the only influence", the average influence rating was 7.62 (N=29).

While SEN seems to be effective at reaching out and causing actions, it is unreasonable to expect any individual campaign program or intervention to form the "only" influence on sustained behavior change. When asked what other sources influenced respondents to change their behavior, eight respondents offered the following explanations:

- "Awareness and wanting to be a good example"
- "Being a member of the Green Team in Uptown Charlotte"
- "Energy reduction, personal goals"
- "Environment"
- "General common courtesy interest to make a baby-step contribution"
- "Our sustainability department"
- "Personal belief to reduce energy waste"
- "Verbal notice of lights left on"

In addition to these influences, respondents were asked whether their office had been a participant of any other program or company-wide effort to reduce energy use, other than Smart Energy Now. Seven respondents reported that their offices did participate in other energy reduction programs, including:

- Duke Energy Sustainability Corps
- Green Team
- Internal Sustainable Office practices
- LEED certified building
- Ozone Awareness/Air Quality
- Sustainable Design Initiative

While these respondents reported that they took part in other Duke Energy programs, none of the programs in which they identified themselves as being a participant are programs for which Duke Energy is claiming savings.

Respondents reported that they took actions promoted by SEN campaigns ranging anywhere from one to 35 times (or more) each week, with an average of 8.95 actions per week. Even with acknowledgement that this question is likely being applied to a wide range of categorically different actions, this is a high number for people to report taking or repeating actions and is an indicator of effectiveness. Respondents also reported that on the whole, these actions were not inconvenient, with only two respondents giving a rating of "moderately inconvenient", and the remaining respondents rating the actions as neutral to extremely convenient. Likewise, most respondents reported that they were either extremely interested or moderately interested (N=23 or 82%) in taking the actions promoted by the campaigns. Only six (18%) were neutral to extremely uninterested in the actions.

Twenty-five respondents also shared what they liked and disliked about the campaigns. The top three "likes" were 1) that they felt effective in saving energy and money (N=7 or 28%), 2) that the campaign was engaging and fun (N=6 or 24%), and 3) that the campaign was informative and raised awareness (N=6 or 24%). Three respondents (15%) each also shared that they liked that the campaign was a group effort and that they felt they were helping people. Three other respondents said that what they liked best about the campaign was that progress was tracked and shared (15%).

Fourteen respondents shared what they disliked about the campaigns: The most frequent issue was that the campaign was negative (N=4 or 29%), or "punishing bad behavior" with campaigns such as "Crab You're It", rather than positive reinforcement for good behavior. Three respondents mentioned that they didn't have enough participation or support from co-workers (N=3 or 21%) indicating some level of disinterest within a subset of office peers. The remaining few reporting respondents thought their campaigns were not effective, took too much work, or they lost the props[9].

New Campaigns

One of the premises of the Smart Energy Now program was that encouraging the participating offices to create their own campaign would allow those who were experts in their own office's culture to design suitable behavior-change activities. The SEN program managers reported that the initial conceptualization of these campaigns focused on "the concept of constant dialog with the tenants in a creative manner. They really felt you needed to have a ton of ideas." The program managers reported that once they launched the games, they realized some of the law firms didn't like them because they had a more formal office culture. The program managers explained, "We didn't have a nice bag of assets to choose from depending on the culture. They [the behavioral experts] kept saying you have to have fun."

However, these new, company-designed campaigns were not tracked to the degree that campaign-specific responses could be evaluated. For the participant response to campaigns to be evaluated, SEN would need to track the number or percentage of people within a company who were participating in that campaign. While SEN is in the process of improving its tracking, that data is not currently available to support an estimate of a campaign's effectiveness within a company. The SEN program managers reported that they had a list of campaigns that were submitted on the SEN website (see list below), but that system did not track which offices were conducting which campaigns.

The campaigns submitted on the Smart Energy Now Website were:

- 12th Floor Power Savers
- Adopt a Light
- Be Power-Full!
- Coffee Maker Timer
- Compliance Crabs
- Crab, You're it!
- CreativeEnergy

[9] Such as the toy plastic crab used in the "Crab You're It" campaign.

- DL vs KWh
- Don't Be Afraid of the Dark
- Energy Sprint
- Energy Stars
- Energy Surgeons
- Energy Vampires Education
- Envision Charlotte
- Escalator Efficiency
- Flipped Off
- Flipping Out
- In the Dark
- Last Out - Lights Out
- Less is More!
- Let’s help
- Light Switch Petrol
- Lights Off
- Lights Out & Monitor Off
- March Madness
- Pacing to Preserve
- Power Down
- Race to Reduce
- Reduce Energy Usage
- Sensor Control
- Sleep More
- Smart Energy Now Tip of the Week
- Smart Office
- Summer Time Awareness
- Sustainability Moments
- Taking the Stairs
- The “Monitor Monitor”
- The 3A's for Success!
- The Purple Peeper!
- Unplug It
- Walk Down the Energy Bill
- Watt Counts!
- Whatabrightlightwow

The evaluation team attempted to assess the prevalence of these new campaigns and included questions in the survey asking if the respondents had created or designed a new campaign for SEN. Unfortunately, respondents identified only four types of campaigns, including “Crab You’re It”, “Energy Vampire”, “Flipping Out, Powering Down”, and “You can be an Energy Star”. Given the small sample size, a quantitative assessment is not suitable within this current evaluation. Furthermore, several Energy Champions reported that they had created their own campaigns. However, an assessment of these self-generated campaigns was not included in our

Energy Champions survey due to concerns about the length of the surveys. Because of the lack of tracking, this component of SEN's efforts cannot be evaluated in its current state. Neither the program managers nor the evaluators have the necessary data to determine whether a quantitative or qualitative approach would be appropriate. Because of this, the evaluation team has decided that a better approach would be to suggest case studies on the most successful of the new campaigns, and identify those campaign characteristics that drive their success. If Duke Energy can provide data on the extent to which these new campaigns were being implemented, then a quantitative approach can be considered.

The evaluation team was able to determine that the building occupant respondents did feel it was important for Smart Energy Now to continue to encourage people to create their own campaigns. On a scale of 0 to 10, where 0 indicated "not important at all" and 10 indicated "critically important to the success of Smart Energy Now", 50 building occupant respondents provided an average rating of 6.78 (SE=.385). However, the data is skewed: Half of the respondents (25 out of 50) rated this self-generated component as an important factor, with a rating of eight or more on the importance scale. This is a resounding affirmation of SEN's design, and the fact that these activities are not tracked more closely is the biggest lost opportunity that the evaluation team sees within the Smart Energy Now program.

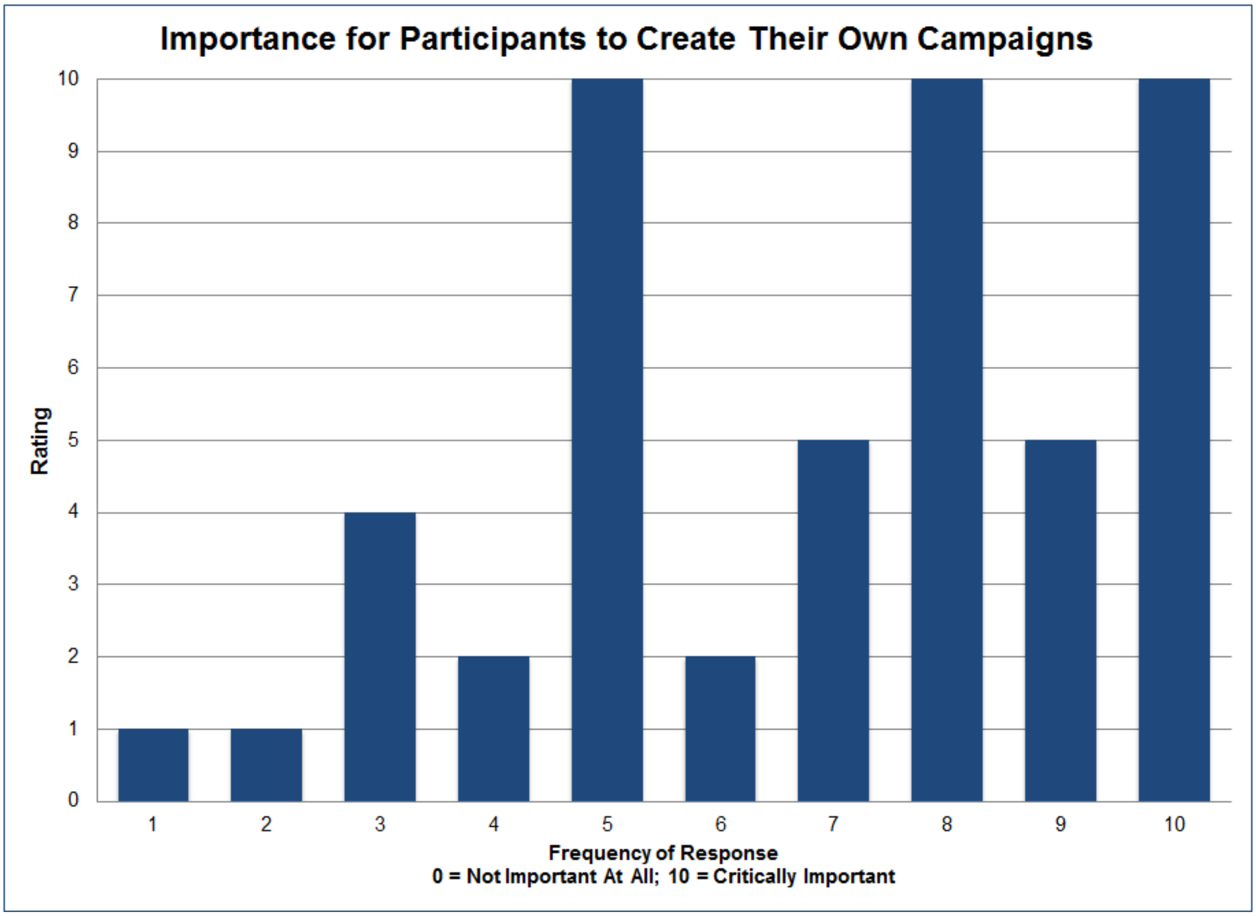

Figure 18. Importance for Participants to Create Their Own Campaigns

RECOMMENDATION: To support a rigorous evaluation of the new campaigns, Duke Energy would need to survey each office and record which campaigns they were running. While this kind of data can be gathered during the evaluation phase, it is less costly to build suitable program data tracking processes into regular program operations. In addition to helping to communicate the successes of Smart Energy Now, regular tracking of this data would be useful in improving the program managers' current understanding of program operations. Duke Energy should also consider the importance for developing a campaign use tracking system to help support rigorous effectiveness evaluation of new campaigns.

The building occupants we surveyed would likely be in agreement with this recommendation to track the achievements of the campaigns. When asked to rate how important it is for the participating office to measure a campaign's achievements, 50 respondents gave an average rating of 8.70 (SE=.196) on a scale of 0 (not important at all) to 10 (critically important). Likewise, these occupants also believed it was important for SEN program managers to track the achievements of these campaigns, with an average rating of 8.48 (SE=.241, N=50).

One barrier to tracking these campaigns may be the cost of tracking these activities. While there are a multitude of quantitative and qualitative methods by which the value of new campaigns can be measured, they all require, at minimum, tracking of their existence in order to evaluate. New campaigns are essentially new program components. The bottom line is this: If you cannot know what effect a new program component is having, then it is hard to determine if that component should be continued, changed, or terminated. In particular, it is critical for a behavior-change program to know the activities of its behavior-change campaigns.

The community-based marketing approach has shown success in some offices, as seen in the popularity of "Crab You're It" and "Adopt a Light". However, for offices where games may not fit the office culture, experts in change management and organizational change may be able to convey the behavior-change message in terminology that resonates better than a "fun" approach. While the basic principles of behavior change remain the same, the tools and language used by organizational change experts may be more familiar and thus more easily accepted in some offices that have a more business-formal culture. We continue to recommend the involvement of trained experts, whether they be organizational change experts or social marketing experts, so that SEN may benefit from other viewpoints on how to measure a campaign's effectiveness. Many social marketing and organizational change campaigns include tracking of campaign outcomes, and the use of feedback from those outcomes to inform future campaign design. If the tracking and feedback were both used, this would allow SEN to better understand its own effectiveness and ultimately help SEN achieve their behavior-change objectives.

1. RECOMMENDATION: Duke Energy should consider the costs and benefits of continuing to encourage participants to create their own campaigns. Several of the participant developed campaigns were more effective than the campaign developed by experts. For example, the "Crab You're It" campaign was particularly effective, however not every individually developed campaign was as successful. It may help if Duke Energy considered offering more behavior-change campaign development coaching or training to those who are interested in designing new campaigns for their office. This may be accomplished by

supporting campaigns with "campaign consultants" or campaign guidance principles provided by Duke Energy to help train people in companies that are interested in customizing the campaigns already developed or in developing their own campaigns. The expert marketing development consultants could provide advice or concept documents to support the self-development efforts of companies who want to develop their own campaigns.

Kiosk

Kiosk Content

The Smart Energy Now kiosk is considered by most to be the most iconic element of Smart Energy Now. It represents the height of technological innovation in the use of the Smart Grid, and many had hopes it would play a central role in driving behavior change. During the planning phases of Smart Energy Now, Duke Energy engaged with a number of behavior experts who held two workshops at the Massachusetts Institute of Technology (MIT) to discuss both the overall behavioral approach that SEN might use as well as the role of the kiosk in behavior change. The program managers report that the workshops were very useful. The subject matter experts at the workshop spent a lot of time discussing the look and the feel of the kiosk, the purpose of the kiosk, and how the kiosk might be best used to drive behavior change. They also adjusted the expectations of the SEN staff regarding interactivity with kiosk users (for example, explaining that most people would not spend more than 30 or 40 seconds at a kiosk so that SEN should not expect users to type in a lot of information).

One of the original designers of SEN reported that one of the initial purposes of the kiosk was to share stories of SEN participants, from the community of office workers in the Uptown Charlotte area, on a regular basis. When asked about the content, one of the program managers explained it was expensive to change the content, and that since the original unveiling of the kiosk in October 28, 2011, the kiosk has undergone only one change in its content (in late summer of 2012).

The SEN program managers also expressed regret that they were unable to display the main content that they believed would drive behavior change. As one program manager said, “The type of information that would really drive people to change is not on the kiosk, and we can’t put it on the kiosk: How much energy are we saving? How do I, in my building, compare to others? We can’t do that. All we can put, and what they’re seeing, is raw data. We were handcuffed in ways that affected [the kiosks’] impact.” The program managers explained that according to the kiosk installation agreement, customer confidentiality would be preserved by only displaying data in aggregate. The aggregated data is also sent to the Compass Tool, a web-based interface that requires a password. One program manager said, “Right now our data is only being impactful in one way, and that’s through the facility manager through the Compass Tool.”

However, there were seven buildings who had given permission to display their building-specific information. The program managers had offered that capability to a limited number of participants on a trial basis. The program managers had high hopes that they would be able to revise the kiosk agreements to offer this capability to other interested buildings. However, during the kiosk content revision in late summer of 2012, all building-specific data had been removed and has yet to be reinstated. The program managers reported that several of those buildings asked for it to be reinstated, and one building moved the kiosk to a less conspicuous location because it no longer contained their building’s data. (Four months after these interviews, Smart Energy Now had not only reinstated the capability but had begun offering it to other buildings).

Kiosk Hardware

Duke Energy’s SEN efforts were supported from a manufacturer and marketing perspective through their partners, Cisco and Verizon Business. Verizon Business provided wireless capability and equipment for the 4G LTE network. This use was the first use of this real-time wireless capability in this way in the world. As the project evolved, a number of different players came in to provide additional support including analysis of the data, and digital streaming to the kiosks. This use of the wireless network was both complex and groundbreaking. At one time, there were approximately 8-10 different companies collaborating on different pieces of the kiosk development (See Figure 19).

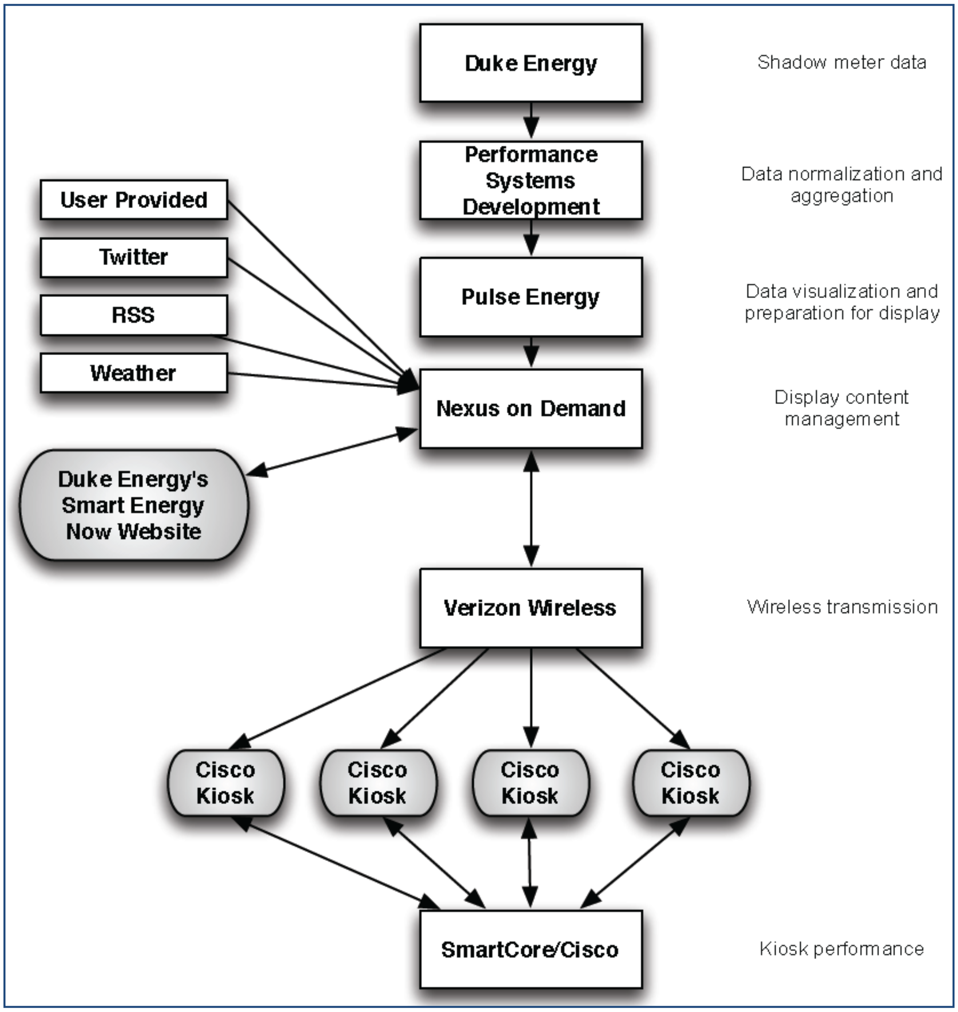

Figure 19. Kiosk technical architecture and vendor roles (adapted from diagrams shared by Duke Energy and kiosk vendors

SmartCore. SmartCore was a subcontractor to Cisco to design the digital media architecture of the kiosks and to get the kiosks working in each of the buildings. That objective was accomplished early in the program. Their current role is to support the kiosks as changes are needed or as operational issues are uncovered. One of the principals at SmartCore reports that they have been involved in these efforts since the fall of 2009, when Cisco asked them to help support the development of the technical architecture for SEN displays.

As SmartCore explains it, these were the early days of Verizon's 4G LTE network and there were substantial technical issues and barriers. The establishment of the 4G LTE network in

Uptown Charlotte was a significant achievement because the network was new at that time, and the presence of the high-rise buildings posed a challenge by interrupting line-of-sight transmissions.

SmartCore's current responsibility is to monitor the kiosks' wireless-connection uptime. The main issue that affected the kiosks' performance at the beginning of the efforts was the wireless connectivity. The kiosk would either reboot itself or it would present usage data with a time lag (instead of in real-time) if connectivity was interrupted. The kiosk was designed so that there would always be some kind of content on the screen, even if there were connectivity problems. SmartCore notes that connectivity has improved since the early days of Smart Energy Now.

When asked if anything could have been improved about the coordination process, SmartCore credited a lot of the success of managing the different contributors to the Duke Energy program manager at that time. "[He] was the guy with the gloves off making it all happen." According to SmartCore, these efforts would not have come together and began to work well without the constant monitoring and expediting efforts of the Duke Energy SEN program manager.

Kiosk Data

Smart Energy Now was able to provide live building energy usage data through the use of "shadow meters" so that there is no need to replace or affect the revenue meter or billing meters already in use. Duke Energy's kiosk agreements with the building owners also specified that the kiosks would not be used for advertising but provide content that was relative to the behavior-change effort associated with SEN.

Performance Systems Development (PSD). PSD's role is to take the live data from the SEN shadow meters taken at 15 minute intervals and send it to Pulse Energy, who is then responsible for displaying it on the kiosks. PSD began their engagement in May of 2011, working throughout the summer to prepare the data for the launch of the kiosks in October of 2011.

The data sent to the kiosks is a composite feed, showing how buildings within the SEN district are performing. In addition, PSD provides the Compass Tool, which any building owner can access from their personal computers. This allows them to go into their individual accounts and see how their building is performing, in real-time, at a high level of accuracy. At any 15 minute interval, the building owner or facility manager can see what their energy use is against an adjusted baseline calculated by PSD.

PSD mentioned that, over time, SEN has increased their focus toward targeting the facility manager. According to PSD, these people are more receptive to the opportunities for using the data to acquire energy savings than others. In December of 2011, PSD worked with Duke Energy to prioritize SEN's approach by focusing the process on screening for the larger levels of savings associated with larger buildings and less of a degree on the available savings from tenants and occupants. PSD was asked to identify buildings where they thought "there was the most potential for engagement with the building managers to result in savings." PSD reports that they did an analysis based upon the buildings' size and the energy intensity, and identified the top 10 opportunities across all the SEN buildings. PSD readily acknowledges that this type of analysis is biased against the smaller buildings. But with these top 10 buildings, PSD was able to provide Duke Energy with the buildings' operational signatures: "This could be fodder for conversation with the building manager." PSD reports that the newly hired staff at Duke Energy was giving the responsibility for following up on these targets.

PSD also generates monthly reports for Duke Energy on the sum total energy usage of all the SEN buildings as well as of the individual buildings. Determining the baseline was a challenge, as some buildings did not have existing interval data. In other buildings, PSD has had to simulate the baselines, with different approaches required for each building depending on whether PSD had full or partial data for the building. "If we were to do it again, we would start by looking at that piece, based on what we've learned, and decide how we would standardize those approaches, based upon the amount of quality of preexisting data."

PSD also had a number of innovative suggestions for the use of the data. For example, PSD has heard feedback from building owners that they would like to install lighting and then quickly be able to see the impact on savings. They could then go to management and justify further investments. As PSD puts it, "The depth [of the project] is driven by the ability to see the impact more quickly."

PSD believes that a savings data stream (where users can see a data stream showing energy savings rather than just energy usage) has the potential to become another channel through which to engage the utility customer. "The savings data stream becomes a way to engage with your customer around the valued topic of savings. And that's different from the data stream around how a building is using energy. We saw the power of that savings data stream, it's motivating and it gets used in ways that is only beginning to be explored by the facility managers." PSD reports that others have acknowledged the potential of this data stream as well, and that they have already been approached by other companies who were interested in using this as part of an ESCO service. PSD reports that another vendor was being managed (i.e., their performance was tied to) to their buildings' EPA scores, and explains that PSD's system is based on some of the same inputs so it could be used as a faster performance metric: "With EPA…you have to wait a year."

Nexus On Demand. Nexus provided the software platform, "AppSpace", which was used to manage the kiosk content "on the back end" to drive kiosk displays. In addition, Nexus provided Duke Energy with some general consulting for SEN and the operations of the kiosks. Nexus' scope of work supporting SEN lasted for about 6-8 months. Nexus reports that they developed and successfully deployed the initial proof-of-concept operational formats for the kiosk content that was created by a content design agency that partnered with Duke Energy. After the kiosk content was developed and deployed, Nexus continued to provide consulting expertise whenever SEN made changes to the content for the kiosk display that had to be uploaded and operationalized. They also provided support to Duke Energy to help make SEN's website displays consistent with the kiosk displays.

Following the proof-of-concept testing, the content for the kiosk was and is provided by the SEN program managers. It was structured so that changes in content can be made by replacing display-system files. The live data used in the kiosks is processed and normalized by other Duke Energy partners, and is provided for use in AppSpace. The CEO of Nexus explains that "AppSpace ingests data and content and makes it easily manageable." AppSpace also provides day-to-day analytics and allows monitoring of the hardware, the network, and devices on the network. This data is available to the SEN program managers via their account on AppSpace.

When asked if there could be any improvements made to the developmental process, the CEO of Nexus reported that Nexus had joined the SEN development team a little later in the SEN development process, and were unable to successfully bring some of their expertise into the design of the kiosk. Despite coming to the process later than they would have desired, Nexus was able to present a number of ideas that were incorporated into the kiosk content. Moving forward, Nexus suggests that Duke Energy should take a look at the analytics collected to date, to see what users are touching and using on the screens, and evaluate how frequently the messages are being updated and if that timing is what is needed. "It's a living, breathing [tool]; if it's updated people will use it." Nexus believes the kiosks can be more successful if the kiosks are reviewed and optimized on a regular basis. "You can't leave those things unattended for an extended period of time. Nothing major [is needed], just a little TLC."

The only challenge Nexus encountered was the short developmental timeline. "It was a fantastic team to work with. I think given the condensed timeline everyone did a fantastic job. It's provided successful messaging. The only thing to be considered is a design that allows data to be updated in a more easily consumed fashion."

Kiosk Interface

Earth Markets. Earth Markets reports that, like the development of any newly developed complex communication tool, the kiosk development process was fraught with fits, stops, and starts. "We broke a lot of new ground in terms of technology; it was complicated and messy and we had technical glitches. Everything that you would expect when doing something for the first time." Earth Markets says that the technology itself was not new, but the integration of these different technologies was new. Development of the kiosk interface was conducted in parallel with the development of the kiosk technology, resulting in a need to redesign critical elements of the interface when the team learned that the technical capabilities were not as expected. "The design team would go down a path with technical expectations you have in terms of response times. Then you'd design the interface, and have a hiccup with the technology and have to go back to the table because that [response time] is then not available to use." One of the components of the kiosk under development was an interactive tool. The kiosk design team spent a lot of time developing an engagement mechanism through that tool, only to learn that the response time of the kiosk would not support the kind of interactivity they had hoped.

One observation Earth Markets shared was that "a lot of time was spent on designing the kiosk to be the primary engagement tool with the customer, but the kiosks were then placed where the majority of the foot traffic consisted of people passing by, rather than places where people would be waiting." Earth Markets suggests that engagement with customers who are on the move might be more successful through other channels, such as the web or mobile devices.

Survey Results

A sample of building occupants were asked how frequently they looked at the SEN kiosk within the past 30 days. Of this sample, 47.9 % (35 out of 73) had looked at a kiosk, with seven (9.6%) reporting they didn't know. Another 24 (32.9%) reported they had not looked at the kiosks in the last 30 days, and the remaining seven (9.6%) reported they didn't know where the kiosk was in their building and had never seen it. (This last group of respondents was channeled to another SEN survey).

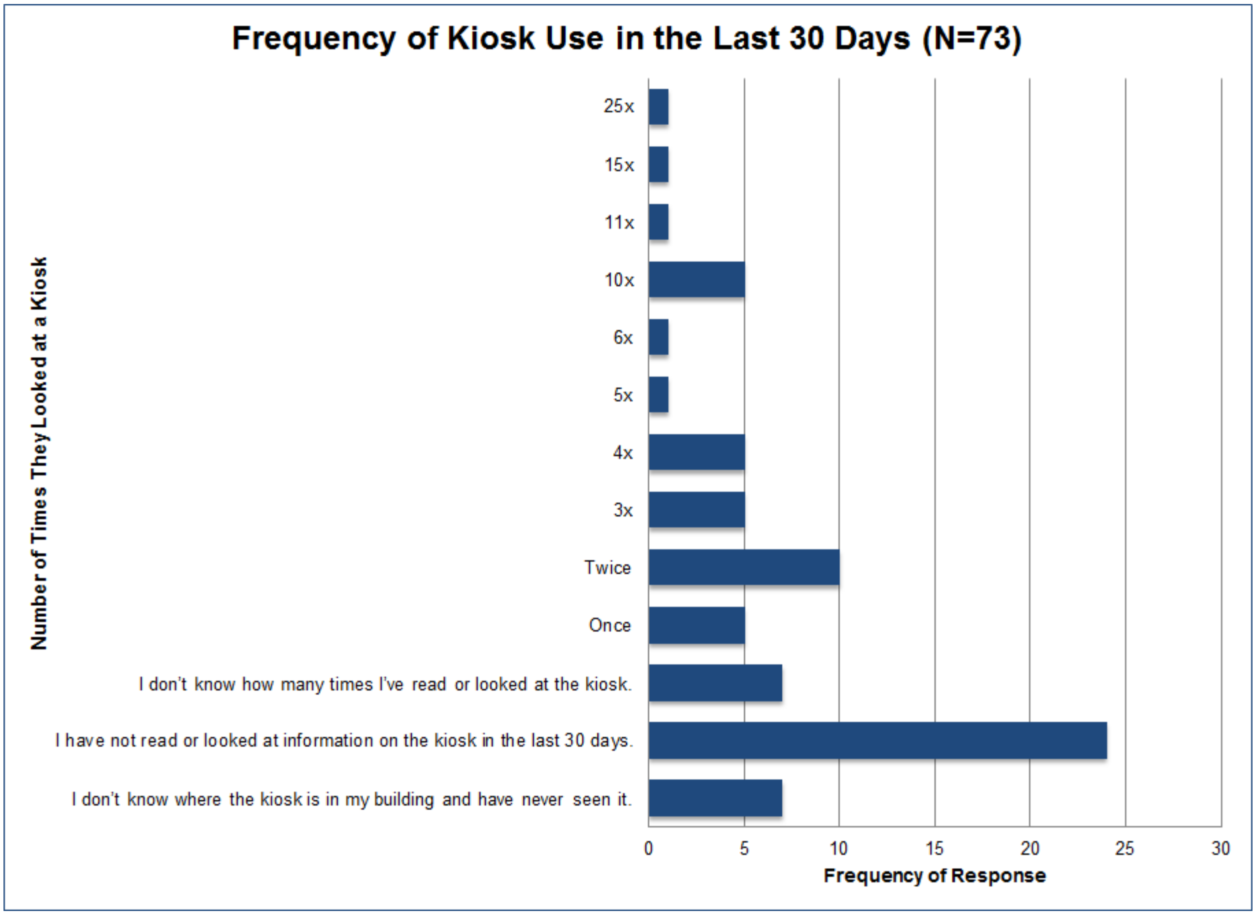

Figure 20. Frequency of Kiosk Use

The 35 respondents who had looked at the kiosk reported that they had looked at the kiosk an average of 4.91 times (SE=.848) within the past 30 days. However, Figure 20 shows that the modal response was a more conservative two times over that 30 day period, and that the distribution is skewed by a few outliers. This data indicates that the kiosks were not looked at very frequently, and even then the respondents looked once every two weeks.

In addition to their kiosk visitation behaviors, 63 respondents who reported visiting the kiosks were asked how many times over the past week they had discussed with co-workers the information displayed. Fifty one respondents (81%) reported that they did not discuss the kiosk information in the past week with anyone, indicating that these respondents viewed the kiosk for their own use and that that use did not lead to peer discussions. Five of the respondents (7.9%) did not remember if they had discussed the kiosk content, and seven reported that they had these content discussions (11.1%). These seven further clarified that they had these discussions an average of 1.43 times a week (SE=.429), with a maximum of three times a week. This data suggests that for a subset of the viewers, the information on the kiosk is generating peer group discussions, but that for most viewers, the kiosk information is for personal consumption without significant sharing of that information in peer discussions.

Occupant Interest in Types of Information Displayed on Kiosks

Respondents were asked about their interest in various types of information that the kiosk provides. On a scale of 0 (zero interest) to 10 (primary interest), most respondents showed a moderate to moderately-high level of interest across most of the different types of information. That is, they are somewhat interested in all of the types of information, but are interested in some types more than others. A paired t-test found that respondents were significantly ($p<.01$) more interested in Uptown Charlotte's current energy usage compared with past usage (Mean rating = 6.69, SE = .31) than they were in live tracking of Uptown Charlotte's energy usage (Mean rating = 5.87, SE = .33). In fact, of all the kiosk information they were presented with, the respondents seemed the least interested in live tracking of Uptown Charlotte energy usage, one of the main reasons for having the kiosks available. However, caution is urged in interpreting this data. The difference between the low and high levels of interest is small. This does not mean that respondents are disinterested, but rather that there is not a lot of variance in the level of interests across the types of information. None of the levels of interest associated with any type of information scored low. In all cases the mean level of interest is near a score of six or greater.

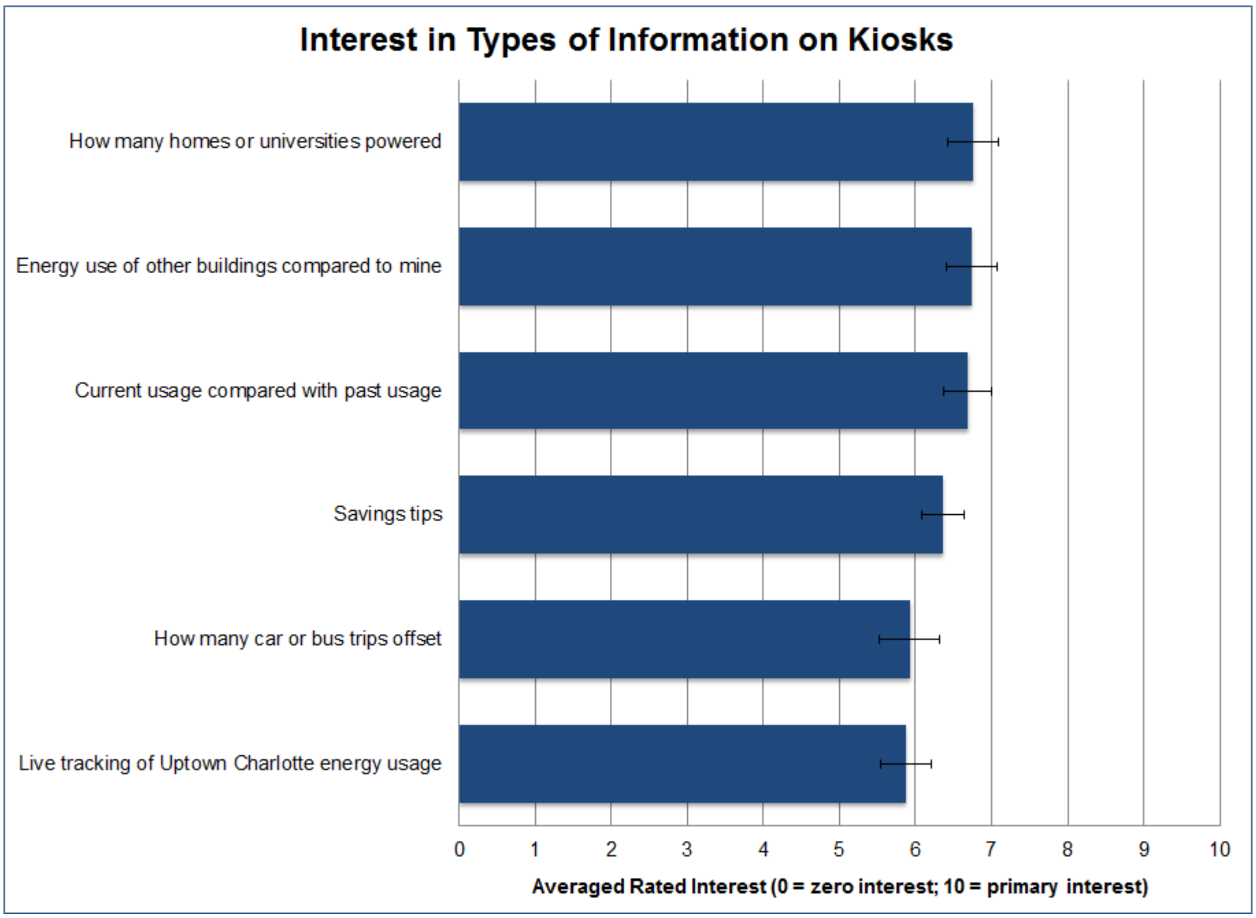

Figure 21. Interest in Types of Information on Kiosks

Respondents were also asked to provide ratings of their agreement with various statements about the characteristics of the kiosk.

Respondents were in agreement that the location of the kiosks was good, that the kiosks were technologically innovative, and that the kiosks served as good reminders to save energy (even if people only look at the kiosks occasionally). This last point was one that was also articulated by the SEN program managers.

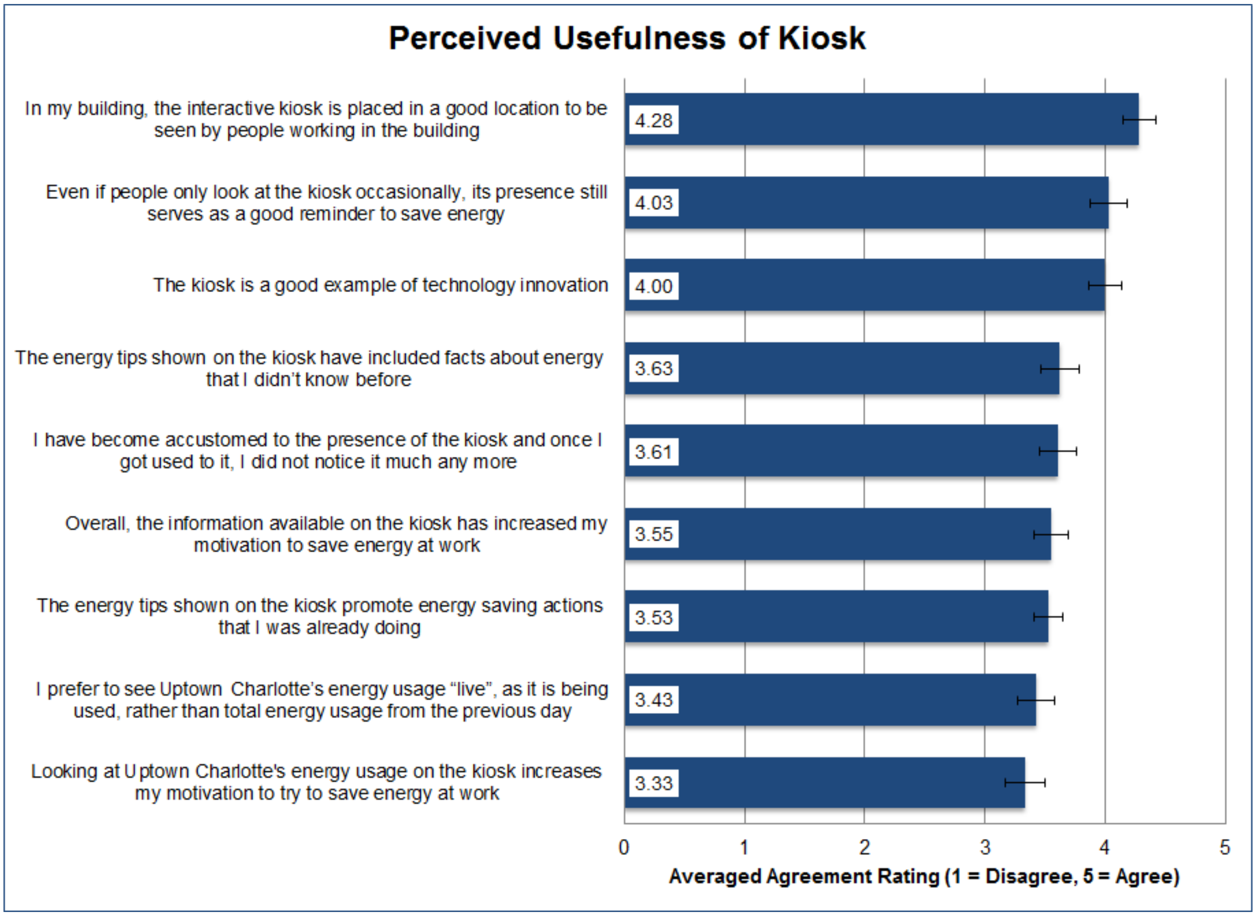

Figure 22. Perceived Usefulness of Kiosks

Respondents were neutral to "somewhat agreed" as to whether they had acclimatized to the presence of the kiosks (3.61, SE = .16), whether the information on the kiosks motivated them to save energy (3.55, SE = .15), whether the tips shown on the kiosk involved energy saving actions they were already taking (3.53, SE = .12), and whether they wanted to see Charlotte's energy usage live (3.43, SE = .15), or whether seeing this usage increased their motivation to save energy at work (3.33, SE = .16). On the whole, these respondents' attitudes toward the kiosks could be described as engaged but not highly engaged. However, the placement of each kiosk was chosen with the understanding that the kiosks were not meant to be a high engagement tool, but a digital sign to periodically act as a message reminder and focal point. It also suggests that the kiosks may be utilized better to some degree if there is a way to make them more engaging. If the content is not new, updated, and engaging, interest in the kiosk will diminish.

The SEN program managers are aware these kiosks may be underutilized, and they have mentioned the challenges associated with presenting fresh content. However, based upon the survey results from these respondents, it is clear that the kiosks are a tool of interest that has the capability to generate repetitive visits by the users. It is hard to make an evaluation-based judgment about this aspect of the kiosk. These are the first of their type in the world. There is no baseline for what constitutes high, medium, or low use of these types of kiosks used in this way. Therefore, it is not clear if the level of use being seen can be defined as high or low, or in need of improvement. The ability to assess use and engagement will come over time as different programs follow the Duke Energy lead and replicate these implementation processes. Only then will the evaluation field have the comparative information to assess current kiosk use.

What is known at this time is that a significant amount of creative effort went into making live energy use data available within the SEN displays. Based upon the findings of this survey, respondents find the contents moderately engaging. They view most content with similar levels of interest, with some content being somewhat more engaging than others. In our assessment, the kiosk visitor, on average, is more interested in seeing and understanding their real-time energy reduction. However, the live data feed does not provide that level of performance information. The viewer is interested in tips and ancillary information only to a limited degree and they are interested in seeing content changes each time they visit the kiosk.

When asked to provide suggestions on how the kiosks might be improved, the respondents had these to offer:

	N	Percent
Present our own building/floor's energy use	4	18%
Compare our use to other buildings	3	14%
Show our progress, usage against baseline, month to month usage	3	14%
Add a general news portal with information such as date and time	2	9%
Show the kiosk's own energy use	2	9%
Change the content more frequently	2	9%
List SEN projects	1	5%
Show live energy usage	1	5%
More translation of live energy use tied to specific behaviors	1	5%
Provide residential tips	1	5%
Move the kiosk to a better location	1	5%
Display current energy-related events	1	5%
Total	22	100%

The first three categories of responses all reflect a desire by the respondents to understand what SEN has been achieving, and moreover, what their own workplace efforts have been achieving[10]:

- "I think each building should have its own information displayed."
- "I think the plan should be focused on each floor not an entire building."

[10] The capability to display each individual building's energy savings was added after these surveys were conducted.

The next theme in the suggestions seem to be to make the content more relevant to the user, even if that content may not be directly energy-related.

- "Date and time!"
- "Horoscopes, sports scores, weather forecast. I'm not kidding. Make the kiosks usable for more than just SEN and you'll see scores more people using them on a regular basis. You can then share SEN information with workers as they look at content that is more helpful to them."
- "The kiosk could be used to alert people to key issues such as high ozone days where personal actions are needed or provide information on any special events that are taking place to communicate energy initiatives."

The SEN program managers and designers have spent considerable effort in deciding what to put on the kiosk and deciding what objectives the kiosk information should achieve. However, the first step toward any objective is to entice the passerby to look at the kiosk. Perhaps this following suggestion trumps all academic analysis about a kiosk's role in behavior change:

- "Just needs to change more often. It is boring that it never changes."

RECOMMENDATION: If Duke Energy decides to continue the use of the kiosks, they should change significant portions of the content of the kiosks on a regular basis. Most of the suggestions provided by the survey respondents have some merit, as did probably many of the original ideas the kiosk designers considered. Duke Energy could consider selecting a subset of these suggestions and rotate them on a weekly or biweekly basis, while keeping other elements such as the energy usage counter. This will present passersby new information, and may eventually lead them to check the kiosk more regularly to see what is new. Duke Energy could monitor the usefulness of the changing content by having "like" or "dislike" buttons at the bottom of each screen, tallying the number of responses each week.

To summarize our findings on this topic, the kiosks do not seem to be implemented as they were originally designed. As implemented during the first year , they may have ended up not being a critical component of the SEN effort. When a program (or program element, such as the kiosk) is not achieving its desired effect, the program management should examine whether it was the program's plan (or "program theory") that needs improvement, or whether it was the implementation of the plan that needs improvement. In this case, because the kiosks were not implemented as designed, this evaluation team does not have the data to conclude that the program theory was flawed. In other words, kiosk may very well be able to make an important contribution to engaging participants, if it had been implemented as designed. At this point, the evaluation team can only conclude that these kiosks, as implemented, did not have the desired effectiveness.

It should also be noted that if decisions about future kiosk use in SEN were only based upon this set of survey findings, then the kiosks' current level of use as an indicator of effectiveness has become a "chicken or the egg" question: Are building occupants not reading the kiosk because the content is not changing, or is the content not changing because the program managers believe the building occupants are not reading the kiosk? Since the kiosk content has only changed once since the unveiling of the kiosk, it may be too early for the SEN program management to decide that occupants are not interested in reading the kiosk.

That said, the evaluation team notes that although much of the original conception of Smart Energy Now focused heavily upon the role of the kiosk, the SEN program management likely has a better understanding now of how much weight to place upon a kiosk as part of a behavior-change program, and may wish to assign it a smaller role in the future. The SEN program management has also mentioned that it was very costly to maintain the kiosks. There may be several valid reasons to use other channels to communicate program information in the future, that would not require the use of kiosks. However, the evaluation team merely wishes to make clear that of all the reasons for not using kiosks in the future, there is insufficient data to conclude that the idea of using kiosks at all was a poor idea.

Overall Conclusions about the Design Period

The inception of Smart Energy Now seemed to have been complicated by the fact that the funding of this project was "dynamic", and there were contributors who were providing equipment and expertise without cost. As one interviewee put it, "I don't know who was getting paid [or not], but sometimes you get what you pay for." That imparted a degree of uncertainty with regards to the respective roles and relative contributions of all the actors. As another interviewee put it, "[That] Duke Energy was able to own that and manage that [with all the developmental uncertainty] is a magical thing."

More than one of these companies certainly made their contribution with the hopes that they would be able to generate similar business upon the completion of the pilot. One interviewee provided the anecdote that one early contributor had agreed to provide expertise, without cost, for a certain number of pilots with the expectation that they would be able to charge for these services when the pilot was commercialized. However, as it became clearer that the pilot would not be immediately commercialized, pressure mounted for that company to be able to justify its continued no-cost contributions during the remainder of the pilot period.

As one of the designers explained, he believed that the contributors may have all been providing goods and services that were "beyond our scope for the better goal in mind." But he believed that now that the initial learning curve had been surmounted, "knowing you can do it better the next time, we should be under contract the next time," rather than being asked to volunteer services. This interviewee also believed that Duke Energy would agree that the relative strengths of the contributors became clearer throughout the process. "I would have to believe that [the Duke Energy program managers] would say, *we don't need to do that with company X doing that now*."

It seems clear to the evaluation team that the Smart Energy Now pilot program was a pilot on multiple levels, addressing challenges and possibilities that no other energy program, either public or private, had to address in the past. This program broke substantial new ground with newly developed and developing technologies that are often characterized as the "bleeding edge" of the developmental process. As one designer said, "Conceptually, we were all cutting our teeth…there's been a lot of programs that other cities and utilities have tried to do, but nothing is yet to be anything like this."

One developer remarked about the kiosk, “I think it’s trying to do too much. [There were] a lot of great ideas, but the execution was difficult to manage. Pare it down, and focus on the data you really want.” Another developer said, “They were overly optimistic thinking the displays would solve their problems.” This individual seemed to be skeptical that any information displayed on a kiosk would be substantial enough to significantly change behavior once that individual viewed the kiosk. Others were more optimistic.

Another developer spoke of the different priorities that each of the companies pushed, reflecting each company’s area of expertise and their individual objectives for what the pilot would accomplish for them in return for their contributions and participation. However, the developers and designers all indicated that this was a unique opportunity for them to make a contribution. “There’s been a tremendous amount of publicity being given to all entities involved that has been leveraged by people selling services, [publicity about] Duke Energy being energy conscious and Charlotte being energy conscious.”

Tenants

Smart Energy Now relies upon the building tenants in a number of capacities. In the early months of the program, the SEN program staff found that it was difficult to get a consistent and reliable engagement response from the Energy Champions. As a result, SEN has evolved a new model of engagement where they gain a commitment to SEN at the tenant company's management level, and then ask the tenant to specifically designate an Energy Champion to act as the SEN advocate within their company.

In order to engage with tenants, Smart Energy Now staff needed to first identify the tenant then engage with that tenant in a way that achieved a commitment of some level of participation However, once a tenant was identified, the SEN managers would request a meeting, explain the SEN concept, and ask the tenant if they would be willing to sign a non-legal, non-binding "Declaration of Change" in support of changing behavior to achieve energy savings. (See "Appendix E: Declaration of Change"). Once the tenants signed the Declaration, the SEN program staff would ask for a meeting with one or more of their employees to provide the Energy Champion training. One year after the launch of Smart Energy Now, 32[11] tenants had signed the Declaration of Change, an achievement that SEN celebrated by acknowledging the participating tenants in an advertisement in the Charlotte Observer.

For this process evaluation effort, we emailed invitations to all known tenants (approximately 177, which included the both tenants who had and had not signed the Declaration) asking them to support SEN by taking part in a survey. The tenants were asked to fill out a 9-question survey on the characteristics of their building (See "Appendix F: Tenant Leader Survey"), and were given the option of exiting the survey, or continuing on to the main evaluation data collection instrument. Response to the survey request was lower than required. As a result, after the initial round of invitations, the SEN program managers sent a separate appeal to the tenants for their participation in the process evaluation. Of the seven tenants who answered the 9-question survey, five had signed the Declaration of Change. Of these 7, four continued on to take the main survey and three chose to exit.

Due to the low response rate, the information presented in this process evaluation report should be considered preliminary. To increase response rates and provide more reliable findings, the evaluation team has decided to review the possibility of conducting a second process evaluation survey with the tenants during the impact evaluation phase and report those results along with the energy impact report in 2014.

[11] As of July 2013, this number is 46.

Facility and Property Managers

We surveyed 32 facility managers and property managers who managed the buildings participating in Smart Energy Now. Of these, nine were facility managers, 11 were property managers, and 12 identified themselves as both the facility manager and property manager for their building. Of these 32, nine also managed other buildings in the Uptown Charlotte area that were not participating in SEN. On the whole, the facility managers in our sample were also well-experienced. 42.5% (N=17) had more than 10 years of experience (see Figure 23). Ten facility managers were employed by a property management company, 15 were employed directly by the building owner, and another six responded with “other”.

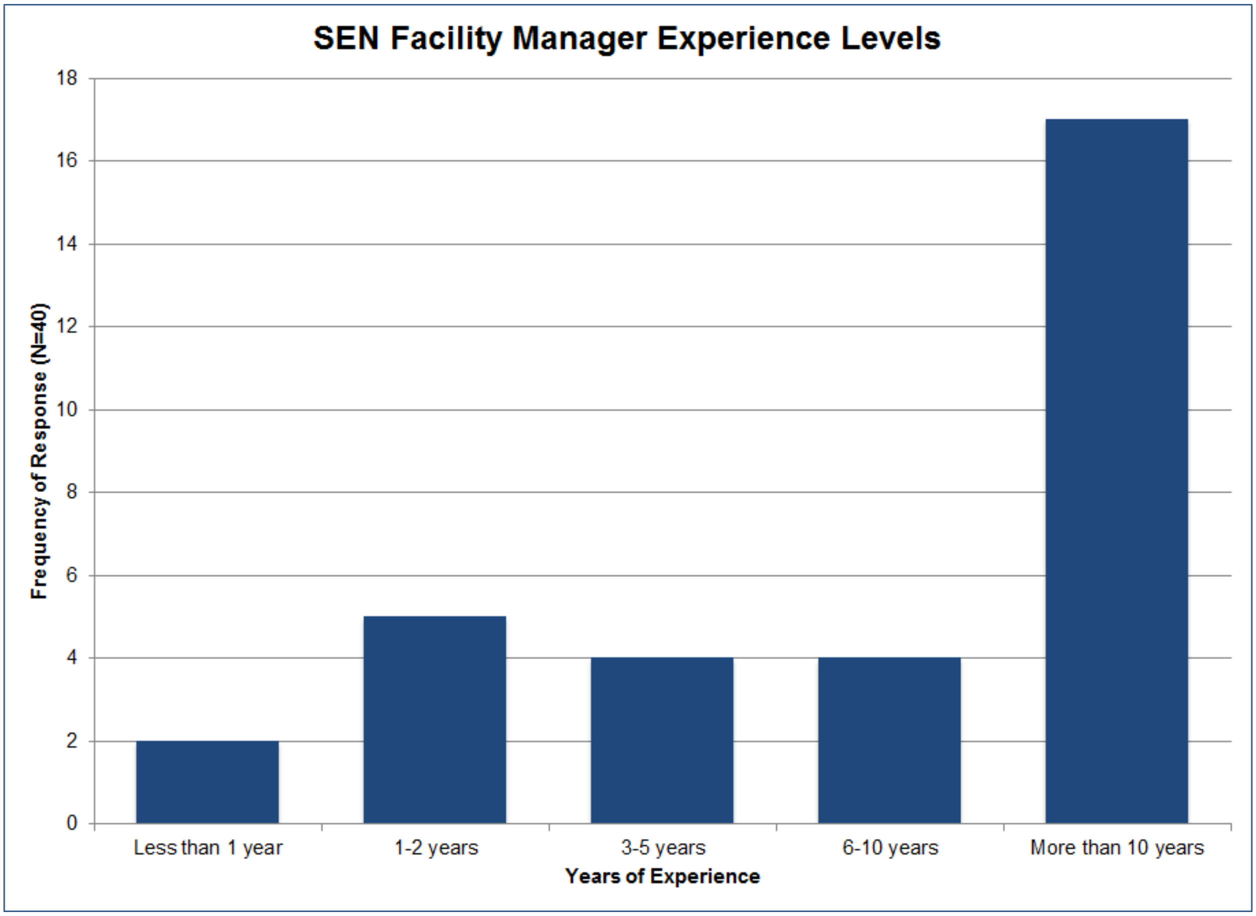

Figure 23. SEN Facility Manager Experience Levels

When asked if they were aware that their building was currently participating in Smart Energy Now, 31 of 32 respondents said “yes”, one said “don’t know”. In a follow up question, facility managers were all asked if they recalled the public unveiling of the (first) Smart Energy Now kiosk on October 28, 2011. Twenty-eight of 32 respondents said they did, four did not remember.

When asked, “What objective do you think Smart Energy Now is trying to accomplish?”, 28 respondents provided explanations that contained the following concepts (multiple responses were accepted from each person).

Concepts mentioned in their explanation of SEN's objective	Frequency of Response	Percent N=28
Energy Savings	23	85%
Generic energy efficiency objectives	9	33%
Educating tenants, building owners	7	26%
20% quantitative goal	6	22%
Uptown Charlotte	6	22%
Changing behavior/habits	5	19%
Measurement/tracking/reporting	4	15%
Mentioned Charlotte without specifying Uptown	2	7%
Water	1	4%
Avoided cost of building generation plants	1	4%
Reduce operational cost	1	4%

While all respondents seemed to understand the basic objective of saving energy, nine respondents (33%) describe SEN as a program with a generic energy efficiency objective. Most respondents agreed that they could "still do more to reduce energy use" than they are now doing (N=29 or 72.5%). Another eight felt they were doing all they could to reduce energy use (20%), while one felt he or she was doing more than necessary when it came to reducing energy use. Neither of these groups of respondents provided details on their responses when asked.

The first group of respondents was asked to provide details on what more they thought they could be doing. Of the 24 facility managers who responded, the majority mentioned a lighting or lighting controls retrofit project (N=16 or 67%), another seven (29%) mentioned an HVAC retrofit project. See Table 1 below.

Table 1. What More Could Be Done

Project Type	Frequency of Response	From % of Respondents
Lighting Retrofit/ Lighting controls	16	67%
HVAC, Chillers, Boilers, VFDs	7	29%
Monitoring, EMS, DDC	5	21%
Educate/involve tenants	3	13%
Lighting Behavior	2	8%
Operations & maintenance	2	8%
Other (e.g. going for LEED rating, efficient revolving doors)	5	21%

When asked what barriers were preventing them from doing those things, three of 20 respondents clarified that the projects were in progress and that there no barriers. Of the remaining 20, over half (N=13 or 65%) cited financial barriers, another four (20%) said their tenant or owner was not interested, and the remaining four cited issues relating to timing, technical feasibility, or staffing.

Biggest Challenges to Facility Managers and Program Managers

Because a facility manager's responsibilities cover more than just energy efficiency, energy efficiency efforts likely compete with several other priorities for funding and attention. Facility managers were asked to share what they thought their biggest challenges were. The question was worded without mentioning energy, although its placement in a survey about an energy program may have still biased responses toward discussion of energy-related issues. Over half of the 29 facility managers who responded cited lack of funding or other resources (N=15). Another five cited difficulty in maintaining tenant satisfaction and managing tenants (17%).

Challenge Type	Frequency of Response	From % of Respondents
Funding/Resources/Staffing	15	52%
Tenant satisfaction/ managing tenants	5	17%
Owners	2	7%
Maintaining old equipment	2	7%
Tenant buy in	1	3%
Staff compliance	1	3%
Parking garage lighting	1	3%
Lack of submeters	1	3%
Leasing vacant space	1	3%
Lack of time	1	3%

Perceived Interest in Reducing Energy Use

The facility managers were asked to rate their own interest in energy efficiency as well as that of their building owners and that of the tenants. Figure 24 shows the average ratings of interest, suggesting that the facility managers believe the tenants have the least interest in energy efficiency.

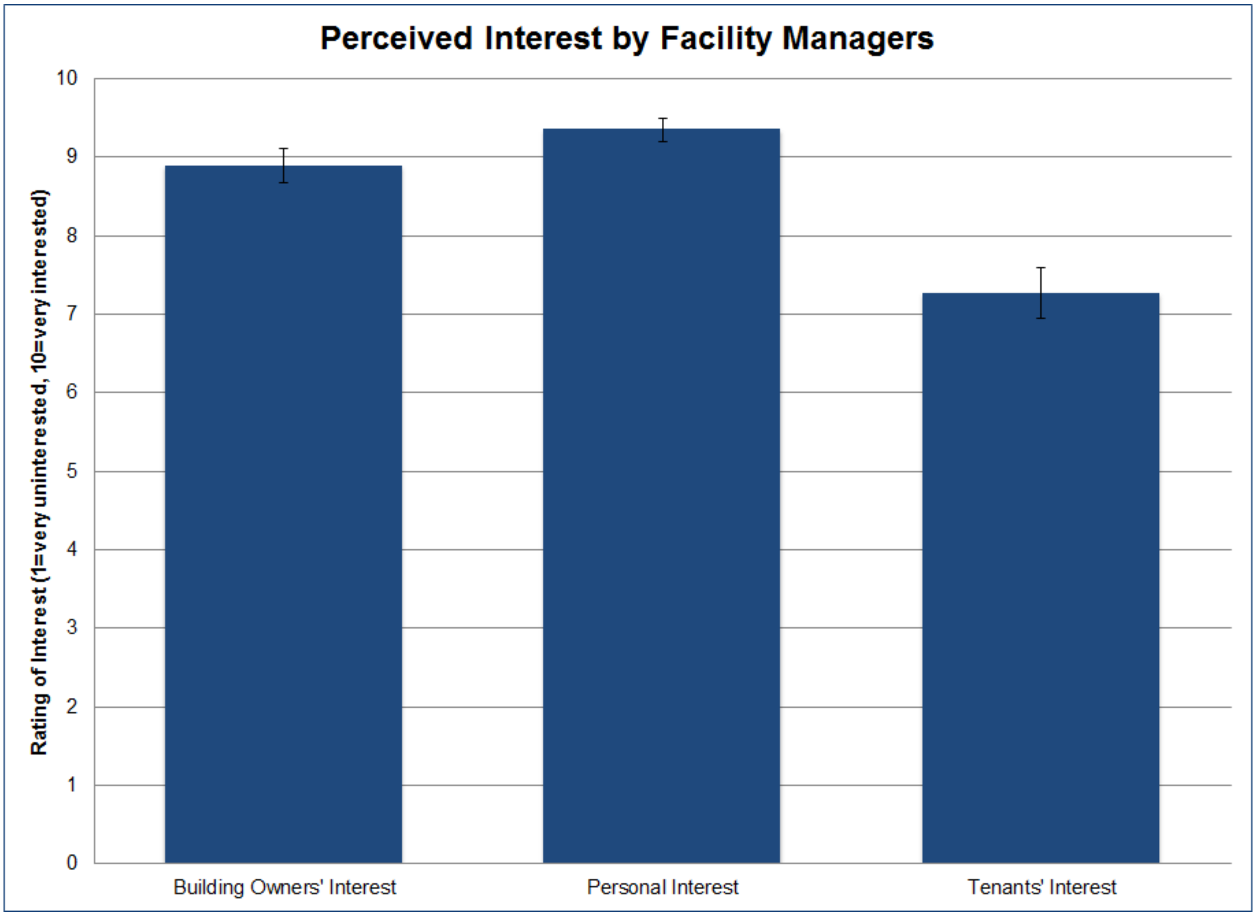

Figure 24. Perceived Interest in Energy Efficiency by Facility Managers

Energy as Percent of Budget

Thirty-four facility managers reported that on average, the electricity costs of their building take up 23% of their budget (SE=.026).

When asked if they personally received any incentive for keeping operating costs low, 32 facility managers said they did not, and two said they did. Of those who were employed by property managers, five (12.5%) reported that their property management company received an incentive for keeping operating costs low, 15 (37.5%) said no, and 3 reported they didn't know.

The facility managers' financial constraints have caused them to defer maintenance (N=13, or 32.5%), and defer energy efficiency projects (N=17 or 42.5%).

Decision-Making

Most of the facility managers have a decision-making role in new equipment purchases: 24 (60%) report that they are part of a team that makes decisions, another three (7.5%) reported they had the authority to make a final decision, while the remaining 11 (27.5%) said they were able to make recommendations but did not make the final decision.

The importance of energy efficiency in new purchase decisions

When asked about the importance of energy efficiency as a criterion for new equipment, all 38 of the respondents said that energy efficiency was moderately to extremely important (See Figure 25). When asked whether energy efficiency considerations have become more important in their building's decision-making process, however, 34 facility managers indicated only slight agreement (mean rating of 3.59, SE = .12, where 1 = strongly disagree; 2 = disagree; 3=neither disagree nor agree; 4 = agree; and 5 = strongly agree).

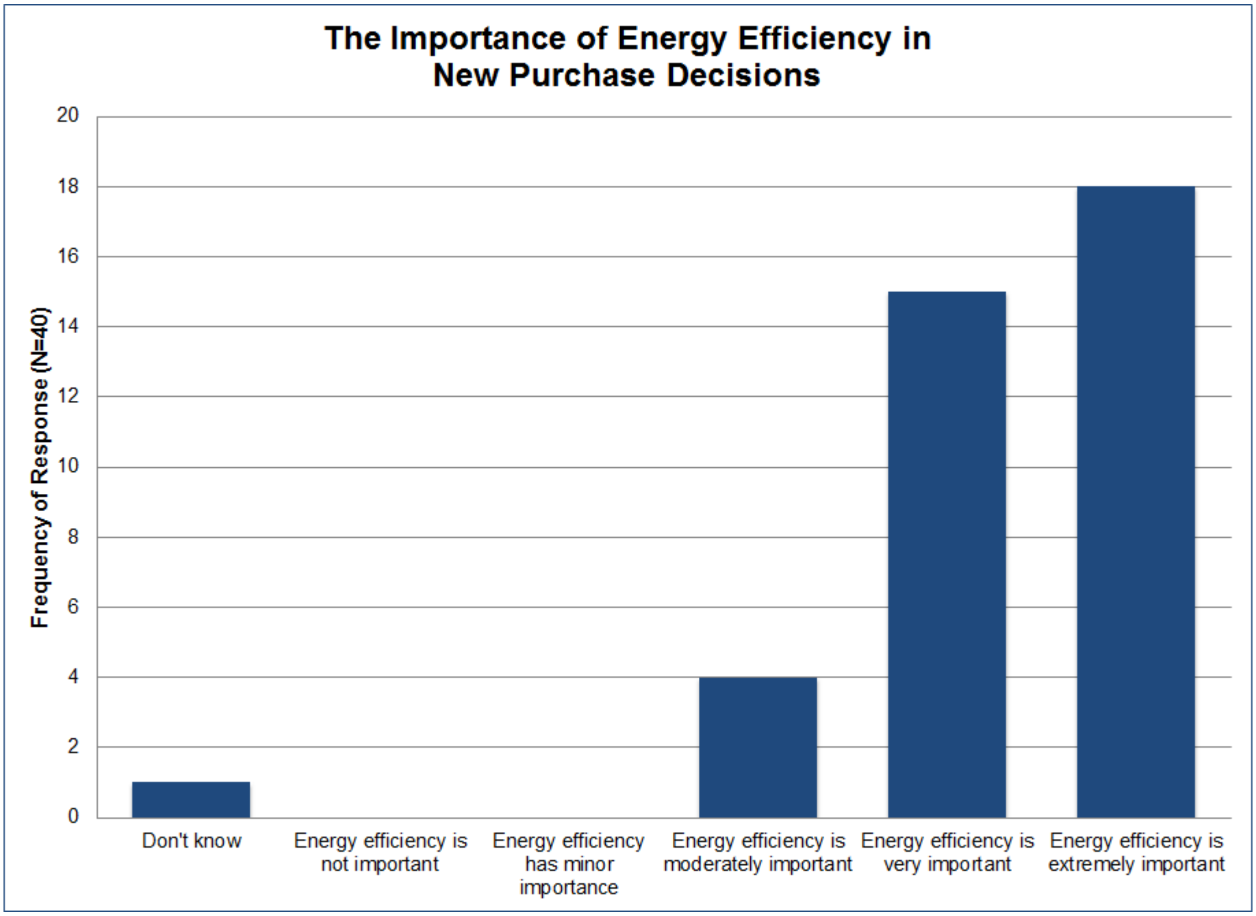

Figure 25. The Importance of Energy Efficiency in New Purchase Decisions

The importance of lifecycle costs in new equipment purchases.

When asked whether there was any consideration for life cycle costs during decision making, most facility managers said they were equally important (N=23 or 57.5%), but 25% (N=10) of the other facility managers said that decisions were made primarily on lifecycle costs, whereas only three said decisions were made primarily on initial costs (7.5%).

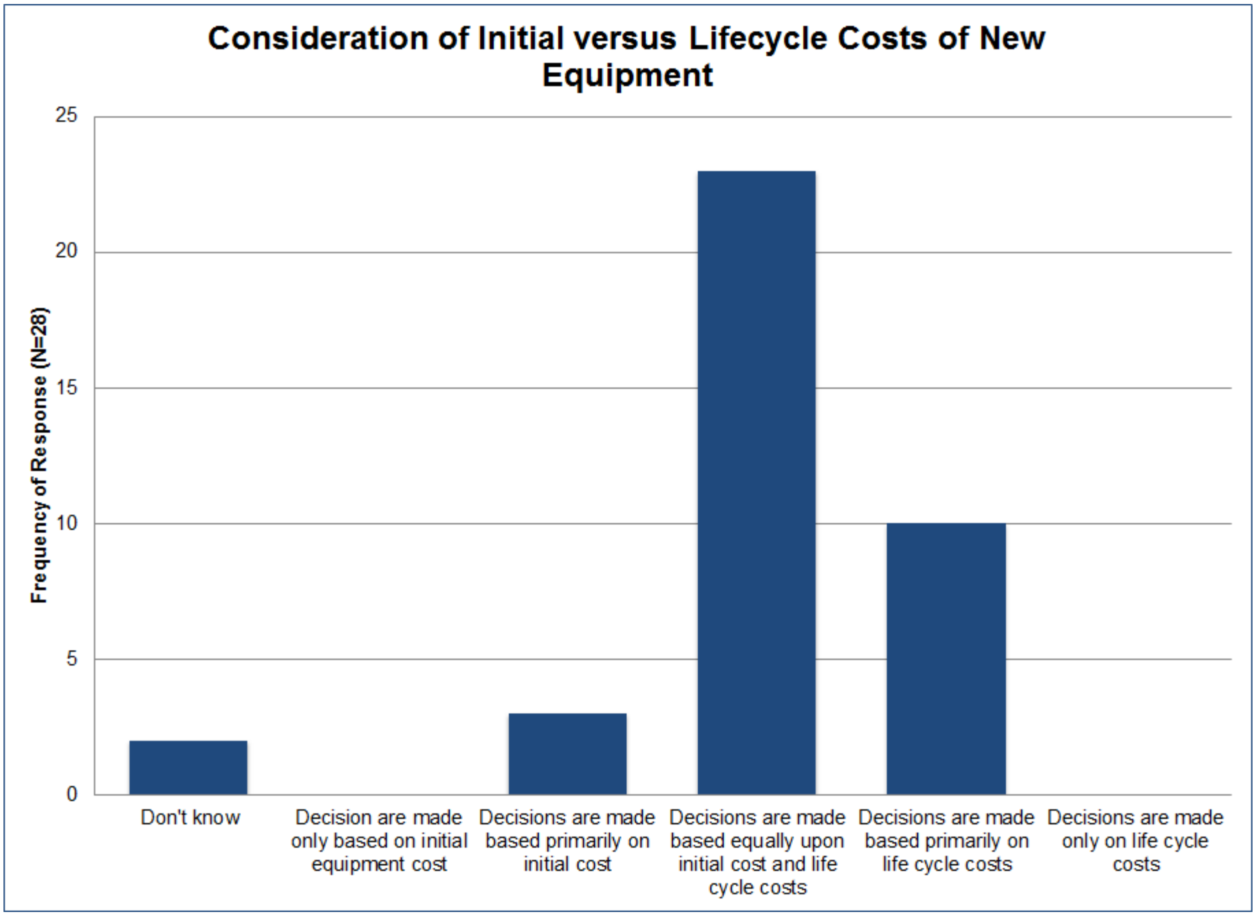

Figure 26. Consideration of Initial versus Lifecycle Costs of New Equipment

Town Halls

Smart Energy Now conducted one meeting with property owners and property management in January of 2012, and three Town Hall meetings with facility and property managers in 2012. These meetings were facilitated by the Charlotte branch of U.S. Green Building Council (USGBC) North Carolina, who also wrote a whitepaper after each meeting event to summarize the proceedings. See “Appendix G: Town Hall Whitepapers”. This was a successful partnership by both accounts. The SEN program manager said that “Our charge is to create the environment for robust conversations at these Town Hall sessions,” but also added, “The real fun part of this in my opinion was that we did this in partnership with USGBC.”

The January session was targeted to owners and high-level company management, presenting the business case for energy efficient operations. They discussed government regulations, tax incentives, and presented case studies of what has worked for other major companies across the country as well as their return on investment. They presented data on the top 10 most-frequently implemented projects, and wrote a summary of this event in a whitepaper.

Town Hall 1 – NASCAR Hall of Fame, March 15, 2012

The three Town Hall sessions were held at various buildings throughout Uptown Charlotte. The first Town Hall was held on March 15, 2012 at the NASCAR Hall of Fame. The agenda included a round table. During the round table, participants were given time to share their best practices in managing energy use in small groups, with questions around which to center the discussion. The director of the USGBC Charlotte chapter reports, “That was a wonderful event. They appreciated the opportunity to share what has worked and not worked in their buildings, specifically around energy efficiency improvements.” See “Appendix G: Town Hall Whitepapers” for a whitepaper summarizing the discussions and presentations from each of the three Town Halls. At each of these Town Halls, participants were given a written survey in which they could make suggestions for the next Town Hall agenda.

Town Hall 2 – Bank of America Conference Center, June 21, 2012
The second Town Hall was held on June 21, 2012, at the Bank of America Conference Center. The format of the second Town Hall was one in which presentations were made on topics that were solicited during the first Town Hall.

Paul Ehrlich of Building Intelligence Group made the keynote presentation. His presentation addressed how to take recommendations from an energy audit, develop a business case, and bring that to upper management.

There were two tracks of presentations, one oriented toward those who had not made any energy efficiency improvements, and another for those property managers who were more advanced. The resulting audience was approximately 60% beginners and 40% advanced. The first track included presentations on energy accounting and benchmarking, understanding utility rate structures, and life cycle costs. The second track included presentations on energy audits, how to train your team to do internal audits, audit scorecards, what an outside auditor should provide and what to do with those recommendations.

The Director of Smart Energy Now gave an update on SEN activities, including recent efforts to have tenants sign SEN’s Declaration of Change. The Declaration of Change is a non-legal, non-binding document in which the tenants express their commitment to lead by example and engage employees “to take action by supporting and passing on the message.” (See “Appendix E: Declaration of Change”).

A project manager from Duke Energy also gave a presentation on the Compass Tool, emphasizing the benefits of using the tool for both the building manager as well as for SEN’s purposes of tracking energy usage.

Town Hall 3 - Duke Energy Tower, November 8, 2012
The third Town Hall returned to the roundtable format and was held on November 8, 2012 at the Duke Energy Tower. The primary focus of this Town Hall was a training presentation made by Performance Systems Development on the use of the Compass Tool. The attendees were taught ways in which data used by the Compass Tool could be useful to the individual property managers as well as to Duke Energy.

The discussions were centered on questions designed to encourage sharing of each facility managers’ experience, including, “Do you have examples of energy efficiency improvements undertaken in your buildings?” and “What is the financial justification for energy efficient improvements?”

USGBC also presented a building recognition program to celebrate the energy savings achievements of SEN participants. This building recognition program was designed to use Compass data from the months of February 2012 through February 2013[12].

Town Hall Facilitation
The Town Halls were facilitated by USGBC and drew upon the expertise of a number of vendors and subject matter experts. The North Carolina chapter of USGBC entered into an information partnership with Smart Energy Now to educate property managers and property owners. USGBC's mission is "to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life." According to the executive director, "We wanted to engage in this partnership because the market of existing commercial buildings and operating more efficiently is part of our mission." This partnership has been collaborating since the fourth quarter of 2010 and has been working well by all accounts.

One of USGBC's key roles is to assist Smart Energy Now in organizing the Town Hall sessions. The USGBC helped to determine the content, found presenters, facilitated the meetings, and facilitated conversations between the participants at the meeting. Afterward, USGBC helped document the outcomes of those meetings for inclusion in communications shared with the SEN network.

USGBC reported that they also worked with IFMA at Duke Energy's suggestion, utilizing IFMA's expertise to find the best ways to target the audience of property managers, facility managers, and engineers.

In addition to the Town Hall meetings, the USGBC developed the building recognition system mentioned above, intended to culminate with a luncheon in the spring of 2013. The executive director reported that were looking at the percentage improvement of each building's performance against a baseline. They do not plan to reveal the amount of energy savings achieved, but will recognize those buildings that have excelled, as well as recognize any outstanding facility engineers, property managers, and property engineers, based upon nominations from their peers.

Lessons Learned
The Town Hall at the Bank of America Conference Center was open to people outside of the Smart Energy Now contact list. The executive director reported that a number of vendors came to the meeting for networking purposes, which meant that there were fewer people from their target audience in attendance to learn the information that was intended to be shared.

USGBC also learned that participants seemed to get more out of the interactive sessions. The roundtable sessions were conducted at the first and third property manager Town Halls, while the second Town Hall was structured as a presentation with question and answer sessions. The

[12] On May 3, 2013, after these evaluation interviews were concluded, Smart Energy Now and USGBC held a ceremony recognizing the top three buildings in three square-footage size categories with recognition of their achievements. According to the announcement on the SEN website blog, they only used data for a three month period instead of the year-long period originally planned. http://blog.smartenergycharlotte.com/2013/05/03/building-recognition/

executive director believed that the biggest success of the Town Halls was the opportunity for the property manager and facility engineers to interact with one another to share common efforts, contacts, and resources. In addition, the Town Halls gave them a clear understanding of their role within and potential contribution to Smart Energy Now.

One of the original designers of SEN also agreed on the value of the round tables, “The first time we got them all together, I thought they all knew each other. [But] a lot of them don’t know each other; they never talk to each other.” He reported that when one of the large banks was asked if they minded that another company implemented the same activity, the bank said, “This is not about competition, this is about the greater good.” This designer believed the Town Hall offered an opportunity for collaboration and learning between big and small buildings.

In our sample, only ten facility managers had attended a Town Hall meeting. Due to this small sample size, the findings we report may not represent the actions of the larger facility manager population. The facility managers who attended a Town Hall were asked for suggestions on how future Town Halls might be improved. There was only one suggestion, “Might be nice if contact info was provided so more networking can take place.”

Likes and Dislikes

When asked what they liked about the Town Hall meeting, seven facility managers said they liked the networking (N=3), the updates on the SEN program (N=2), and learning new ways to save energy (N=2), and one said they liked that it was targeted toward facility managers. Furthermore, the facility managers reported that there was nothing that they disliked about the Town Hall meetings.

Audits

Audits were one of the key activities promoted at the Town Hall meetings. Facility managers were asked if they had conducted an audit as a result of the Town Hall, 10 (25%) reported they did conduct an audit but it was not due to SEN’s influence, another 20 (50%) reported they did not conduct any audit at all, and two or three each of the remaining respondents said they had conducted a Level 1, Level 2, or Level 3 energy audit[13]. Of those who had conducted an audit, 11 were planning or had begun to implement the recommendations.

Compass Tool Training

PSD, the developer of the Compass Tool, was asked to conduct a couple of training sessions on the use of the Compass Tool. PSD reports that the response to training has been varied: some building owners are very excited by what they can do with the tool, while others never showed up for the training even though they had enrolled. To address this lack of training, PSD reports that Duke Energy has hired an additional staff member in January 2012 with whom PSD has conducted “very extensive training” and who can help train additional people.

[13] These are the different levels of energy audits according to the ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Handbook. Level I consists of a walk-through assessment; Level II consists of an energy survey and engineering analysis; Level III consists of a detailed analysis of capital-intensive modifications.

PSD believes that a large factor in Compass Tool training's reach is the size of the buildings, with the larger buildings more likely to have the engineers on staff who are interested in energy and can understand the data and its implications.

The Compass Tool includes the capability for the user to enter "building events." PSD explains that there are two types of events to be entered. One was an adjustment to the occupancy, the other was a change in space characteristics. In the Town Hall sessions, SEN program staff explained that entering these building events would allow SEN to calculate accurate energy savings.

PSD reports that there were some building managers who had been actively using their EPO (Energy Profiler Online) accounts and they had been updating EPO regularly with space occupancy. These users were able to send their EPO data to Duke Energy and Duke Energy then updated the Compass Tool. An SEN program staff member explained that the energy displayed on the Compass Tool would take into account any updates to the building's space characteristics.

PSD believes the building event capability in Compass Tool has been underused: "I don't think that part of things got used very much…It's voluntary, so I don't know if it's that meaningful [to the building managers]."

Survey Results

In the evaluation survey, of the 12 facility managers who received Compass Tool training, five had been trained at one of the Town Hall meetings, and another two went to a training class. The remaining facility managers received training via phone, by reading a document, by attending a citywide PowerPoint presentation, and one received training on site (at a Duke Energy building). The usefulness of the training, however, was questionable. On a scale of 1 (extremely not useful) to 10 (extremely useful), 17 facility managers gave an average rating of 6.0 (SE=.582). When asked "What could have been done to make the training more useful?", only two facility managers provided suggestions, both mentioning that the training was generic:

- "During the training, the tool availability was sporadic with missing data (system was new and still had some software / hardware glitches). Training was very general."
- "It shouldn't have been a Generic Citywide PowerPoint Presentation. The training should have been done on an individual building basis."

Compass Tool Usefulness

On the same scale, respondents were asked to rate how useful the Compass Tool was to them. Eighteen facility managers rated it a 6.11 (SE=.61). When asked for suggestions on improving the usefulness, four facility managers responded with the following:

- "Email me the info."
- "Improve the training, make it easier to access and put the Compass Tool on the kiosks."
- "It seems to be more of a tool for Duke Energy to track what we are doing than a tool for us, as end users, to utilize for the building."
- "More training and training that is specific to the building."

When asked whether they agreed that the Compass Tool helped them understand their building's energy usage, 30 facility managers responded. Eleven of them (35%) responded saying they didn't know. Of the remainder, they gave an average rating of 3.84 (SE=.12), on a five point scale where 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = agree. These findings conflict slightly with the earlier rating of the Compass Tool's usefulness reported above.

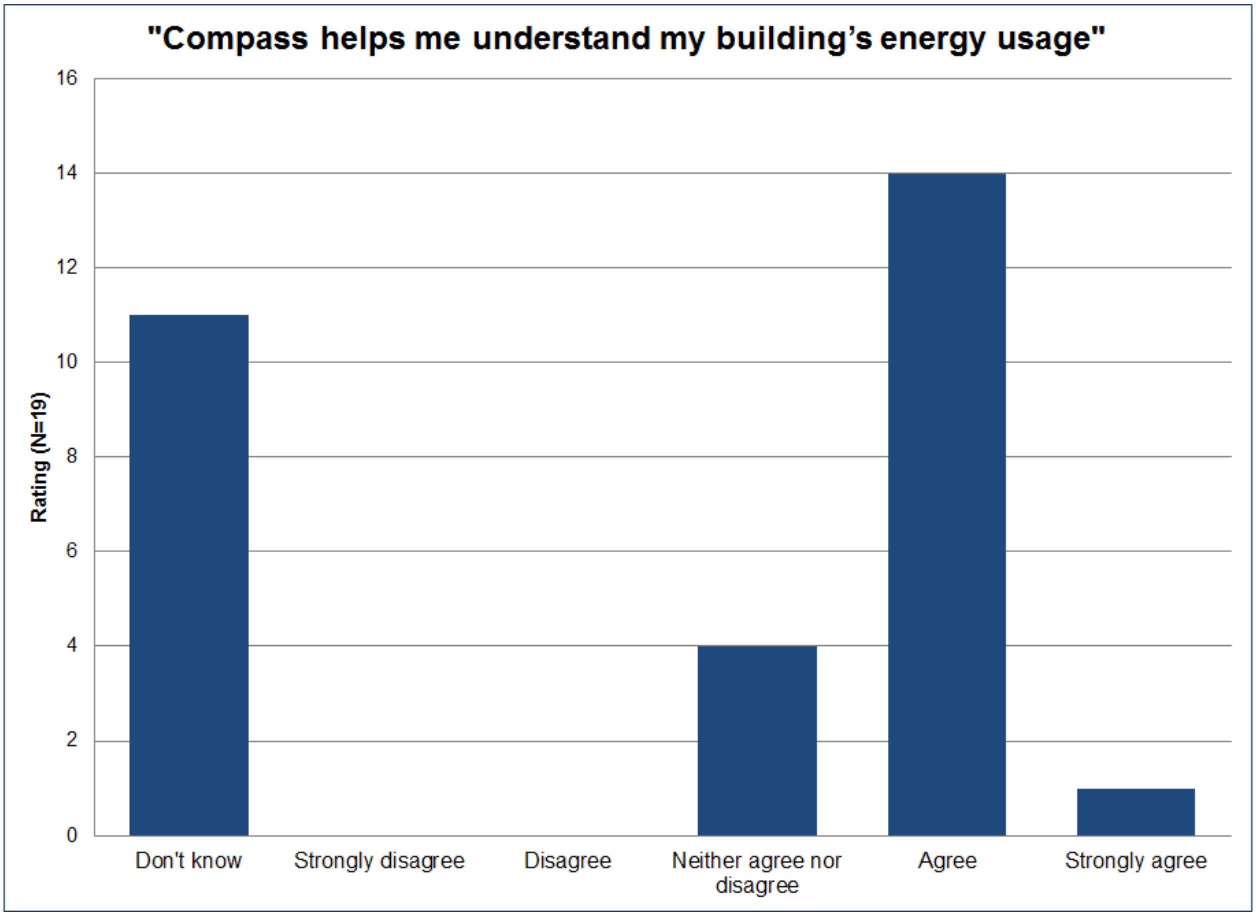

Figure 27. Compass Tool Usefulness

Frequency of Compass Tool Use

The Compass Tool was also not widely used by those in our sample. Of the 30 respondents, 23 (57.5%) said they did not use the Compass Tool at all in the last month. Four (10%) used it once or twice, one facility manager said he or she used it three to five times, and the remaining two did not know. When they did use the Compass Tool, 19 facility managers said they used it to review the building's energy usage, another three said they used it to review the building's energy savings, and only one said he or she entered a change in number of occupants. See Figure 28 below.

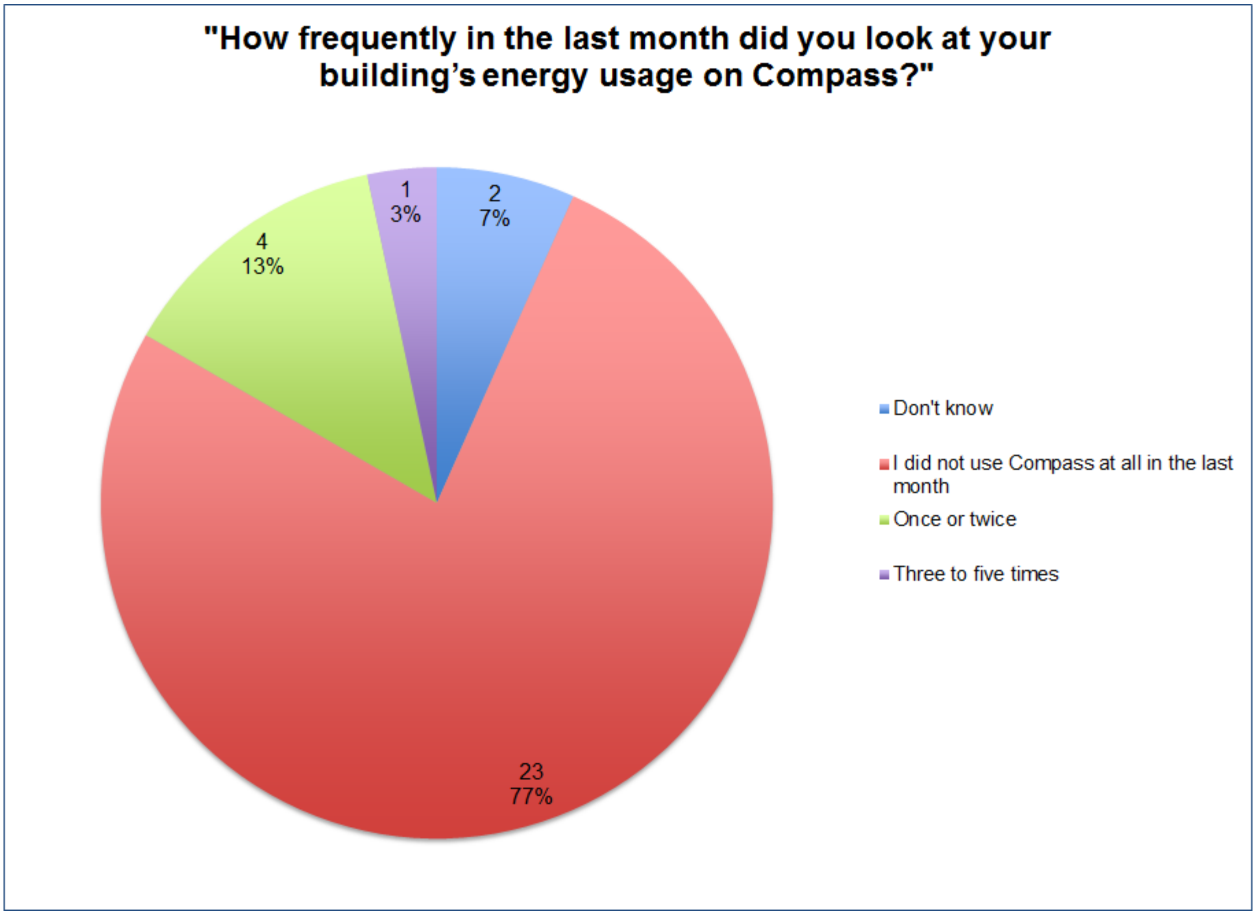

Figure 28. Frequency of Checking Building Energy Usage

When asked to rate the user-friendliness of the Compass Tool on a scale of 1 (extremely unfriendly) to 10 (extremely friendly), 18 respondents provided an average rating of 6.89 (SE=.56), indicating it was acceptable. There were no suggestions on how to make it more user-friendly.

Barriers to using the Compass Tool

The Compass Tool was also designed to help track events that might affect a building's energy usage, such as the implementation of a behavior-change program or a change in the building's occupancy. However, the weak link in this feature is that someone must enter the information. When the evaluation team requested a list of "events" that had been entered, we found that there had only been two entries made, out of approximately 60 participating buildings.

The survey also included a closed-end question, "Is there another way you prefer to share events with Smart Energy Now?", with three options for sharing events. Eighteen respondents said "No". Ten respondents chose "Yes, I would prefer that someone periodically emails me a reminder (such as once a quarter) to enter events on Compass". The remaining four respondents chose "Yes I would prefer that someone periodically emails me asking about events, and I can just 'reply' to the email".

Respondents were then asked: "What are some of the reasons why you think you are not looking at the building's energy use on Compass more frequently?" Multiple responses were accepted. The most popular response was simply that they didn't have the time to log in (N=11 or 31%), followed by three categories of responses that all boiled down to the lack of a need for the Compass Tool: eight facility managers (23%) had another tool they used, another five (14%) said they just used the monthly invoices to track energy usage, and another five (14%) who said they didn't need to track building energy usage.

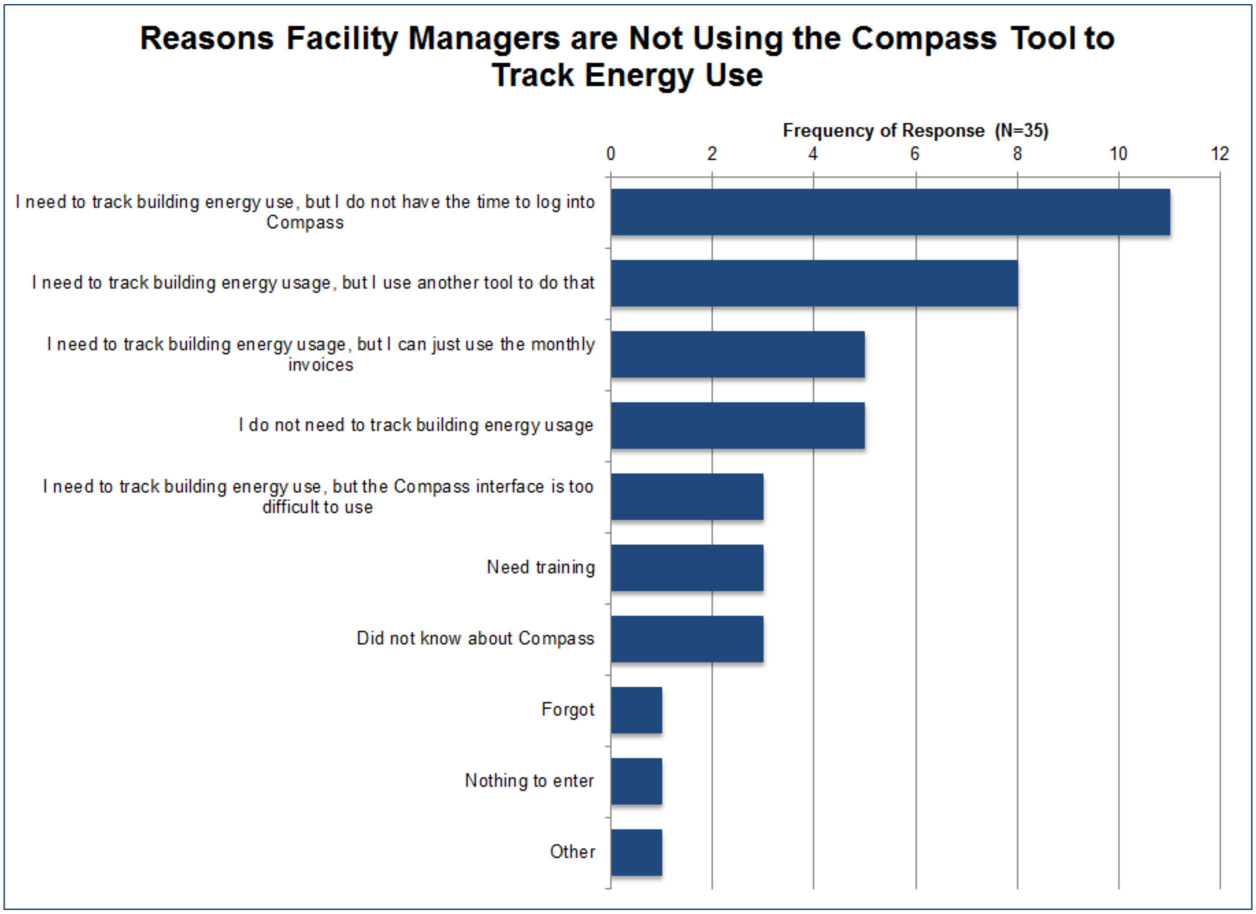

Figure 29. Reasons Facility Managers are not Using the Compass Tool to Track Energy Use

One possible reason the facility managers were not using Compass Tool could be that they were using Duke Energy's Energy Profiler Online (EPO). We investigated this, but found that the majority of facility managers in our survey didn't know what EPO was (9 or 22.5%) or have not used EPO (16 or 40%). Only 3 facility managers said they have used both and prefer EPO, while only one said they preferred the Compass Tool.

When asked if there was anything Duke Energy could do to make the Compass Tool more useful, only 13 facility managers offered suggestions. Five of those suggestions were requests for training. Two of the 13 respondents reported they had never used the tool, and another three said they had no suggestions.

There are several main themes that clearly emerge from across all the feedback from the facility managers: 1) Facility managers need more training on how to use the Compass Tool, 2) While facility managers agree that the Compass Tool can show them the building's energy use, they do not require use of the Compass Tool specifically in order to get building energy use information, and 3) Facility managers do not have the time nor perhaps the interest to use the Compass Tool to help SEN track its progress. From the responses we gathered, it seems to the evaluation team that while the Compass Tool offers cutting-edge technology, it may be offering more than the facility managers need.

> RECOMMENDATION: Duke Energy should examine the degree of need and the perceived value of the Compass Tool from the customer's perspective. The assessment should focus on identifying the needs and wants of facility managers and on understanding how (if at all) building usage data is being used to support the formulation of actions to reduce energy use or to track savings being achieved. Following this assessment, Duke Energy should determine if the Compass Tool should be 1) maintained going forward (supplemented by more training, perhaps), 2) replaced with something more appropriate for SEN participants based upon their stated needs and wants, or 3) not used at all.

Perceived Reduction in Energy Use

The facility managers also have greater visibility into the building's energy use than the other populations we surveyed. We took this opportunity to ask them whether they thought their building had increased or decreased its energy usage, since October 28, 2011 when Smart Energy Now launched.

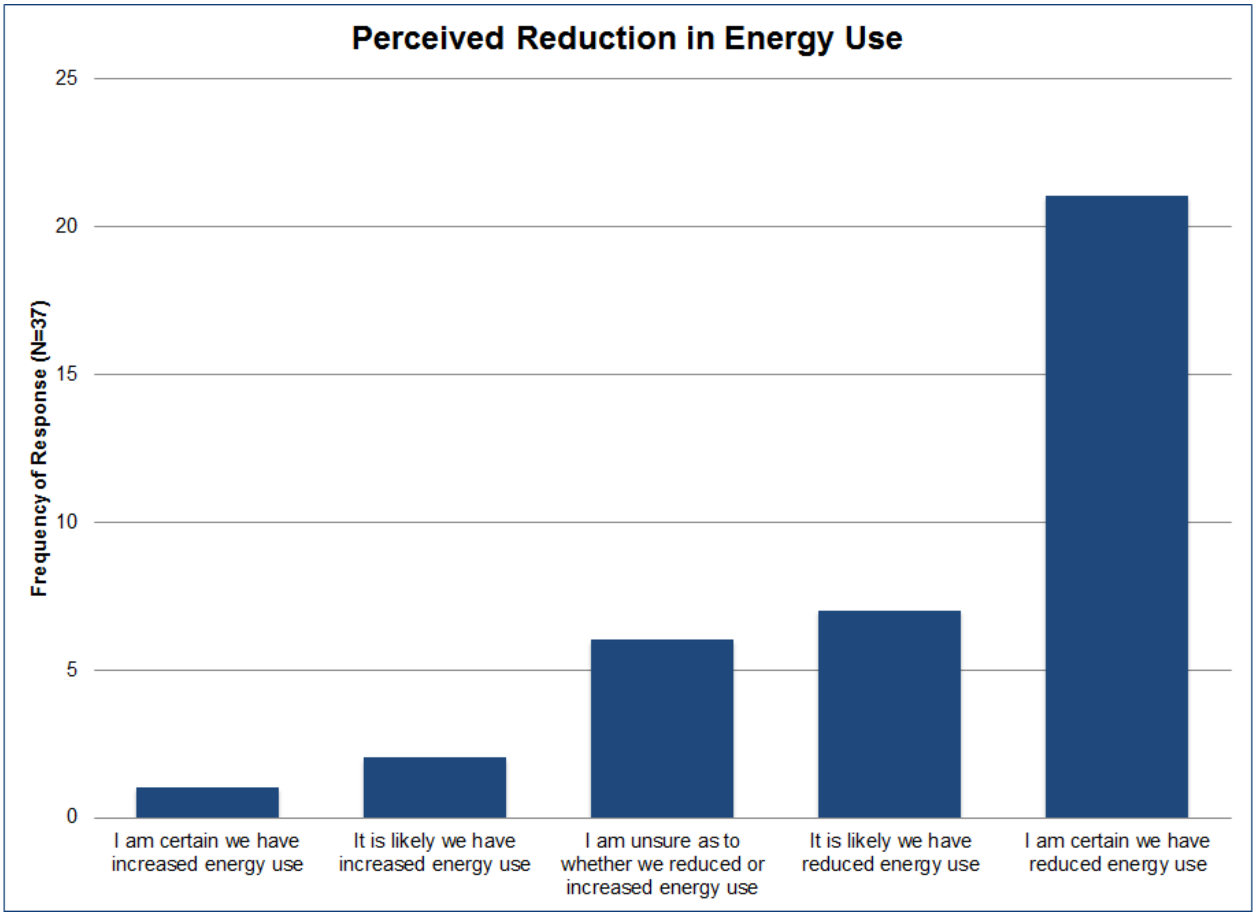

Figure 30. Perceived Reduction in Energy Use

Figure 30 above shows very clearly that the majority of the facility managers believed their building had successfully reduced energy use.

SEN Likes and Dislikes

The facility managers didn't have many responses when they were asked "What is the worst part of the Smart Energy Now program?" As might be expected, the most frequent response was lack of time to participate in the program (4 of 18, or 22%). The second most frequently mentioned aspect of SEN is the kiosk, with three facility managers saying this was the worst part of SEN:

- "We were over promised on the kiosk capabilities. We thought the kiosk would be more interactive and work like a smart phone. It is primarily an electronic billboard."
- "The kiosk is not yet building-specific."
- "Not a huge supporter of the kiosks, not utilized much by building occupants from what I can tell."

Overall Satisfaction Ratings

The facility managers were asked to provide overall satisfaction ratings on Smart Energy Now's effectiveness in helping to identify potential areas in which to save energy, with 1 meaning "very dissatisfied" and 10 meaning "very satisfied". Figure 31 shows that SEN was perceived as being moderately effective in identifying areas in which to save energy (Mean = 7.44, SE = .22). Likewise, SEN was perceived to be moderately effective in helping to achieve an energy reduction in the building (Mean = 7.41, SE = .21). Facility managers' satisfaction with Smart Energy Now overall was slightly higher (Mean = 7.81, SE =.21), but not as high as their overall satisfaction with Duke Energy (Mean = 8.46, SE = .22).

Figure 31. Facility Managers' Overall Satisfaction Ratings

Other SEN Pilot Activities

There are a number of other efforts that were initiated by Smart Energy Now as part of their process of refining their program offerings.

Gamification with UNCC

The University of North Carolina Charlotte (UNCC) was one of the early partners of Smart Energy Now, and remains a part of Envision Charlotte. UNCC had a role in a number of projects. The first was an analysis of the communications infrastructure with the smart grid. The second project was to develop a way to normalize building usage data within the urban environment. The third project involved the development of a game interface for helping people engage with Smart Energy Now through the development of a social network and community.

UNCC completed the first task, and part of the second task before the SEN team realized that more input was needed. The challenge of the second task was to provide a solution that was useful (and detailed enough) for the data analysis and while still not compromising the privacy of the individual building owners and tenants so that it could be made available to the public. As the Dean of the Computer Science Division explained, “They felt they needed more input from other groups that were involved in SEN in order to complete this. I think they needed to bring more expertise in.”

The third task was a “Farmville” type social network game, where players earn a form of currency by taking action with respect to energy. With the points, players could plant a garden, share aspects of those gardens with other people, and work together. UNCC reports it was intended to be played mostly on the web or a smart phone.

Although SEN eventually decided the game was not suitable for their purposes, UNCC is also planning to use some of these games and tools with Envision Charlotte. UNCC is working on a follow-on project beyond Smart Energy Now to develop a sustainability modeling system. This system would not only include energy usage, but also transportation, water usage, and air quality. This model would extend beyond the Charlotte Uptown area in order to include a representation of where people live and how they travel to Charlotte’s Uptown.

UNCC reports that their collaboration with SEN has led to other opportunities. “One advantage of working with Duke Energy and Smart Energy Now is that we could come up with a strategy that was a broader strategy for reaching a community.” UNCC reports they have submitted a couple of proposals for external funding. One of these proposals is to the National Science Foundation with Envision Charlotte as a partner. “If we get this we will be developing capabilities that will be [useful on] the large touchscreen and in engaging people. Two problems [that we will address] are retaining engagement, and then being able to analyze what the social interactions are.”

Building Diagnostics and Fault Detection Pilot

SmartCore describes that at the beginning of SEN, the discussion of how to use Smart Grid data included some building automation ideas, because Cisco also manufactured switching architecture and security appliances. Smart Energy Now (still known as Envision Charlotte back then), was initially conceived to first provide live aggregated data to visually show how much energy the building was using, and then to use that data in building automation applications. SEN included a pilot program to develop applications to perform building diagnostics and fault detection. SmartCore had a central role in the design of the architecture necessary for building automation, and they successfully completed the planned scope of work for building automation pilots at two of the early-launch SEN buildings in Uptown Charlotte. SmartCore believes that the building automation pilots' success did not immediately lead to adoption at other buildings simply because of the economic conditions at that time, but believes it is the natural next step to leveraging the data infrastructure that was created by SEN.

Another one of the original implementers of the fault detection pilot reported that one of the original buildings participating in the pilot, who chose not to continue at that time, has now engaged his company to continue that work. This implementer reports, "I think SEN might have helped, it got them interested. We were not quite there yet [back then], but they were excited. They could see the potential." An SEN program staff member reports that the pilot was completed and presented to the Commission in 2012.

Analysis of Participation in Comparable Cities

Methodology

We compared the participation levels in four Duke Energy energy efficiency programs (Residential Smart $aver® HVAC, Residential Personalized Energy Report® (PER), Non-Residential Smart $aver Custom, and Non-Residential Smart $aver Prescriptive) between the Charlotte metro area and other Duke Energy territories over 2011 and 2012. The results for PER indicate possible effects of the SEN program on participation, and are reported in this section. The results of the analysis for the other three programs do not indicate a significant effect of SEN on participation; these analyses are found in "Appendix H: Comparing Program Participation for Residential Smart $aver HVAC and Non-Residential Smart $aver".

The geographical definitions of comparison groups are summarized in Table 2 below, and lists of cities that define the three metropolitan areas in the Carolinas are included in "Appendix I: Lists of Cities Used to Define Geographic Comparison Areas". Note that state-level groups only include the Duke Energy territory in those states.

Table 2. Definitions of Duke Energy Territories Used for Comparisons

Territory	Definition
Charlotte	Service address in city of Charlotte, NC
Metro excluding Charlotte	Service address in metro Charlotte (including part of SC) excluding city of Charlotte – see Appendix I: Lists of Cities Used to Define Geographic Comparison Areas
Metro Charlotte (total)	Combination of Charlotte and Metro excluding Charlotte (the entire MSA[14])
Cincinnati	Service address in city of Cincinnati, OH
Metro excluding Cincinnati	Service address in Ohio excluding city of Cincinnati, plus all service addresses in Kentucky
Metro Cincinnati (total)	Combination of Cincinnati and Metro excluding Cincinnati (all Duke Energy territory in OH and KY)
Greensboro/Winston-Salem	Service address in city of Greensboro, NC and city of Winston-Salem, NC (the two largest cities of "The Piedmont Triad")
Metro excluding Greensboro/Winston-Salem	Service address in metro Greensboro/Winston-Salem excluding cities of Greensboro and Winston-Salem – see Appendix I: Lists of Cities Used to Define Geographic Comparison Areas
Metro Greensboro/Winston-Salem (total)	Combination of Greensboro/Winston-Salem and Metro excluding Greensboro/Winston-Salem (the entire Piedmont Triad MSA)
Greenville	Service address in City of Greenville, SC
Metro excluding Greenville	Service address in metro Greenville excluding city of Greenville – see Appendix I: Lists of Cities Used to Define Geographic Comparison Areas
Metro Greenville (total)	Combination of Greenville and Metro excluding Greenville (the entire MSA)
Indiana	All Duke Energy territory in IN
Remaining Carolinas	All Duke Energy territory in NC and SC, not including the Metro totals for Charlotte, Greensboro/Winston-Salem and Greenville (i.e., all Duke Energy territory in the Carolinas which is not in one of the three

[14] MSA = Metropolitan Statistical Area, as defined by the U.S. Office of Management and Budget.

	comparison markets)
All other Carolinas	All Duke Energy territory in NC and SC, excluding the Metro Charlotte Total (same as Remaining Carolinas plus totals for Metro Greensboro/Winston-Salem and Metro Greenville)
All Other Duke Energy territory	All Duke Energy territory in IN, OH, KY, plus NC and SC excluding Metro Charlotte Total
All Carolinas	All Duke Energy territory in NC and SC (*including* Charlotte Metro Total)

The Challenge of Finding Comparable Markets

There are limited points of comparison for Charlotte within Duke Energy territory, since there are very few comparably large cities that are serviced by Duke Energy. The other major metropolitan area serviced by Duke Energy is Cincinnati, OH (including a portion of Kentucky congruent to Cincinnati), which also has a metropolitan area of about two million people, and similar levels of daytime commuting into the city center.[15]

Table 3. Comparing Charlotte to Cincinnati

	MSA pop	city pop	daytime commute pop increase	workers who live & work in city
1. Charlotte, NC	1,795,500	751,000	21.2%	82.2%
2. Cincinnati, OH	2,130,000	297,000	31.0%	60.4%

The next-largest metropolitan area in Duke Energy territory is the "Piedmont Triad" in North Carolina, which includes the two mid-sized cities of Greensboro and Winston-Salem. Unlike the Charlotte metro area, which is dominated by a single city center, this metro has two central cities of about equal size (250,000 people apiece).

Table 4. Comparing Charlotte to Greensboro/Winston-Salem (The Piedmont Triad metro)

	MSA pop	city pop	daytime commute pop increase	workers who live & work in city
1. Charlotte, NC	1,795,500	751,000	21.2%	82.2%
2. Piedmont Triad (Greensboro + Winston-Salem)	*1,603,000*	*499,600*	*26.3% **	*75.5% **

**Commuting and workers stats for Greensboro by itself (not including Winston-Salem).*

As of the writing of this report, there are no other metro areas in Duke Energy territory with populations of over one million people. The next-largest metro area in the Duke Energy territory in the Carolinas is Greenville, SC. Though the total metro area has more than a half-million people in it, the central city has a population of under 100,000 and different commuting patterns than a larger city like Charlotte.

[15] Daytime commuter population increase and workers who live and work in the city are taken from City-Data.com. MSA and city populations taken from Wikipedia.

Table 5. Comparing Charlotte to Greenville

	MSA pop	city pop	daytime commute pop increase	workers who live & work in city
1. Charlotte, NC	1,795,500	751,000	21.2%	82.2%
2. Greenville, SC	653,000	90,900	97.3%	56.1%

In addition to population and other city characteristics that make comparisons between Charlotte and other metropolitan areas in Duke Energy territory difficult, there are other factors that may explain differences between markets that are not included in this analysis. These would include climate and seasonal temperature variations, as well as other geographic differences between different areas of North America. A related factor would be the differences in building structures, materials, ages, and sizes that would be expected between markets in different geographies with different climates. Because energy efficiency often requires the investment of resources, differences between local economies may be another confounding factor. Finally, there are state and program-level factors which can be identified, but whose effects cannot necessarily be quantified for analysis (the five states included in this analysis have different regulatory environments, and therefore different program schedules and promotions).
Although metro-to-metro comparisons are provided in this report, we feel that the most relevant measure of the potential effect of Smart Energy Now is the comparison of program participation growth rates over the years 2011-2012 between the Charlotte Metropolitan Total and the category defined in Table 2 as “all other Carolinas” (all Duke Energy territory in North and South Carolina except for the Charlotte Metropolitan total). Relative to other comparisons, this minimizes the confounding factors of state and program-level effects as well as some of the geographic and climate factors (by limiting the comparisons to only programs and customers in North and South Carolina).

Comparing Program Participation: Residential Personalized Energy Report (PER)

Figure 32 shows participation levels in the PER program in Charlotte compared to other Duke Energy territories. While participation almost doubled in the city of Charlotte (+84%) and also grew in the larger Charlotte metro area (+9%), participation fell by -11% in the Carolinas outside of the Charlotte area. However, participation in this program outside of the Charlotte metro tripled in 2012 (+200%).

This extreme growth in participation outside of the Charlotte area (from 30,000 participants in 2011 to 90,000 in 2012) is due entirely to this program being launched in Indiana: participation in this state was zero until 2011, then in 2012 the program acquired 77,943 participants in Indiana alone, dwarfing the simultaneous loss of almost 15,000 participants in Ohio and Kentucky. (Participation totals by year and geography are listed in Table 11).

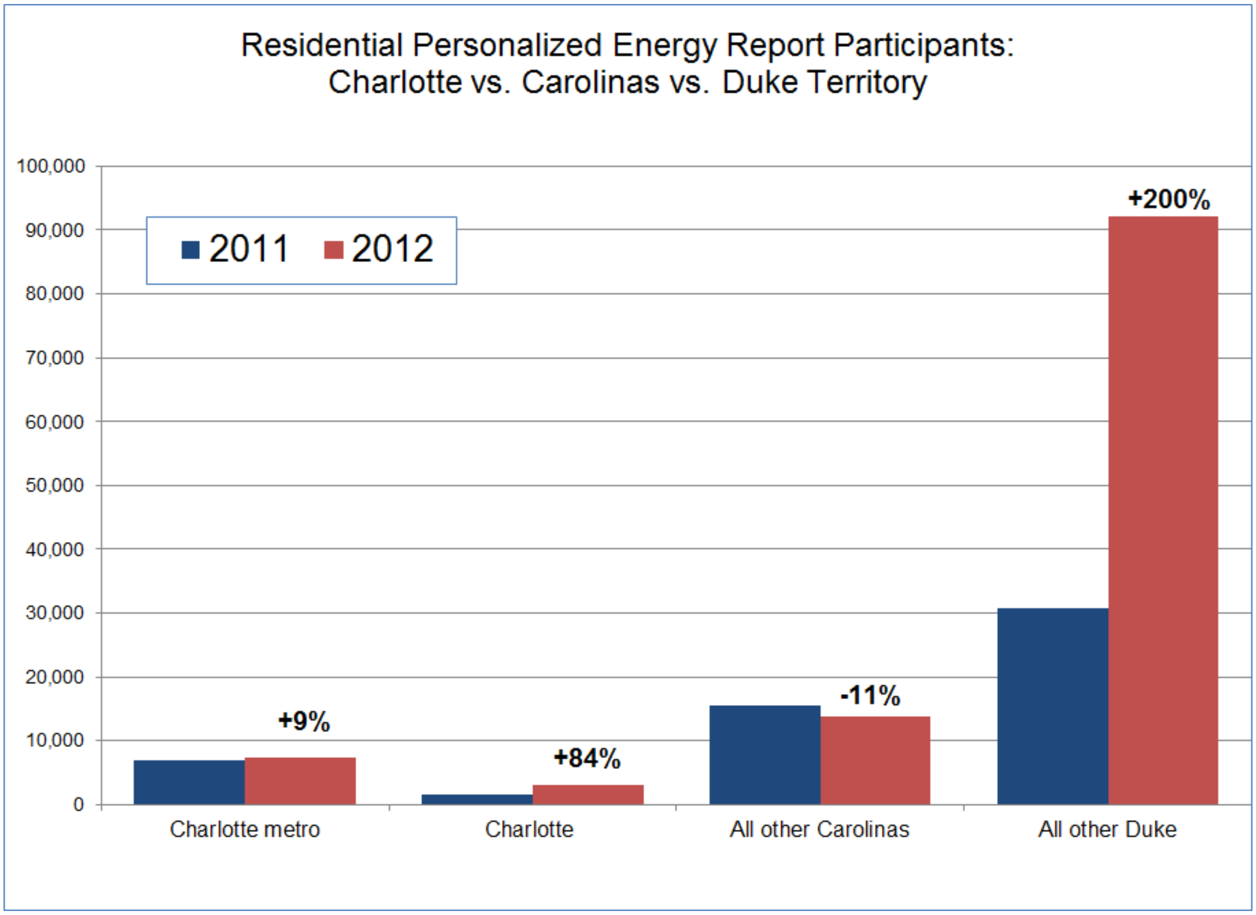

Figure 32. Residential PER Participation: Charlotte vs. Carolinas vs. Duke Territory

Figure 33 shows that while PER participation in Charlotte (+84%) and the surrounding metro (+9%) has grown since 2011, the program in the Cincinnati area (i.e., Duke Energy's Ohio and Kentucky territory) all but stopped in 2012. Although the program had not ended in these states during the period of this evaluation, by 2012 it was not being promoted and the program no longer included the offer of free CFL bulbs. Overall participation in the Cincinnati metro fell by 98%, and fell by 100% in the city itself (there was only one participant listed for Cincinnati in 2012, down from 1785 in 2011).

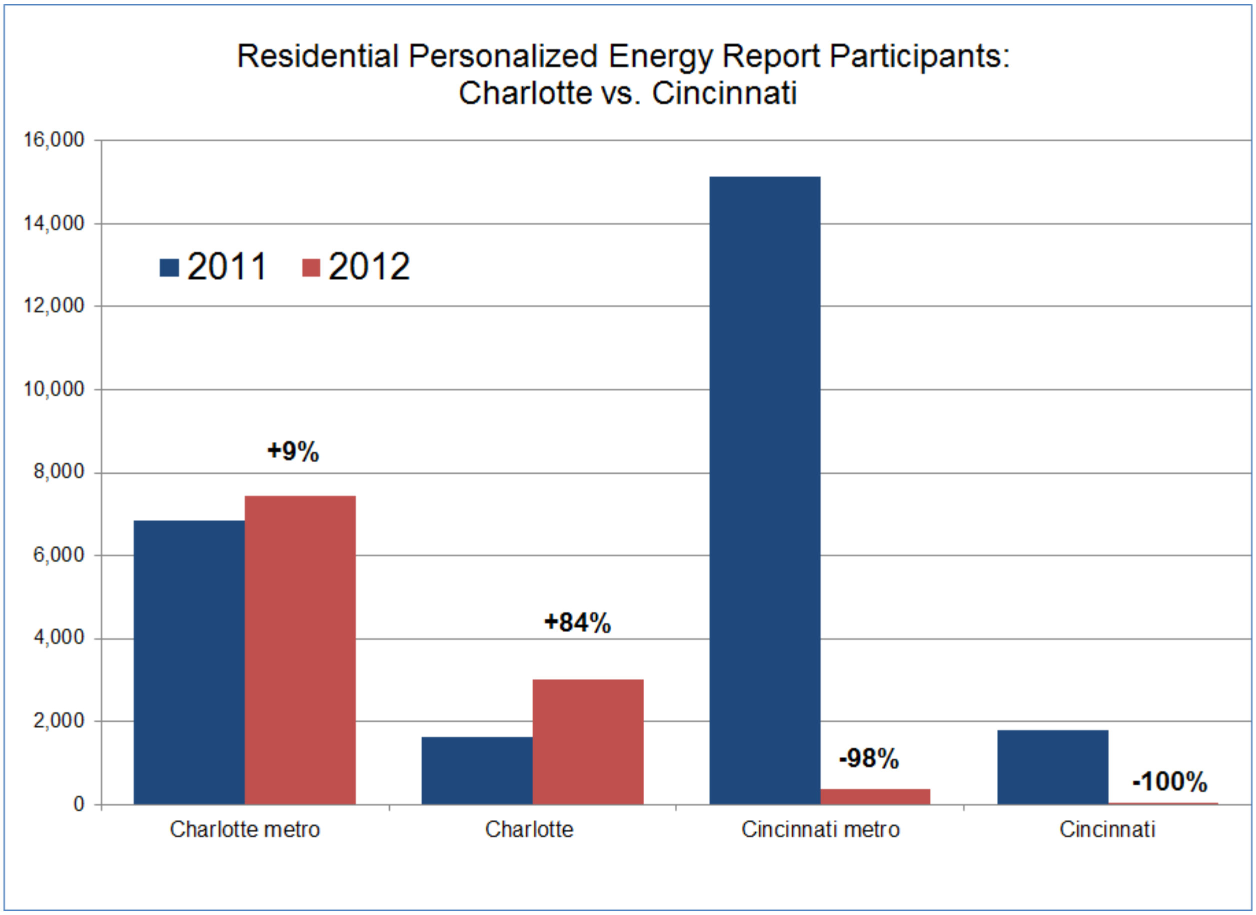

Figure 33. Residential PER Participation: Charlotte vs. Cincinnati

PER participation in Charlotte is compared to the Greensboro/Winston-Salem market in Figure 34. While participation climbed +17% in the cities of Greensboro and Winston-Salem, during the same period participation grew +84% in the city of Charlotte. When the entire metropolitan areas are taken into account, participation in the Charlotte metro grew +9% while in the Greensboro/Winston-Salem area it fell by -9%. Across all the Carolinas (including Charlotte), participation was down -5%.

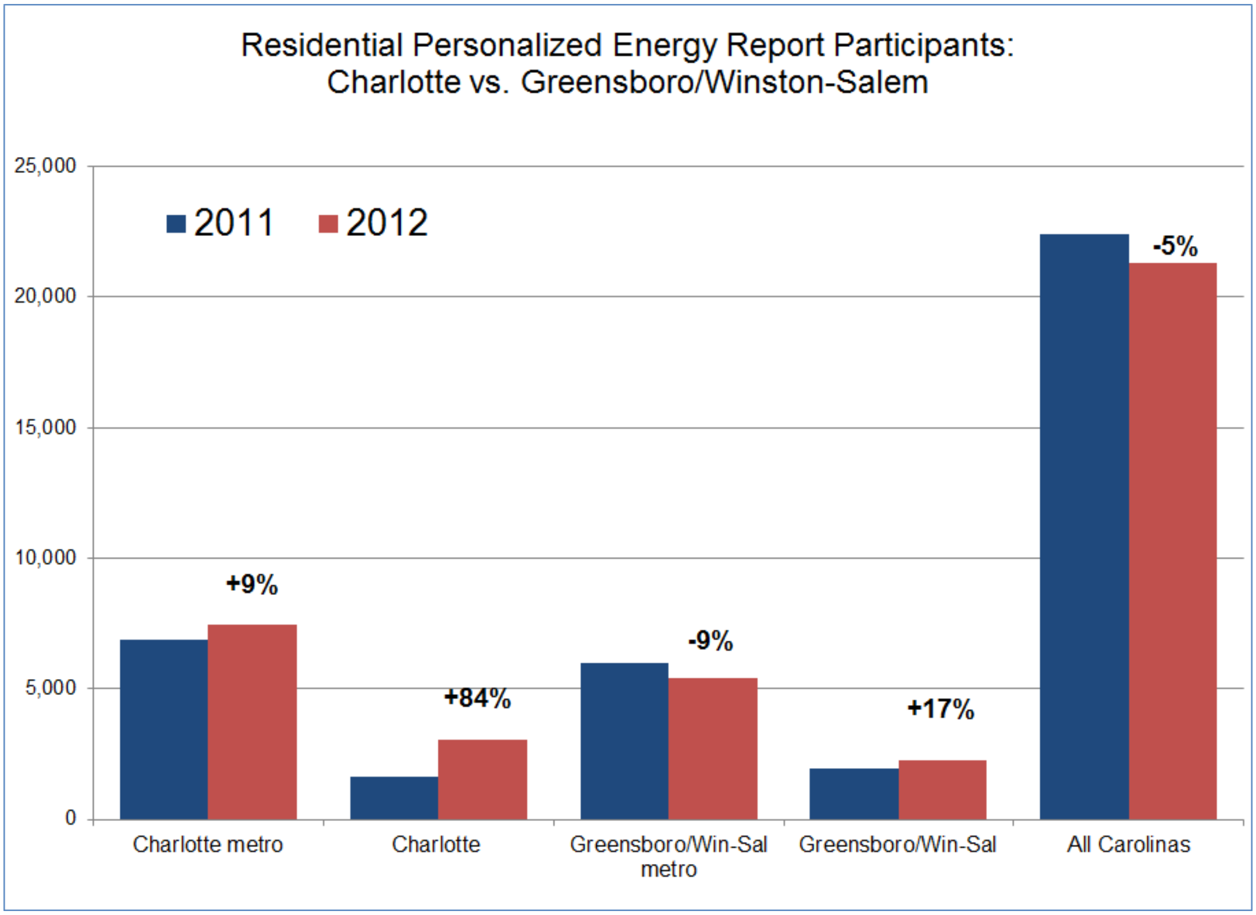

Figure 34. Residential PER Participation: Charlotte vs. Greensboro/Winston-Salem

Figure 35 compares the PER program in Charlotte with Greenville, SC. Participation in Greenville fell in 2012, down -37% in the city and -18% for the whole metropolitan area, while participation in Charlotte grew (+84% city, +9% metro).

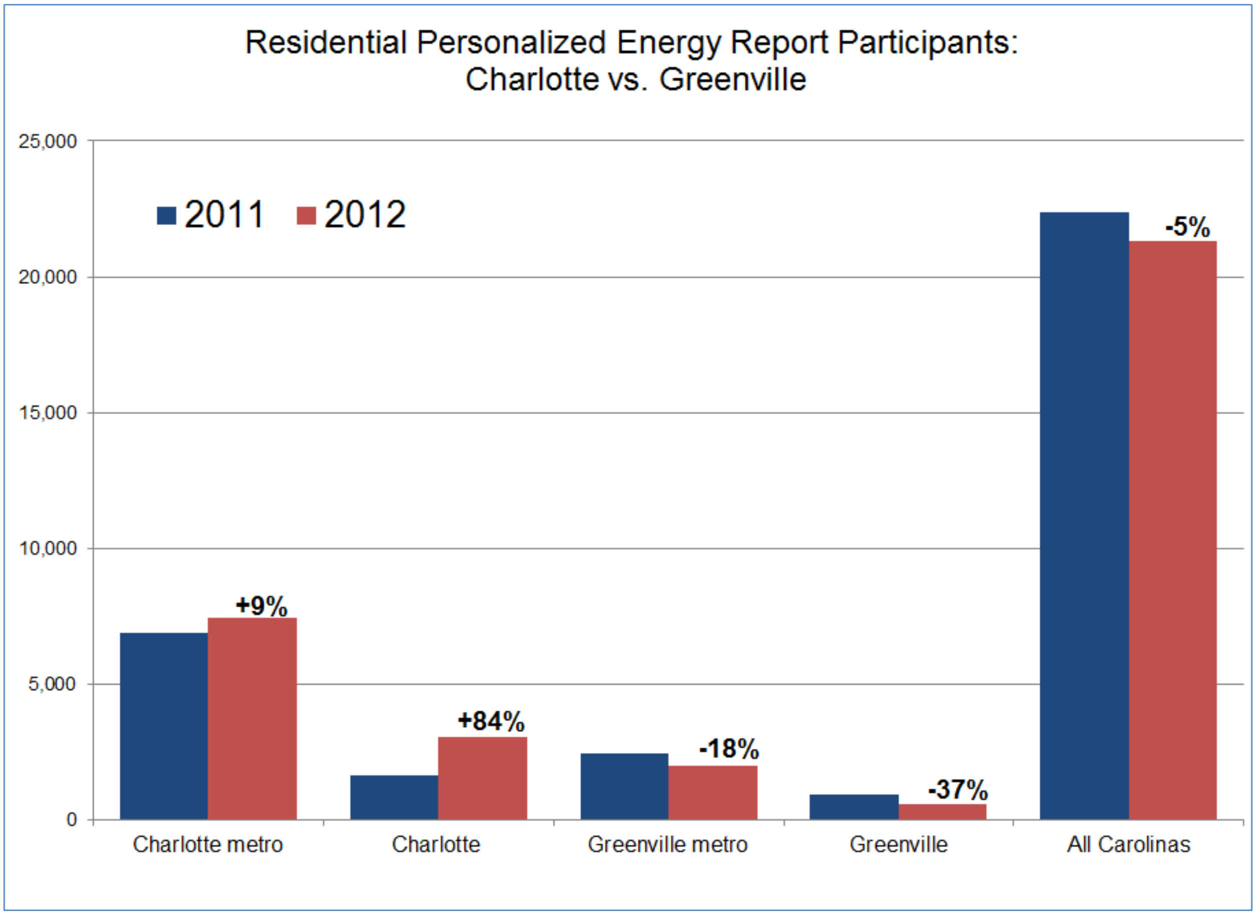

Figure 35. Residential PER Participation: Charlotte vs. Greenville

Table 6 shows the statistical significance levels[16] of the rates of change in this program from 2011 to 2012, comparing the Charlotte metropolitan area with the other Duke Energy territories as seen in the preceding charts in this section. Since there is a very large number of participants in this program (nearly 100,000 total households in 2012 with several thousand in the Charlotte area), every difference between Charlotte and the comparison groups is highly significant: participation in Charlotte grew in 2012 while it fell in the rest of the Carolinas, including Greensboro/Winston-Salem and Greenville. The steep decline in participation in Cincinnati and steep increase in participation in "all other Duke Energy" territory are due to program-level decisions (sunsetting the program in Ohio and Kentucky, launching it in Indiana) and do not reflect natural growth of the program in these regions.

However the +9% increase in the Charlotte Metro is significantly better than the -11% decrease in "all other Carolinas", indicating a possible correlation between Smart Energy Now and enrollment in PER. There was at least one causal link between SEN and PER, in that the Smart Energy Now section of the Duke Energy website included a link to enroll in PER. According to Google analytics provided by Duke Energy, during the 15-month period from October 1, 2011 to December 31, 2012 this link to PER was visited 524 times with average length of time spent on

[16] The statistical test used in all tables that compare the rate of change between Charlotte metro and other markets is Pearson's chi-square for 2-way effects (log-linear contingency table analysis).

the site between one and two minutes. It is also probable that some unknown number of people in the Charlotte area may have visited the Duke Energy website via the front page (or some other portal) driven by curiosity about Smart Energy Now, and some number of these may have enrolled in programs. However, there are not any web analytics available to measure this second potential source of program enrollment driven by Smart Energy Now. It is also possible that some customers may have called customer service numbers driven by curiosity about Smart Energy Now, but we do not have data about this potential driver of program participation either.

Because participation in Charlotte grew significantly faster than comparable areas in the Carolinas, and there was at least one direct causal link (the PER link on the SEN website), Smart Energy Now may have been a significant factor driving enrollment in the PER program in the Charlotte area.

However, any potential energy savings from the PER program which may have been driven by Smart Energy Now are not being claimed as savings from the Smart Energy Now program, since we cannot separate the amount of PER savings that may be due to Smart Energy Now from other PER savings that are not due to Smart Energy Now.

Table 6. Residential Personalized Energy Reports (PER): Significance Tests

Residential PER	Change from 2011 to 2012		
	Comparison market	Charlotte metro	Significance level
All other Duke Energy	200%	9%	p<.01
All other Carolinas	-11%	9%	p<.01
Cincinnati metro	-98%	9%	p<.01
Greensboro/ Winston-Salem metro	-9%	9%	p<.01
Greenville metro	-18%	9%	p<.01

Participation numbers for the PER program across all Duke Energy territories 2009-2012 can be found in “Appendix J: Total Program Participation in Four Duke Energy Programs 2009-2012”.

Summary

It is clear from our evaluation that Smart Energy Now is a groundbreaking program, both in its technological innovations and in the types of relationships that Duke Energy has formed with its commercial sector customers. Through our surveys, we found that SEN participants had a clear understanding of Smart Energy Now's objectives. Participants are actively engaged, taking energy savings actions that they attribute to SEN's influence, and they agree that more can be done. Building occupants have a very high interest in reducing energy use in the workplace. Facility managers not only agree that SEN has helped them to identify ways to save energy, but in equal measure credits SEN with helping them to achieve energy savings, a noteworthy finding as it is much easier to identify than to achieve energy savings. With the program less than a year and a half old, these achievements can be considered significant movement towards SEN's objective of 3%-5% energy savings through behavior changes in the workplace.

On the whole, the Smart Energy Now community of allies, partners, and stakeholders firmly supports the program's objectives and are eager to find more ways to engage. One key to SEN's success is the degree to which SEN encourages participants to customize their own engagement experience. However, not all participants have the time to devote to the customization process, and may not find the current pre-designed campaigns to be suitable to their office culture. SEN could achieve even greater success by allocating some resources to developing more pre-designed campaigns for this population. That said, SEN's success with the individual campaigns may be significant. We say "may be" because SEN's success with the campaigns cannot be documented with the current methods of campaign tracking. This is a lost opportunity for Smart Energy Now. The inability to evaluate or assess the success of a campaign begins with the inability to identify which campaigns were used in which buildings. What we do know is that over half of the building occupants surveyed believed that the option of creating their own campaigns is "critically important to the success of Smart Energy Now," and that the majority of Energy Champions who launched their own campaigns considered it to be one of the activities most worth recommending to other Energy Champions. The story we would like to tell is one where Smart Energy Now can document the number of offices that are running campaigns, which campaigns they are running, and how many people are being influenced by these campaigns. Given the engagement that we have seen via this evaluation, we expect these campaigns to be reaching a considerable percentage of the Uptown population. The SEN program managers are aware of this need and have begun to track the campaigns more diligently, though the tracking still cannot support estimation of energy savings from behavior. The criteria for how well the campaigns are being tracked for Smart Energy Now are not arbitrary criteria: the bottom line is that these data need to support the estimation of energy savings due to behavior change. At the time this report was being written, Smart Energy Now's campaign tracking is not sufficient for that purpose.

The design, development, and use of the kiosks to engage with the Uptown community has evolved over time, but is and continues to remain one of the primary approaches employed by the program to share progress toward SEN's energy goal via live energy usage data. From our process evaluation findings, it is not clear that the kiosks' effectiveness thus far has warranted this stature. The biggest need expressed by the different populations we surveyed was a need to see what energy savings have been achieved, not just live energy usage information or energy saving tips. Kiosk observers want information to compare what they are doing with an energy use baseline so that they can understand their accomplishments in energy savings terms rather than energy consumption terms. We note that after we conducted our surveys, Smart Energy Now did introduce to all but two of the kiosks the ability to see energy usage of other buildings. This change is moving in the right direction toward greater specificity, but it does not yet allow the user to understand accomplishments. We agree with the Smart Energy Now program managers' expectations that this new information is at least part of what is needed to increase building occupants' interest in saving energy, because the kiosks will display their building's consumption in comparison to others. However, SEN is a behavior-change program and participants want to see savings as a result of their behavior changes.

SEN has in many ways moved the state-of-the-art of behavior-change programs substantially forward. The program is accomplishing its primary objective of changing behaviors to reduce energy use. It is engaging the Uptown community in ways that can be expected to lead to substantial energy savings. The program has designed, developed, and deployed innovative approaches for engaging the community and motivating them to act. From a process evaluation perspective, the program has been a substantial success. The degree to which the success of SEN has resulted in energy savings will be addressed in the energy impact evaluation to be completed in 2014, after the energy use data for the summer of 2013 can be collected and evaluated.

Appendix A: Program Development Partners Interview Guide

Note: this is a general interview guide. The actual questions and discussion will focus on the primary development efforts appropriate for each interviewee.

Name:____
Title:____
Company:____

1. Would you please tell me your role within your company and what your daily responsibilities are?
2. Would you please tell me, what was your role with Smart Energy Now's development?
3. What was the timeframe of your work with Smart Energy Now?
4. What was your objective, or scope of work, on the SEN project?
5. Who else was involved in reaching this objective? Who else was on the team?
6. During this development time, how frequently did you communicate or interact with Duke Energy on this project?
7. Is there anything you would change about the interaction between Duke Energy or others and your efforts during this period?
8. What would you say was the <u>major</u> challenge in meeting your SEN-associated objective? Was there another challenge to meeting your objective?
9. How were these challenges addressed? What was the outcome of this challenge on program design or operations?
10. What would you suggest could be done to anticipate these kinds of challenges in the future?

For Developers of Training/Educational Materials	For Developers of Technology
11. What were the major concepts you wanted to convey with the materials you developed?	12. Would you please tell us the ways in which your work drew upon "tried and true" concepts versus innovative concepts?
13. What techniques or methods did you choose to use to present these concepts? Why did you choose these particular techniques as opposed to others?	14. Why did you decide on this approach to meeting your objective?

15. What techniques did you initially consider, but later chose not to use, and why?	16. What other approaches did you initially consider, but later chose not to pursue? And why?
17. Who was involved in make those decisions?	18. Who was involved in make those decisions?

19. What would you say was the biggest success coming out of your work with Smart Energy Now?

20. What are the applications for the future?

21. Have you followed the activities and achievements of Smart Energy Now after your engagement or your scope of work was completed?
    a. Yes
    b. No

22. If Yes, was the output of your scope of work being used as you had intended?
    a. If no, what should Smart Energy Now do differently in order to obtain full benefit from your work inputs and ideas?
    b. If yes, is your work product having the effect on the program's achievements that you had intended?

23. If another client asked you to help with the design and development of a program similar to Smart Energy Now, are there any lessons learned from your work on Smart Energy Now that you would share with your new client, to improve the process of program design and development?

Appendix B: Occupant Survey Instrument – Phase 1

Survey responses will be kept confidential, and the only identifiers that will be used are for internal purposes of tracking of who has completed the survey.

Info: This will be kept confidential by the independent evaluation team and used only for internal tracking purposes.

1. **What is the name of the company for which you work?**:

   ____

   What is your email address?:

   ____

2. **What is the name or street address of the building in which you work?**

( ) 101 Independence Center
( ) 129 W Trade St
( ) 200 N College
( ) 200 South Tryon
( ) 222 S Church St
( ) 223 N Graham St
( ) 400 S Tryon
( ) 402 W Trade St
( ) 500 S College
( ) 525 North Tryon Building
( ) 526 S Church
( ) Ally
( ) ATT Plaza
( ) Bank of America Corporate Center
( ) Bank of America Plaza
( ) BBT Center
( ) Carillon Building
( ) Carol Belk Children and Family Services Center
( ) Charlotte Chamber of Commerce
( ) Charlotte Mecklenburg Government Center
( ) Charlotte National Building
( ) Charlotte Observer Bldg
( ) Charlotte Plaza
( ) City Hall
( ) County and Courts Offfice Building
( ) Court Arcade
( ) Duke Energy Center
( ) Duke Energy Data Center
( ) Energy Center
( ) Fifth Third Center
( ) First Citizens Bank Plaza

( ) Foundation for the Carolinas Building
( ) Founders Hall Bank of America Corporate Center
( ) Gantt Huberman Architects
( ) Gateway Center
( ) Gateway Village: 800 West Trade
( ) Gateway Village: 900 West Trade
( ) Hal Marshall
( ) Hearst Tower
( ) Interstate Tower
( ) Johnson & Wales University
( ) Johnston Bldg
( ) LandDesign
( ) Mecklenburg County Courthouse
( ) Mecklenburg County Jail
( ) Mecklenburg County Sheriff Office
( ) NASCAR Plaza
( ) One Bank of America Center
( ) One Wells Fargo Center
( ) QSM Building
( ) South Tryon Square
( ) Synergy Insurance
( ) The Boxer Building
( ) The Green
( ) Three Wells Fargo Center
( ) Torrence Building
( ) Transamerica Square
( ) Tryon Plaza
( ) Two Wells Fargo Center
( ) UNCC- Center City Building
( ) United Way Building
( ) Urban League of Central Carolinas
( ) US District Courthouse
( ) Walton Plaza
( ) other

2a. **Other: name or street address of the building in which you work**

____

3. **How long have you been working at this location?**
( ) Less than 1 year
( ) 1 – 2 years
( ) More than 2 years

4. **Are you familiar with a program called Smart Energy Now?**
( ) Yes
( ) I've heard of it, but am not familiar with it

( ) No

"Smart Energy Now is a program from Duke Energy dedicated to helping reduce electric energy consumption in Charlotte's Uptown office buildings."

5. **Does this sound familiar to you?**
( ) Yes
( ) No

6. **Can you please tell us what you think Smart Energy Now is trying to accomplish?**

7. **Right now, in your workplace, do you feel that you:**
( ) **Are doing all you can to reduce energy use?**
( ) **Can still do more to reduce energy use?**
( ) **Are doing more than is really necessary when it comes to reducing energy use?**

8. **What other things do you think you could do, and what keeps you from doing those things?**

9. **What are you currently doing that you think is not really necessary, and why?**

10. **On a scale of 1 to 10, how interested are you in reducing energy use in your workplace, where 1 means you are very uninterested, and 10 means you are very interested?**

very uninterested
( ) 1
…
( ) 10
very interested

11. **Using the same scale, please rate what you think your co-workers' level of interest is in reducing energy use in the workplace.**

very uninterested
( ) 1
…
( ) 10
very interested

12. **Again, using the same scale, how would you rate your interest in reducing energy use in your home?**

very uninterested
( ) 1
…
( ) 10
very interested

13. **Again, using the same scale, how interested do you think your management truly is in reducing energy use in your workplace?**

very uninterested
( ) 1
…
( ) 10
very interested

Please tell us how frequently (if ever) you and your co-workers/friends talk about ways to reduce energy use.

14. **My co-workers and I talk about ways to reduce energy use *at the office*…**
( ) Never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) At almost every possible chance

15. **My co-workers and I talk about ways to reduce energy use *at home*…**
( ) Never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) At almost every possible chance

16. **My friends or neighbors and I talk about ways to reduce energy use *at home*…**
( ) Never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) At almost every possible chance

17. **My friends or neighbors and I talk about ways to reduce energy use *at the office*…**
( ) Never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) At almost every possible chance

18. **I talk with *business associates from other offices* about ways to decrease energy use at the office…**
( ) Never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) At almost every possible chance

18a. **Does that business associate happen to work in the greater Charlotte area, but outside of the 277 loop?**
( ) Yes
( ) No
( ) Don't know

Please indicate your agreement with the following statements:

19. **Smart Energy Now has given me information I can use to reduce energy use at home**
( ) Strongly disagree
( ) Moderately disagree
( ) Neither disagree nor agree
( ) Moderately agree
( ) Strongly agree

20. **How much of Smart Energy Now's efforts should be focused on energy savings at home versus the workplace?**
( ) Smart Energy Now should be focused primarily on the home
( ) Smart Energy Now's focus should be 25% on the home and 75% on the workplace
( ) Smart Energy Now's focus should be 50% on the home and 50% on the workplace
( ) Smart Energy Now's focus should be 75% on the home and 25% on the workplace
( ) Smart Energy Now should be focused primarily on the workplace

21. **Did you sign up to be a Smart Energy Now "Energy Champion"?**
( ) I have never heard of a Smart Energy Now "Energy Champion"
( ) Not sure
( ) No
( ) Yes

Branch 1: Energy Champions

e1. **Please tell us in your own words: What is the role of an Energy Champion (i.e. What does an Energy Champion do?)**

e2. **Approximately how many months has it been since you attended the Energy Champion Training session offered by Smart Energy Now?**
( ) I attended approximately ________ months ago: __________________
( ) I have not attend any Energy Champion training yet

e3. **How much support has your management given to Smart Energy Now's campaigns?**
( ) Not enough support
( ) Enough support
( ) More support than is really necessary

e4. **What should your management be doing more of?**

e5. **What should your management be doing less of?**

e6. **How do you currently get communications from the Smart Energy Now program managers?**
(Please select all channels that apply).
[ ] Special email sent just to Energy Champions
[ ] Newsletter sent to all who signed up on the website
[ ] LinkedIn group
[ ] Twitter
[ ] One-on-one phone calls or conversations
[ ] Other

e6a. **Other - please specify:**

e7. **How frequently do you share the content of these communications with your office co-workers?**
( ) Don't know
( ) Almost never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) Almost always
( ) Other

e7a. **Other - please specify:**

e8. **How frequently have your office co-workers contacted or emailed you to talk about this content from Smart Energy Now?**
( ) Don't know
( ) Almost never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) Almost always
( ) Other

e8a. **Other - please specify:**

e9. **How often do your co-workers show interest in this content from Smart Energy Now?**
( ) Don't know
( ) Almost never
( ) Infrequently
( ) Occasionally
( ) Frequently

( ) Almost always
( ) Other

e9a. **Other - please specify:**

e10. **How often do your co-workers act upon the tips and information in the materials from Smart Energy Now?**
( ) Don't know
( ) Almost never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) Almost always
( ) Other

e10a. **Other - please specify:**

e11. **How often do you share your own ideas for saving energy with others in your office?**
( ) Don't know
( ) Almost never
( ) Infrequently
( ) Occasionally
( ) Frequently
( ) Almost always
( ) Other

e11a. **Other - please specify:**

e12. **What do you think could be done to improve the value of the Smart Energy Now communications? Please mention if your suggestion applies to just one channel (e.g. just to emails), or if they apply to all channels.**

e13. **Please indicate the extent of your agreement or disagreement with the following statements.**

	Not sure	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree
I signed up to be an Energy Champion mainly because my management asked me to.	( )	( )	( )	( )	( )	( )
The Smart Energy Now materials promote energy saving actions that my office co-workers were already doing.	( )	( )	( )	( )	( )	( )
I signed up to be an Energy Champion because I wanted to help coordinate an office-wide effort to reduce energy use.	( )	( )	( )	( )	( )	( )
I signed up to be an Energy Champion because it sounded	( )	( )	( )	( )	( )	( )

like fun.						
I signed up to be an Energy Champion because I am concerned about the environment.	( )	( )	( )	( )	( )	( )
I signed up to be an Energy Champion because I am concerned about energy costs in the workplace.	( )	( )	( )	( )	( )	( )
I signed up to be an Energy Champion because my colleagues were also signing up.	( )	( )	( )	( )	( )	( )
Smart Energy Now promotes actions and activities that can also be done at home.	( )	( )	( )	( )	( )	( )

As an Energy Champion, I have conducted the following activities

e14. **Conducted an energy "mini" audit of our office (a walk-through of the office to visually identify ways to save energy)**
( ) Never
( ) Once
( ) Two or three times
( ) More than three times

e14a. **What, if any, recommendations from the audit were implemented at your office?**

e15. **Ran a campaign designed by myself**
( ) Never
( ) Once
( ) Two or three times
( ) More than three times

e16. **Ran a campaign designed by others**
( ) Never
( ) Once
( ) Two or three times
( ) More than three times

e17. **Held meetings to discuss specific ways to reduce energy use in the workplace**
( ) Never
( ) Once
( ) Two or three times
( ) More than three times

e18. **Provided information about energy saving actions to individual co-workers**
( ) Never

( ) Once
( ) Two or three times
( ) More than three times

e19. **Reminded co-workers about taking energy saving actions**
( ) Never
( ) Once
( ) Two or three times
( ) More than three times

e20. **Assumed leadership for energy saving actions in common spaces**
( ) Never
( ) Once
( ) Two or three times
( ) More than three times

e21. **Other**
( ) Never
( ) Once
( ) Two or three times
( ) More than three times

e21a. **If "Other", please specify:**

e22. **Which of these above activities do you consider to have had successful results, and that you would recommend to other Energy Champions?**
[ ] Conducted an energy “mini” audit of our office
[ ] Ran a campaign designed by myself
[ ] Ran a campaign designed by others
[ ] Held meetings to discuss specific ways to reduce energy use in the workplace
[ ] Provided information about energy saving actions to individual co-workers
[ ] Reminded co-workers about taking energy saving actions
[ ] Assumed leadership for energy saving actions in common spaces
[ ] Other

e23. **How would you rate your satisfaction of the Energy Champion Training that was conducted by Smart Energy Now staff?**
not at all satisfied
( ) 0
…
( ) 10
completely satisfied

e24. **What could be done to improve the Energy Champion training in the future?**

Branch 2: Occupants (about Energy Champions and Social Media)

A1. **Do you know someone who is an Energy Champion for Smart Energy Now?**
( ) Yes, I know one person who is an Energy Champion
( ) Yes, I know more than one person who is an Energy Champion
( ) No
( ) I don't know

A1a. **An Energy Champion is someone who has volunteered to receive Smart Energy Now training on how to lead their co-workers to get excited about reducing their individual energy waste around the office. If this now sounds familiar, do you know someone in your office who is an Energy Champion?**
( ) It does not sound familiar
( ) This sounds familiar but I do not know anyone who is an Energy Champion in our office
( ) Yes, this sounds familiar and I know someone who is an Energy Champion

Please indicate your level of agreement or disagreement with the following statements about the Energy Champion. If you know more than one person who is an Energy Champion, please think of the one you have interacted with most frequently, and respond to the following questions with that particular person in mind.

A2. **The Energy Champion informed me about specific ways to reduce energy use in the workplace that were new to me**
( ) Don't know
( ) Strongly disagree
( ) Moderately disagree
( ) Neither disagree nor agree
( ) Moderately agree
( ) Strongly agree

A3. **The Energy Champion informed me about the benefits of reducing energy use in the workplace that were new to me**
( ) Don't know
( ) Strongly disagree
( ) Moderately disagree
( ) Neither disagree nor agree
( ) Moderately agree
( ) Strongly agree

A4. **The Energy Champion was effective in helping my office to reduce overall energy use**
( ) Don't know
( ) Strongly disagree

( ) Moderately disagree
( ) Neither disagree nor agree
( ) Moderately agree
( ) Strongly agree

A5. **In my opinion, the best thing about having an Energy Champion is**

A6. **In my opinion, the worst thing about having an Energy Champion is**

D1. **Please think back for a moment: How many times in the last week did you look at the information on Smart Energy Now website (smartenergycharlotte.com)?**
( ) # of times: _________________
( ) Don't Know

D2. **Have you pledged your support for Smart Energy Now on the website?**
( ) Yes
( ) No, and I don't plan to
( ) I plan to, but haven't gotten around to it yet
( ) Don't know

D3. **Have you signed up for the Smart Energy Now newsletter? (You can sign up by checking a box while pledging your support on the website.)**
( ) Yes
( ) No, and I don't plan to
( ) I plan to, but haven't gotten around to it yet
( ) Don't know

D4. **Have you gone to the Smart Energy Now website to find information on campaigns (such as "Adopt a Light" or "Crab You're It")?**
( ) Yes
( ) No, and I don't plan to
( ) I plan to, but haven't gotten around to it yet
( ) Don't know

D5. **Did you find at least one campaign that you would like to launch at your workplace?**
( ) Yes, and we have already launched it
( ) Yes, but we have not launched it yet
( ) No
( ) Not sure

D6. **Do you follow Smart Energy Now on Twitter?**
( ) Yes
( ) No
( ) Don't know

D7. **How many times in the past week did you read the Smart Energy Now Twitter feed?**
( ) I didn't read the Twitter feed at all last week
( ) # of times: _________________
( ) Don't know

D8. **Have you ever read the Smart Energy Now blog on the smartenergycharlotte.com website?**
( ) Yes
( ) No
( ) Don't remember

D9. **Did you happen to read it within this past week?**
( ) Yes
( ) No
( ) Don't remember

D10. **Did you join the Smart Energy Now group on LinkedIn?**
( ) Yes
( ) No
( ) Don't know

D11. **How many times in the past week did you read a post on the group's LinkedIn page?**
( ) I didn't look at the LinkedIn Group posts last week
( ) # of times: _________________
( ) Don't know

D12. **How many times in the past week did you start or join a conversation on the group's LinkedIn page?**
( ) # of times: _________________
( ) Don't know

Branch 3: Occupants about Campaigns

B1. **Has your office participated in or adopted specific activities that are part of the Smart Energy Now Campaigns?**
( ) Yes
( ) No
( ) Don't know

Some examples of Smart Energy Now Campaigns are "Crab You're It" and "Adopt A Light", which are games that co-workers play to motivate each other to turn off unused lights.
B2. Do either of those campaigns sound familiar?
( ) Yes

( ) No
( ) Don't know

B3. **How many total campaigns have been launched at your workplace?**
( ) 0
( ) 1
( ) 2
( ) 3 or more
( ) Don't know

Please identify a campaign and describe what activity or action it was promoting. If you do not recall either the name of the campaign or what it asked you to do, please indicate that as well.

B4. **Name of campaign**
( ) Name: ____________________
( ) I don't remember the name

B5. **Action/Activity being promoted**
( ) Action/Activity: ____________________
( ) I don't remember the activity

B6. **Since the Smart Energy Now campaigns started promoting certain activities and actions in the workplace, did you**
( ) Start doing the activity/action for the first time?
( ) Increase the frequency of the activity/action that you had already been doing?
( ) Not change your behavior at all?
( ) Decrease the frequency of the activity/action that you had already been doing?
( ) Stop doing the activity/action?

B7. **If you indicated you changed your behavior, please rate on a scale of 0 to 10 the extent to which Smart Energy Now and its campaigns influenced you to do so, compared with all other influences (for example, such as radio ads or conversations with family members), where 0 indicates "Smart Energy Now had no influence at all" and 10 indicates "Smart Energy Now was the only influence."**

SEN had no influence
( ) 0
…
( ) 10
SEN was the only influence

B7a. **Of the other sources that influenced you to change your behavior, what was biggest influence?**

B8. **Please take a moment to think back: how many times in the past week did you take this action?**

____

B9. **Do you consider the action this campaign asked you to take to be**
( ) Extremely inconvenient
( ) Moderately inconvenient
( ) Neither inconvenient nor convenient
( ) Moderately convenient
( ) Extremely convenient

B10. **Overall, how interested were you in doing the various actions promoted by this campaign?**
( ) Extremely interested
( ) Moderately interested
( ) Neither interested nor uninterested
( ) Moderately uninterested
( ) Extremely uninterested

B11. **What did you like best about this campaign?**

B12. **What did you like least about this campaign?**

B13. **Is there one more campaign launched at your office that you can tell us about?**
( ) Yes
( ) No

B14. **Name of campaign**
( ) Name: __________________
( ) I don't remember the name

B15. **Action/Activity being promoted**
( ) Name: __________________
( ) I don't remember the activity

B16. **Since the Smart Energy Now campaigns were introduced, did you**
( ) Start doing the activity/action for the first time?
( ) Increase the frequency of the activity/action that you had already been doing?
( ) Not change your behavior at all?
( ) Decrease the frequency of the activity/action that you had already been doing?
( ) Stop doing the activity/action?

B17. **If you indicated you changed your behavior, please rate on a scale of 0 to 10 the extent to which Smart Energy Now and its campaigns influenced you to do so, compared with all other influences (for example, such as radio ads or conversations with family members),**

where 0 indicates "Smart Energy Now had no influence at all" and 10 indicates "Smart Energy Now was the only influence."

SEN had no influence
( ) 0
…
( ) 10
SEN was the only influence

B18. **Of the other sources that influenced you to change your behavior, what was biggest influence?**

B19. **Please take a moment to think back: how many times in the past week did you take this action?**

____

B20. **Do you consider the action this campaign asked you to take to be**
( ) Extremely inconvenient
( ) Moderately inconvenient
( ) Neither inconvenient nor convenient
( ) Moderately convenient
( ) Extremely convenient

B21. **Overall, how interested were you in doing the various actions promoted by this campaign**
( ) Extremely interested
( ) Moderately interested
( ) Neither interested nor uninterested
( ) Moderately uninterested
( ) Extremely uninterested

B22. **What did you like best about this campaign?**

B23. **What did you like least about this campaign?**

As part of Smart Energy Now, people can suggest new campaigns and submit them on the Smart Energy Now website; or they can get information on existing campaigns to implement in their office.

B24. **Have you designed or helped design a new campaign for Smart Energy Now for your office?**
( ) Yes
( ) No

B25. **Please provide the name of the campaign and describe the campaign, including the action that was requested.**
Name of the Campaign: ____________________
Action being promoted or recommended (e.g. "Turn off lights"): ____________________

B26. **Description of campaign or activity that was designed to promote the action (e.g. "Put adoption stickers on light switches to remind people")**

B27. **Did you launch this campaign at your office?**
( ) Yes
( ) No

B28. **If not, why not?**

B29. **If yes, do you consider this campaign to be successful?**

B30. **Of those in your office who could have participated, what percentage would you estimate did participate?**
( ) A few
( ) < =25%
( ) >25% to <=50%
( ) >50% to <=75%
( ) >75% to <=100%
( ) 100%

B31. **Did you submit this campaign idea to the Smart Energy Now website?**
( ) Yes
( ) No
If no, **Why not?**: ________________

B32. **Is there one more campaign that you designed (or helped design) that you can share with us?**
( ) Yes
( ) No

B33. **Please provide the name of the campaign and describe the campaign, including the action that was requested.**
Name of the Campaign: ____________________
Action being promoted or recommended (e.g. "Turn off lights"): ____________________

B34. **Description of campaign or activity that was designed to promote the action (e.g. "Put adoption stickers on light switches to remind people")**

B35. **Did you launch this campaign at your office?**
( ) Yes

( ) No

B36. **If not, why not?**

B37. **If yes, do you consider this campaign to be successful?**

B38. **Of those in your office who could have participated, what percentage would you estimate did participate?**
( ) A few
( ) < =25%
( ) >25% to <=50%
( ) >50% to <=75%
( ) >75% to <=100%
( ) 100%

B39. **Did you submit this campaign idea to the Smart Energy Now website?**
( ) Yes
( ) No
If no, **Why not?**: _________________

B40. **On a scale of 0 to 10, rate how important do you feel it is for Smart Energy Now to continue to encourage people to create their own campaigns? (Please use a scale with 0 indicating "Not important at all" and 10 indicating "Critically important to the success of Smart Energy Now").**
not important
( ) 0
…
( ) 10
critically important

B41. **Using the same scale, rate how important do you feel it is for your office to know what was achieved as a result of these campaigns (both new and existing campaigns)?**
not important
( ) 0
…
( ) 10
critically important

B42. **Using the same scale, rate how important do you feel it is for the Smart Energy Now program managers to track the achievements from campaigns? (both new and existing campaigns)**
not important
( ) 0
…
( ) 10

critically important

B43. **Has your office been a participant of any other program or company effort to reduce energy use, other than Smart Energy Now?**
( ) Yes
( ) No
( ) Don't Know

B44. **Please provide the program name (if possible) and describe the action that you were requested to take?**
Name: ________________________
Action Requested: ________________________

Branch 4: Occupants about Kiosk

Smart Energy Now uses an interactive kiosk that is placed in the lobby of participating buildings.

C1. **Within the past 30 days, approximately how many times have you read or looked at the information on the kiosk?**
( ) I don't know where the kiosk is in my building and have never seen it.
( ) I have not read or looked at information on the kiosk in the last 30 days.
( ) I have read or looked at the information approximately _______ times: ________________
( ) I don't know how many times I've read or looked at the kiosk.

C3. **How many times in the past week have you discussed information on the kiosk with your office co-workers?**
( ) I have not discussed information on the kiosk in the past week.
( ) # of times: ________________
( ) Don't remember

For each of the following, please rate your level of interest in the information presented by the kiosk, with 0 meaning "no interest at all" and 10 meaning "my primary interest". If the information was not available on your building's kiosk, or if you are unsure whether it was or not, please indicate "Not available" or "Not sure".

C4. **Level of interest in live tracking of Uptown Charlotte energy usage**
( ) 0
…
( ) 10
( ) Not available on kiosk
( ) Not sure whether it is available

C5. **Level of interest in Uptown Charlotte's current energy usage compared with past energy usage.**

( ) 0
…
( ) 10
( ) Not available on kiosk
( ) Not sure whether it is available

C6. **Within the past 7 days, have you looked at Uptown Charlotte's energy usage at least once?**

( ) Yes
( ) No
( ) Don't remember

C7. **Level of Interest in the energy saving tips shown on the kiosk**

( ) 0
…
( ) 10
( ) Not available on kiosk
( ) Not sure whether it is available

C8. **Level of interest in the energy usage of my building compared to other buildings**

( ) 0
…
( ) 10
( ) Not available on kiosk
( ) Not sure whether it is available

C9. **Level of interest in the information on how many homes (or schools or universities) can be powered by the energy saved**

( ) 0
…
( ) 10
( ) Not available on kiosk
( ) Not sure whether it is available

C10. **Level of interest in the information on how many 100 mile car trips (or bus trips or flights) can be offset by the CO2 abated**

( ) 0
…
( ) 10
( ) Not available on kiosk
( ) Not sure whether it is available

For the next series of questions, please indicate the extent of your agreement or disagreement with each of the following:

C11. **Looking at Uptown Charlotte's energy usage on the kiosk increases my motivation to try to save energy at work**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C12. **I prefer to see Uptown Charlotte's energy usage "live", as it is being used, rather than total energy usage from the previous day**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C13. **The energy tips shown on the kiosk promote energy saving actions that I was already doing**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C14. **The energy tips shown on the kiosk have included facts about energy that I didn't know before**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C15. **I have become accustomed to the presence of the kiosk and once I got used to it, I did not notice it much any more**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C16. **The kiosk is a good example of technology innovation**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C17. **In my building, the interactive kiosk is placed in a good location to be seen by people working in the building**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C18. **Even if people only look at the kiosk occasionally, its presence still serves as a good reminder to save energy**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C19. **Overall, the information available on the kiosk has increased my motivation to save energy at work**
( ) Not sure
( ) Disagree
( ) Somewhat disagree
( ) Neither agree or disagree
( ) Somewhat agree
( ) Agree

C20. **What other information do you think should be included on the kiosk?**

Outro for All

If there was just one thing you could do to improve the Smart Energy Now program, what would it be?

Please rate your level of overall satisfaction with Smart Energy Now, 1 meaning "very dissatisfied" and 10 meaning "very satisfied".

( ) 1
…
( ) 10
( ) DK/NS

What could have been done to make you more satisfied?

Please rate your level of overall satisfaction with Duke Energy, 1 meaning “very dissatisfied” and 10 meaning “very satisfied”.

( ) 1
…
( ) 10
( ) DK/NS

What could have been done to make you more satisfied?

The following questions are Optional.

EC1. **Are you familiar with a program called Envision Charlotte?**
( ) Yes
( ) I've heard of it, but am not familiar with it
( ) No

EC2. **"Envision Charlotte is a public-private collaboration that will try to make Uptown Charlotte the most environmentally sustainable urban core in the nation." Does this sound familiar to you?**
( ) Yes
( ) No

EC3. **Can you please tell us some of the things that Envision Charlotte is trying to accomplish?**

Thank You!

Appendix C: Property Manager and Facility Manager Interview Instrument

Thank you for taking this survey about your building's participation in Duke Energy energy efficiency programs. This survey is conducted by an independent evaluation company, TecMarket Works. Your responses will be kept confidential, and will help improve the effectiveness of Duke Energy's programs.

Information
Name: ________________________
Email address: ________________________

1) **What is the name or street address of the building in which you work?**
( ) 101 Independence Center
( ) 129 W Trade St
( ) 200 N College
( ) 200 South Tryon
( ) 222 S Church St
( ) 223 N Graham St
( ) 400 S Tryon
( ) 402 W Trade St
( ) 500 S College
( ) 525 North Tryon Building
( ) 526 S Church
( ) Ally
( ) ATT Plaza
( ) Bank of America Corporate Center
( ) Bank of America Plaza
( ) BBT Center
( ) Carillon Building
( ) Carol Belk Children and Family Services Center
( ) Charlotte Chamber of Commerce
( ) Charlotte Mecklenburg Government Center
( ) Charlotte National Building
( ) Charlotte Observer Bldg
( ) Charlotte Plaza
( ) City Hall
( ) County and Courts Offfice Building
( ) Court Arcade
( ) Duke Energy Center
( ) Duke Energy Data Center
( ) Energy Center
( ) Fifth Third Center
( ) First Citizens Bank Plaza

( ) Foundation for the Carolinas Building
( ) Founders Hall Bank of America Corporate Center
( ) Gantt Huberman Architects
( ) Gateway Center
( ) Gateway Village: 800 West Trade
( ) Gateway Village: 900 West Trade
( ) Hal Marshall
( ) Hearst Tower
( ) Interstate Tower
( ) Johnson & Wales University
( ) Johnston Bldg
( ) LandDesign
( ) Mecklenburg County Courthouse
( ) Mecklenburg County Jail
( ) Mecklenburg County Sheriff Office
( ) NASCAR Plaza
( ) One Bank of America Center
( ) One Wells Fargo Center
( ) QSM Building
( ) South Tryon Square
( ) Synergy Insurance
( ) The Boxer Building
( ) The Green
( ) Three Wells Fargo Center
( ) Torrence Building
( ) Transamerica Square
( ) Tryon Plaza
( ) Two Wells Fargo Center
( ) UNCC- Center City Building
( ) United Way Building
( ) Urban League of Central Carolinas
( ) US District Courthouse
( ) Walton Plaza
( ) other

1a. **Other address:**

____

2) **Are you a facility manager, a property manager, or both?**
( ) Facility manager
( ) Property Manager
( ) Both

3) **Do you manage any other buildings in the Uptown Charlotte area? Which ones?**
( ) No, I don't manage other buildings

( ) **Yes, I also manage the following:**

____

4) **How long have you worked as a facility or property manager?**
( ) Less than 1 year
( ) 1-2 years
( ) 3-5 years
( ) 6-10 years
( ) More than 10 years

5) **Our records indicate that you and your building are currently participating in the Smart Energy Now program that is offered by Duke Energy. Do you recall participating in this program?**
( ) Yes
( ) No
( ) Don't know

If Yes:
5a. **Can you please tell us what objective you think Smart Energy Now is trying to accomplish?**

If "No" or "DK/NS":
6) **Smart Energy Now is a program from Duke Energy dedicated to helping reduce energy consumption in Charlotte's Uptown office buildings by 5% overall in five years. Smart Energy Now uses a digital grid infrastructure to help building managers and tenants see the energy usage for all participating buildings. This data is displayed on a kiosk in your building's lobby, and includes information about real-time usage, load factors and historical trends. Do you remember participating in this program?**
( ) Yes
( ) No
( ) Don't know

6a. **The Smart Energy Now kiosks in your building's lobby were officially unveiled to the public on October 28, 2011. Do you recall that event?**
( ) Yes
( ) No
( ) Don't know

7) **Please tell us who you are employed by:**
( ) The building owner
( ) A property management company
( ) Other: __________________
( ) Don't know

8) **How many people currently work in this building (please estimate if you do not know the exact number)?**

____

9) **Has the number of people working in this building changed significantly since Smart Energy Now launched in October of 2011 (over the past seven quarters), such as might happen with a tenant moving in or out? If so, would you please estimate how many people moved in or out, and in which quarter this happened?**
leave blank if no significant change

	# of people moving in	# of people moving out
Q4 2011		
Q1 2012		
Q2 2012		
Q3 2012		
Q4 2012		
Q1 2013		
Q2 2013		

10) **To the best of your knowledge, how many tenants are in your building?**
( ) # of tenants: __________________
( ) Don't know
( ) Not Applicable

11) **Does your building have a master meter?**
( ) No, each tenant is individually metered
( ) Yes, there is a master meter for the entire building
( ) Yes, there is a master for all tenant loads and a separate master for non-tenant loads
( ) Other: __________________

12) **Right now, in your building, do you feel that you**
( ) Are doing all you can to reduce energy use.
( ) Can still do more to reduce energy use.
( ) Are doing more than is really necessary when it comes to reducing energy use.

If "Can still do more":
13) **What other things do you think you could do?**

If "Can still do more":
14) **What keeps you from doing those things?**

If "doing more than is really necessary":
15) **What are you currently doing that you think is not really necessary, and why?**

If "doing more than is really necessary":
16) **Why are these not really necessary?**

17) **Please tell us, what are the biggest challenges you face as a property manager or facility manager? (Please list up to three)**

1: ____________________________
2: ____________________________
3: ____________________________

18) **On a scale of 1 to 10, how interested do you think your building owners are in reducing energy use in your building, where 1 means very uninterested, and 10 means very interested?**

very uninterested
( ) 1
…
( ) 10
( ) Don't know
very interested

19) **Again, using the same scale, how interested are you personally in reducing energy use in your building?**

very uninterested
( ) 1
…
( ) 10
( ) Don't know
very interested

20) **Again, using the same scale, on average, how interested do you think the tenants are in reducing energy use in your building?**

very uninterested
( ) 1
…
( ) 10
( ) Don't know
very interested

21) **In your operating budget for this building, what percentage of the budget would you estimate goes toward electric energy costs?**

____

22) **Do you as an individual, receive any incentives for keeping operating costs low?**

( ) Yes
( ) No
( ) Don't know
( ) Not applicable

23) **If you are employed by a property management company, does your property management company receive any incentives for keeping operating costs low?**

( ) Yes
( ) No

( ) Don't know
( ) Not applicable

24) **Since October of 2011, have you needed to defer maintenance due to budget limitations?**
( ) Yes
( ) No
( ) Don't know

25) **Since October of 2011, have you deferred energy efficiency upgrades due to budget limitations?**
( ) Yes
( ) No
( ) Don't know

26) **What is your role in making decisions on equipment purchases for the building, such as HVAC or lighting equipment?**
( ) I am the sole decision maker
( ) I am part of the team that makes decisions
( ) I make recommendations on new products, but do not make the final decision
( ) I am not involved in the decision-making process
( ) Other: ___________________

27) **In situations where you need to replace a piece of equipment that has failed, how important is the energy efficiency of the new equipment to the decision-making criteria?**
( ) Energy efficiency is not important
( ) Energy efficiency has minor importance
( ) Energy efficiency is moderately important
( ) Energy efficiency is very important
( ) Energy efficiency is extremely important
( ) Don't know

28) **For decisions that pertain to the replacement of equipment when it has failed, please indicate the relative importance of life cycle cost versus initial cost of the new equipment in the decision-making process.**
( ) Decision are made only based on initial equipment cost
( ) Decisions are made based primarily on initial cost
( ) Decisions are made based equally upon initial cost and life cycle costs
( ) Decisions are made based primarily on life cycle costs
( ) Decisions are made only on life cycle costs
( ) Don't know

29) **When upgrading equipment that is still operating (not failed equipment), how important is the energy efficiency of the new equipment to the decision-making criteria?**
( ) Energy efficiency is not important
( ) Energy efficiency has minor importance

( ) Energy efficiency is moderately important
( ) Energy efficiency is very important
( ) Energy efficiency is extremely important
( ) Don't know

30) **When upgrading still-operational equipment (not failed equipment), please indicate the relative importance of life cycle cost versus initial cost of the new equipment in the decision-making process.**
( ) Decision are made only based on initial equipment cost
( ) Decisions are made based primarily on initial cost
( ) Decisions are made based equally upon initial cost and life cycle costs
( ) Decisions are made based primarily on life cycle costs
( ) Decisions are made only on life cycle costs
( ) Don't know

31) **Have you attended any of the Smart Energy Now Facility Managers Town Hall Meetings?**
( ) Yes
( ) No
( ) Don't know

31a. **Please indicate which one(s)**
[ ] I attended the March 15, 2012 Town Hall at the NASCAR Hall of Fame
[ ] I attended the June 21, 2012 Town Hall at the Bank of America Conference Center
[ ] I attended the November 8, 2012 Town Hall at the Duke Energy Tower

If "attended Smart Energy Now Facility Managers Town Hall(s)":
32) **Do you have any suggestions for Duke Energy on how to improve future Town Hall Meetings?**

If "attended Smart Energy Now Facility Managers Town Hall(s)":
33) **What did you like best about the Town Hall meeting?**

If "attended Smart Energy Now Facility Managers Town Hall(s)":
34) **What did you like the least?**

35) **Have you conducted an audit of your building as a result of SEN or the Town Hall meetings?**
( ) I / We did not conduct any audits of my building
( ) I / We conducted an audit, but it was not due to SEN or the Town Hall meetings
( ) Yes, I / we conducted a Level 1 Audit (walk-through assessment to identify low cost improvements)
( ) Yes, I / we conducted a Level 2 Audit (energy survey and engineering analysis to identify technology investments and upgrades)
( ) Yes, I / we conducted a Level 3 Audit (detailed analysis of capital-intensive modifications that requires in-depth engineering and design information)

If "Yes, conducted audit":
36) **Of the recommendations that came out of the audit, which ones have you adopted so far?**

37) **Since October of 2011, have you asked janitorial staff or security staff to start taking any particular actions to save energy?**
( ) Yes, I asked them to: _________________
( ) No
( ) Don't know

If "Yes" :
38) **When did you tell them to start taking this action? (nearest quarter/year is fine)**
____

38b. **Please rate on a scale of 0 to 10, how much influence did SEN have, if any, on your decision to ask them to take action, with 0 meaning "no influence" and 10 meaning "sole source of influence"?**
no influence
( ) 0
…
( ) 10
( ) Don't Know
sole source of influence

39) **Have there been any other changes in your building in the past year that would affect energy use?**
Please check all that apply
[ ] Remodeling
[ ] No tenant turnover, but changes in occupancy hours
[ ] Other

The Compass Tool is provided to facility and property managers free through your participation in Smart Energy Now. This tool allows you to track normalized energy usage and to input details about your building's operational changes that might affect energy use.

40) **Have you received training on how to use the Compass Tool?**
( ) Yes
( ) No
( ) Don't know

41) **If you have received training on the Compass Tool, how did you receive that training (e.g. at a Town Hall meeting or through a training document or another way)?**

42) **On a scale of 1 to 10, please rate how useful the Compass Tool training is to you, where 1 means extremely not useful and 10 means extremely useful?**

extremely not useful
( ) 1
…
( ) 10
( ) DK/NS
extremely useful

42a. **What could have been done to make the training more useful?**

43) **Using the same scale, please rate how useful the Compass Tool itself is to you?**
extremely not useful
( ) 1
…
( ) 10
( ) DK/NS
extremely useful

43a. **What could have been done to make the Compass Tool more useful?**

44) **How frequently in the last month did you look at your building's energy usage on Compass?**
( ) I did not use Compass at all in the last month
( ) Once or twice
( ) Three to five times
( ) Six times or more
( ) Don't know

45) **On a scale of 1 to 10, please tell us how user-friendly the Compass tool is, with 1 indication extremely unfriendly and 10 indicating extremely friendly**
extremely unfriendly
( ) 1
…
( ) 10
( ) DK/NS
extremely friendly

45a. **What could have been done to make the Compass Tool more friendly?**

46) **Please indicate the extent to which you agree or disagree with the following: "Compass helps me understand my building's energy usage."**
( ) Strongly disagree
( ) Disagree
( ) Neither agree nor disagree
( ) Agree
( ) Strongly agree
( ) Don't know

47) **The Compass Tool allows users to enter "events", or, changes to affecting "lighting in common areas", "computers and office equipment", etc. Sometimes it is difficult to find time to enter updates on Compass. Please tell us, of all the events that have happened to your building since January of 2011, approximately what percentage were you able to enter on the Compass Tool.**
( ) None of them
( ) Up to 25% of them
( ) Up to 50% of them
( ) Up to 75% of them
( ) All of them
( ) My building has not had any events to report
( ) Don't know

48) **What could be done to make it more convenient for you to enter events on the Compass Tool?**
( ) _: __________________
( ) Not applicable
( ) Don't know

49) **Is there another way you prefer to use to share events with Smart Energy Now?**
Please select all that apply
[ ] No
[ ] Yes, I would prefer that someone calls me periodically for updates (such as once a quarter)
[ ] Yes, I would prefer that someone periodically emails me a reminder (such as once a quarter) to enter events on Compass
[ ] Yes I would prefer that someone periodically emails me asking about events, and I can just "reply" to the email
[ ] Other

50) **What are some of the reasons why you think you are not looking at the building's energy use on Compass more frequently?**
Please select all that apply
[ ] I need to track building energy usage, but I use another tool to do that
[ ] I need to track building energy usage, but I can just use the monthly invoices
[ ] I need to track building energy use, but I don't have the time to log into Compass
[ ] I need to track building energy use, but Compass interface is too difficult to use
[ ] I don't need to track building energy usage
[ ] Other

51) **Please indicate all of the functions you used on Compass:**
Please select all that apply
[ ] Review the building's energy usage
[ ] Reviewed the energy savings of the building
[ ] Entered an event (a capital improvement or behavioral improvement)
[ ] Entered a space change

[ ] Entered a change in number of occupants
[ ] Entered a change in principal activity of a tenant
[ ] Entered a change in hours of operation
[ ] Other
[ ] None

Duke Energy's web-based tool Energy Profiler Online (EPO) is designed to help large customers manage their energy use by providing load profiles, usage history and a variety of statistics.

52) **If you have used Duke Energy's Energy Profiler Online (EPO) as well as the Compass Tool, which tool do you prefer for understanding your energy usage?**
( ) I have not used EPO
( ) I prefer EPO
( ) I prefer Compass
( ) I have no preference
( ) Don't know

If "I prefer EPO" or "I prefer Compass":
53) **What is the main reason for this preference?"**

54) **Is there anything that Duke Energy do to make the Compass tool more useful for you?**

55) **Please indicate the degree to which you agree or disagree with the following statement: "As a result of Smart Energy Now, energy efficiency considerations have become more important in my building's decision-making process"**
( ) Strongly disagree
( ) Disagree
( ) Neither disagree nor agree
( ) Agree
( ) Strongly agree
( ) Don't know

56) **From all the information currently available to you, do you think your building has reduced its energy use since October of 2011? Please indicate the most appropriate response:**
( ) I am certain we have reduced energy use
( ) It is likely we have reduced energy use
( ) I am unsure as to whether we reduced or increased energy use
( ) It is likely we have increased energy use
( ) I am certain we have increased energy use

57) **What is the worst part of the Smart Energy Now program?**

58) **What is the best part of the Smart Energy Now program?**

59) **Please rate your level of satisfaction with Smart Energy Now's effectiveness in helping to identify potential areas in which to save energy, 1 meaning "very dissatisfied" and 10 meaning "very satisfied".**

very dissatisfied
( ) 1
…
( ) 10
( ) Don't Know
very satisfied

If rating is 7 or less
59a. **What could have been done to make you more satisfied?**

60) **Using the same scale, please rate your level of satisfaction with Smart Energy Now's effectiveness in helping to achieve a reduction in energy use in your building?**

very dissatisfied
( ) 1
…
( ) 10
( ) Don't Know
very satisfied

If rating is 7 or less
60a. **What could have been done to make you more satisfied?**

61) **Please rate your level of overall satisfaction with Smart Energy Now, 1 meaning "very dissatisfied" and 10 meaning "very satisfied".**

very dissatisfied
( ) 1
…
( ) 10
( ) Don't Know
very satisfied

If rating is 7 or less
61a. **What could have been done to make you more satisfied?**

62) **Please rate your level of overall satisfaction with Duke Energy, 1 meaning "very dissatisfied" and 10 meaning "very satisfied".**

very dissatisfied
( ) 1
…
( ) 10
( ) Don't Know
very satisfied

If rating is 7 or less
62a. **What could have been done to make you more satisfied?**

63) **Thank you for taking this survey. Please provide any additional comments below:**

Thank You!
Thank you for taking our survey. Your responses are very important to us.

Appendix D: Mini-Audit

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Part I. Facility Staff's Top 10 Energy Practices:

1. Shut off **Task Lighting**
2. **Use Blinds** to Conserve Energy
3. Report non-working **Motion Sensors** (remind peers that they still can shut off lights when they leave)
4. Endorse the use of **Power Strips**
5. Use "**Stand-by Mode**" for computer, laptop shutdown
6. **Hunt for Appliances** (individual coffee makers, fans…where extra consumption occurs)
7. Put an end to **Vampire Power**
8. Hunt for Incandescent Light Bulbs (**replace with CFLs**)
9. **Walk the halls**, use the Audit Tool provided
10. Partner with **your Facility Manager**

Part II. Plug in Electrical Devices and Appliances

1. *Identify energy-using equipment.* In the table below, list all the office equipment and appliances in your work space, including computers, monitors, copy and fax equipment, refrigerators and freezers, vending machines, and anything else that is plugged in. Write down each item individually, including things that go together (PC, monitor and speakers), and items that are not in use right now (coffee grinder, battery charger).

2. *Describe how it is typically used.* List who uses this item and for how many hours per day. Is the item used continuously or only as needed?

3. *Think about efficiency opportunities. Be sure to let people know what you are doing.* Make notes regarding potential efficiency measures. Consider:
   - Is equipment turned off when not in use and at night? Are power strips being used around clusters of electronics?
   - Where are the **Vampire** loads? Are any appliances ever left "on" and using energy when not needed during the day? (Note applies to chargers and appliances with any indicator light or display that continues to use energy while plugged in.)
   - Are there ways to turn the equipment off ? Are there ways to change default settings (e.g., setting computer power settings to "energy saver", or printers to double sided)? Does the equipment have energy saving, standby, or sleep modes (e.g., is there a stand-by setting for the copy machine)? Does it have power management software? Are these settings being used?
   - Is equipment EnergySTAR rated? Who makes the purchases in your department?

1. Equipment	2. Normal Use	3. Efficiency Opportunities

Bonus question: Do you have server room? Have the servers been evaluated for their power utilization, server capacity and cooling system performance?

Notes, Questions, & Follow-up Items

Part III. Lighting

1. *Identify all lighting.* In the table below, list all the overhead and task lighting in your work area. Include hallway lights, exit signs, etc.

2. *Describe how it is typically used.* List who uses these lights and the average hours per day that they are on. Are lights on continuously or only when needed, especially desk or task lighting? Are there motion sensors or timers?

3. *Think about efficiency opportunities.* Make notes regarding potential efficiency measures. Consider:
   - Do employees use natural lighting when possible?
   - Are blinds closed on the hottest days to keep heat out?
   - Do employees use task lighting? Is lighting focused where people need it?
   - Are lights left on when spaces are unoccupied? E.g, Bathrooms, Offices, Desks, Lunchrooms, Conference Rooms
   - Can you go on a CFL hunt to find out if you use compact fluorescent light bulbs where possible?
   - Could any of the lights have dimmer switches, motion sensors, or timers?
   - Is there excessive or unnecessary light in certain areas? Can a few light bulbs be removed permanently?
   - What are responsibilities of cleaning staff regarding lighting? Do they turn lights off?

1. Lighting	2. Normal Use	3. Efficiency Opportunities

Notes, Questions & Follow-up Items

Part IV. Heating & Cooling

1. *Describe how heating and cooling systems typically operate.* Answer the following questions:

    - How much control over the temperature does your office have, if any?
      Is temperature controlled within the office or through central facilities?

    - Do you know what temperature the thermostat is set at in the summer and winter?

    - Are there parts of your office that are colder or warmer or generally uncomfortable?

    - Are temperature issues relayed to facility staff? If so, how often? Are issues resolved?

    - Are space heaters or fans used, or windows or doors opened, to adjust temperatures in work areas?

    - Is the space well-insulated? Does air leak around windows and doors?

2. *Think about efficiency opportunities.* Write ideas below potential efficiency measures to discuss with your office management and/or facility staff.

Notes, Questions & Follow-up Items

Appendix E: Declaration of Change

Our Declaration of Change

We are joining together with Envision Charlotte and Smart Energy Now® (SEN) to take actions to support the goal of reducing energy waste in Uptown Charlotte. Together, we will cause a chain reaction that will:

- Make business sense for us;
- Promote Uptown Charlotte economic development; and
- Protect the future of our planet by leading to sustainable energy for all.

By signing this declaration, I promise to:

- **Lead by example.** This means reducing my own energy use by turning off unnecessary lights, unplugging unused office equipment and appliances, and finding other opportunities to reduce energy consumption as part of the SEN program.

- **Engage my employees to take action by supporting and passing on the message.** This means our company goal is for our employees to register on the Smart Energy Now® website and that our company will kick-off and submit a campaign. I will inspire goal completion by February 28, 2012.

Signed: ______________________________

Title: ______________________________

Date: ______________________________

Appendix F: Tenant Leader Survey

What is the name of the company for which you work?

____

What is the name or street address of the building in which you work?

( ) 101 Independence Center
( ) 129 W Trade St
( ) 200 N College
( ) 200 South Tryon
( ) 222 S Church St
( ) 223 N Graham St
( ) 402 W Trade St
( ) 500 S College
( ) 525 North Tryon Building
( ) Ally
( ) ATT Plaza
( ) Bank of America Corporate Center
( ) Bank of America Plaza
( ) BBT Center
( ) Carillon Building
( ) Carol Belk Children and Family Services Center
( ) Charlotte Chamber of Commerce
( ) Charlotte Mecklenburg Government Center
( ) Charlotte National Building
( ) Charlotte Observer Bldg
( ) Charlotte Plaza
( ) City Hall
( ) County and Courts Offfice Building
( ) Court Arcade
( ) Duke Energy
( ) Duke Energy Center
( ) Duke Energy Data Center
( ) Energy Center
( ) Fifth Third Center
( ) First Citizens Bank Plaza
( ) Foundation for the Carolinas Building
( ) Founders Hall Bank of America Corporate Center
( ) Gantt Huberman Architects
( ) Gateway Center
( ) Gateway Village: 800 West Trade
( ) Gateway Village: 900 West Trade
( ) Hal Marshall
( ) Hearst Tower
( ) Interstate Tower

( ) Johnson & Wales University
( ) Johnston Bldg
( ) LandDesign
( ) Mecklenburg County Courthouse
( ) Mecklenburg County Jail
( ) Mecklenburg County Sheriff Office
( ) NASCAR Plaza
( ) One Bank of America Center
( ) One Wells Fargo Center
( ) QSM Building
( ) South Tryon Square
( ) Synergy Insurance
( ) The Boxer Building
( ) The Green
( ) Three Wells Fargo Center
( ) Torrence Building
( ) Transamerica Square
( ) Tryon Plaza
( ) Two Wells Fargo Center
( ) UNCC- Center City Building
( ) United Way Building
( ) Urban League of Central Carolinas
( ) US District Courthouse
( ) Walton Plaza
( ) other

Approximately how many people in your company work in this building?

( ) Approximately _____________ people: _________________
( ) Don't Know

How many floors are occupied by your company in this building?

( ) _____________ floors: _________________
( ) Don't Know

What ultimately led you to decide to sign the Smart Energy Now Declaration of Change?

( ) _________________
( ) I have not signed the Smart Energy Now Declaration of Change

Do you lease this office space?

( ) Yes
( ) No
( ) Don't know

Does your lease include utilities (such as electricity use), or do you pay for utilities separately?

( ) Included
( ) Separate

( ) Don't know

Do you see a monthly itemization or invoice that shows your electric energy usage at this location?

( ) Yes
( ) No
( ) Don't know

Thank you for taking the our survey for Smart Energy Now tenants. Would you like to continue to our main survey, or quit at this point?

( ) Continue
( ) Save and Quit

Appendix G: Town Hall Whitepapers

Whitepaper 1

Smart Energy Now® (SEN) is an initiative through Duke Energy and Envision Charlotte that is motivating Charlotte's Center City workforce to conserve energy through small changes in daily routines. Our goal is a 20% reduction by 2016. SEN encourages uptown owners, tenants, employees and Charlotte-area stakeholders and leadership, to invest in Charlotte's future by educating the uptown workforce on what they can do to reduce energy consumption while at work. The goal is for uptown Charlotte to prosper by attracting new businesses, new talent, and other economic development opportunities by becoming the most sustainable urban core in the country.

The USGBC Charlotte Region Chapter and IFMA Charlotte have joined Duke Energy as implementation partners in this effort, and assist with outreach to uptown Charlotte building owners, facility managers, tenants, and occupants. Through meetings, emails, websites and networking, implementation partners educate their local membership and the broader community of SEN of initiatives and program goals.

On March 15 at the NASCAR Hall of Fame 45 attendees met for a forum to discuss best management practices of facility managers and building engineers. Discussions were held on topics regarding their buildings' energy use, the role of the facility manager in the success of SEN and support needed to reach energy reduction goals.

The results of this discussion are presented here.

How does your building use energy?

In most buildings the energy usage is primarily HVAC, lighting, food service, retail tenants and IT. Several buildings house data centers, trading floors and associated emergency support equipment which are obvious energy drivers. Finally, hot water heaters, off hour events and chiller plants were also named as primary energy uses in a building.

What improvements has your building implemented in the last five years?

One discussion group discussed a variety of improvements including installing a new roof, lighting controls and LED lamps. Day lighting has been incorporated and retro commissioning has been conducted. T12 lamps were upgraded to T8 lamps and an ambient temperature sensor was relocated.

In another group, new control schemes were incorporated over the last five years which include: building operations controls (reprogramming of the elevators and requirements for more measurement/ metering), wattage reduction via ballast/lamp changes in interior and exterior lighting (parking decks), installation of LEDs in elevators and CFLs in the loading dock.

LEED certification for Commercial Interiors was achieved in one building which came with a number of energy saving features. Others in the group shared improvements over the last five years: a new chiller/HVAC/BAS, key override of lighting BAS, a daytime cleaning schedule, LED and CFL light bulbs and a jockey pump.

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One building invested in change out of glass over the last five years as well as improving the Telecom/IT closets. Oth er facility managers in this group described BAS upgrades, zone sales, modifying escalator & elevator controls, adding increased control options and cooling tower upgrades.

Geothermal technology has been explored in some properties while new, more efficient HVAC equipment was installed when other equipment reached its end of life. Variable speed drives or VFDs have been installed in several buildings and one facility manager had properties using solar thermal and PV. A list of improvements from this group included adding LED because the cost is coming down now, ice thermal storage, gassifier heat recovery, energy star equipment, motion sensors, daylight harvesting, and energy efficient roofing.

> One facility manager shared an insight into the go/no go decision making for some owners:
> - ROI of 6 months go
> - ROI of 12 months 90% chance of approval
> - ROI of 18 months 70% chance of approval
> - ROI of >2 years not good; but an ROI of 2 to 5 years might be acceptable for a long term tenant
>
> Decisions depend on the building use and owner vs. tenant. This team also recognized LEED EB: O&M and LEED ID&C as ways some of their buildings have achieved energy savings recently.

The final group to share their improvements over the last five years had unique information to present including that fewer tenant complaints were received when the HVAC set points ranged from 70 to 75 degrees and that computer rooms can be optimized by adding a VFD to the air handler and installing hot air containment.

What are the challenges for achieving the SEN goal?

One of the concerns most frequently cited among facil ity managers was the need for policy changes from the top down and tenants/occupants must understand their role in helping the city reach the energy reduction goal. One participant offered that larger buildings will rely more on technology and smaller/older buildings will rely more on behavior to reach the goal of SEN. Another participant stated that his biggest obstacle to reducing energy consumption was controlling the after hours usage.

Capital dollars need to be committed to this goal because in many buildings, the low hanging fruit has already been picked. Rebates and tax incentives help this conversa tion since many times the payback is too long for the decision makers. Money also needs to be dedicated to proper maintenance of energy efficient equipment which is necessary but not exciting; for example, removing the biofilm build up on chillers it's hard to see the benefits of your investment. Some facility managers felt that reaching the 20% energy use reduction would take place through equipment modifications and replacement.

Regarding behavior changes the audience felt more education, promotion and advertising needs to be done to make energy efficiency part of the office worker's daily routine. There also needs to be leadership to change the work culture and achieve buy in from the office workers. The perception was expressed that tenants do not want to participate because they do not care or see the benefits of SEN. It was also stated that behaviors are fluid due to turnover of employees and tenants. Facility managers said they have not observed many people viewing the SEN kiosks and that SEN is still new so more information needs to be shared with the workforce to affect behavior change.

What energy efficient enhancements would you like to pursue?

The energy efficient wish list was broad and ranged from costly to feasible and demonstrated that policies could make many of these enhancements much easier to achieve.

- Install LED lights
- Conduct retro commissioning
- Conduct energy auditing
- Utilize alternative and renewable energy
- Implement better chiller control strategies
- Recover waste heat
- Implement proactive strategies
- Replace windows or install glass film and shade blinds
- Install white roofs and/or green roofs
- Install solar on the roof
- Utilize daylight harvesting
- Have a better BAS with an online override request
- Change lighting from T12 to T8
- Mandate weekend temperatures to be on call instead of constant
- Behavior changes
- Cooling tower upgrades (from galvanized to PVC)
- Automation system upgrades (pneumatics to DDC)
- Building optimization tool
- Improve regular maintenance and subscribe to continuous commissioning
- Get the building back to the design then seek further upgrades
- Make energy a consideration in new projects

What behavior changes would you like to see within your building?

The facility managers offered great insight into this com ponent of the SEN program. Education was mentioned over and over along with the need to share best practices with the occupants. In addition, the need to understand the individuals role in helping the City achieve the goal through simple actions like wearing appropriate seasonal attire, explaining the need for after hours climate control. An economic incentive for behavior change could occur if departments were charged for their energy usage and if individuals could "see" their usage and its impact through monitors and meters. However, some facility managers acknowledged that billing by use is difficult to control and impractical, by floor is a reasonable extent of this concept.

Education of outside contractors who work in the building and their role in the energy management plan such as janitorial procedures regarding lights, cleaning and waste was also cited as an important component of success. Overall, the participants agreed that policy creation, buy in and communication is the best way for tenants and oc cupants to become advocates for energy savings and understand that temperature settings may not be as flex ible as they once were. This requires a corporate culture change in regards to energy conservation. Facility managers suggested that occupants of the work spaces need to understand the bigger picture of energy savings and how small changes may affect the goal such as not using handicap access unless necessary, using revolving doors, not bringing small appliances (lamp, radios, and computers) to work and allowing motion sensors/occupancy sensors to work as programmed.

Conclusion

Information from the March 2012 event will be shared with participants in SEN and parties outside of the SEN geography interested in energy use reduction programs. Duke Energy, USGBC Charlotte Region Chapter and IFMA Charlotte are planning a follow up program to this one that will address and provide resources for the top three issues of concern. This event will take place in June 2012.

Of 45 attendees, 10 were organizers and Duke Energy support staff and 35 were targeted SEN participants. 22 surveys were completed which is 63% of the participants. The results were overwhelmingly positive and guests are interested in continuing the discussions, networking and learning at the June 2012 meeting.

The results are presented here:

Did you find the topic of Smart Energy Now Facility Manager Best Management Practices relevant to your work? **Yes 22/22**

Did you find the content of high quality and informative? **Yes 22/22**

Were there any sustainability practices that you will take back to your company and implement from this session? **Yes 20/22**: Lighting upgrade, educating man agement and tenant, behavior changes, adjusting econo mizer temperatures, education, getting all to understand what can be done, ASHRAE inspections, janitorial key for lighting controls, induction lighting, better education, behavior change, separate Duke submeters for individual consumption (convert leases) **No 2/22**: Already doing what was discussed, no new practices were introduced.

Would you attend part 2 of this session? **Yes 21/22** and one survey with no answer.

How can we improve? More in depth energy classes, provide a list of items for improvements to all attendees, add new information, supply email with meeting summary afterwards, more networking time, more focused group.

General feedback or comments: great start for this kind of meeting, round table is good for networking.

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Whitepaper 2

Smart Energy Now® (SEN) is an initiative through Duke Energy and Envision Charlotte that is motivating Charlotte's Center City workforce to conserve energy through small changes in daily routines. Our goal is a 20% reduction by 2016. SEN encourages uptown owners, tenants, employees and Charlotte-area stakeholders and leadership, to invest in Charlotte's future by educating the uptown workforce on what they can do to reduce energy consumption while at work. The goal is for uptown Charlotte to prosper by attracting new businesses, new talent, and other economic development opportunities by becoming the most sustainable urban core in the country.

The collaboration with the USGBC Charlotte Region Chapter, IFMA Charlotte and Duke Energy continues as we conducted our second town hall meeting with building owners, facility managers, tenants and occupants. The meeting was held at the Bank of America Conference Center at 1 Bank of America on June 21. The subject matter was shaped by input from the first Town Hall Meeting, held March 15 at the NASCAR Hall of Fame. Instead of roundtable discussions, the format for this meeting involved subject matter experts leading discussions on topics of interest raised at the previous meeting.

The results of this discussion are presented here.

What's been happening with Smart Energy Now?

Vincent Davis, Director of Smart Energy Now (SEN), quickly reviewed what Envision Charlotte and SEN are doing in pursuit of reaching their goal of reducing energy usage in Uptown. The SEN team has been engaging the tenants of participating buildings to sign a "Declaration of Change", which is a non legal, non binding document that expresses their commitment to make a change in energy usage in their offices. Thus far, this initiative has been a success, as more and more offices are signing up every day.

Envision Charlotte and SEN have also worked with the Environmental Defense Fund (EDF), securing an EDF Climate Corps Fellow for the summer. The Fellow will work on two projects through the summer: (1) outlining strategies for facility managers to promote energy conservation with overnight cleaning crews through incentives and technological investments, and (2) creating the framework for a non monetary recognition program for facility managers and buildings that are leaders in energy efficiency in Uptown Charlotte.

Vincent Davis, Director of Smart Energy Now, speaks to the attendees of the Smart Energy Now Town Hall meeting (Credit: Morgan Zemaitis)

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Justin LaRoche, Project Manager at Duke Energy, reviewed the Compass Tool with the audience at the Smart Energy Now Town Hall meeting. (credit: Morgan Zemaitis)

Compass tool

Justin LaRoche, Project Manager for Duke Energy, reviewed the Compass Tool. Each facility manager participating in Envision Charlotte and SEN has access to this tool, which provides real time and historical energy usage informa tion for the facility manager's building. Envision Charlotte and SEN want to increase the usage of this tool, as it helps facility managers monitor their building's individual usage and target areas in which they can make adjustments and improvements. The raw data available through the Com pass Tool should be within a range of 2% of the billing data. SEN is looking into incorporating the recognition program mentioned above into the Compass Tool, so facility manag ers can track their own actions and receive points toward the program.

Re-Engineering Existing Buildings to Achieve High Performance Operations

Paul Ehrlich, founder of Building Intelligence Group, LLC, was the guest speaker. His presentation focused on the need for facility managers to find ways to target necessary energy efficiency changes and then implement those changes. Many organizations are able to target the low hanging fruit, which results in a 5 to 10% improvement. But how do those organizations move beyond that low threshold?

Buildings and processes change over time. Oftentimes, these changes result in a building becoming less efficient. It is important to create a baseline for current building op erations. From that baseline, initial and continuous commis sioning can bring that building back to its original design efficiency. Once the original efficiency is achieved, the build ing can then be re engineered to reach high performance operation.

With the building equipped to maximize efficiency, facility managers are able to create a new performance baseline that is sustainable, meaning it will stay the same. Behavioral change and other non technical approaches can then be enacted to attain that maximization level. It is essential to have the tools in place to be successful in combination with behavioral changes.

Track 1: Energy accounting and benchmarking; Utility rates and rate structures; Life cycle costs

Shane Nault of Building EnergetiCx and Charlie Barron of Duke Energy spoke to the participants in Track 1 about capitalizing on energy efficiency and understanding utility rates and rate structures. It is important for facility managers to understand how their building is performing, to recog nize the different types of energy and fuel used, and to understand the related energy units. Through basic energy accounting, facility managers can develop a road map by establishing goals that are clear, measurable, achievable, time constrained, and communicated.

There are a number of charges included in a utility bill: customer charges, energy charges, demand charges, and more. Knowing what these charges are and how they are calculated is critical to understanding how to reduce ener gy usage. For example, the demand charge drives the utility system and is the rate at which a building is consuming energy. For Duke Energy customers, the highest sustained 30 minute period dictates the demand charge. By knowing how to interpret their utility bill and utilizing the Compass Tool to identify opportunities, facility managers can more accurately target areas for potential savings.

Guest Speaker Paul Ehrlich, founder of Building Intelligence Group, addresses the crowd at the Smart Energy Now Town Hall meeting. (Credit: Morgan Zemaitis)

Emily Scofield of the USGBC Charlotte Region Chapter, David Stephenson of Little Diversified Architectural Consult ing, and consultant Bryan Starrette spoke about life cycle costing and some important technological investments that can reduce energy usage. Of the top energy efficiency investments, lighting controls, building automation systems, and variable frequency drives can make a real difference in decreasing energy usage and increasing energy conserva tion. Savings up to 30 50% could be realized through the installation and utilization of these technologies.

Track 2: Energy audits; conducting internal audits; audit scorecards; outside auditors – services provided and implementing recommendations

Dom Lempereur of Lime Energy, Dank Pinckney of Abun dant Power, and Bill Flye of Duke Energy spoke to the participants in Track 2 about energy audits, how to conduct them, and how to implement the resulting recommendations. Lempereur compared an energy audit to a doctor's diagnosis. The results from an audit are like a prescription for a patient. Energy audits can give you a baseline of understanding how your building operates, but also gives suggestions on improving the building and saving money. They are also required in order to achieve LEED or Energy Star certification.

There are three levels of energy audits. Level 1 audits include the primary steps of determining how a building is doing in terms of efficiency and operation. The auditor will examine the building and identify low cost methods of reducing energy expenditures, usually by approximately 3 to 4%. Level 2 audits are the most common type of energy audit. These audits pinpoint more decision making opportunities for reducing energy, including technological investments and upgrades. Level 3 audits are the most intensive and provide in depth engineering and design information.

Dank led a discussion about how to implement energy efficiency projects. In order to finance these projects, certain pieces of information must be analyzed such as the amount of corporate debt, the projects' effects on the balance sheet, the cost of borrowing, and available government rebates and incentives among other things. In order to develop a proposal to present to management, it is important to show the project's payback period and internal rate of return. If an organization can decrease operating expenses, the value of the organization's real estate will increase.

Bill Flye spoke about energy efficiency incentives that are available from Duke Energy. Efficiency is big business for Duke Energy. More efficient energy usage means that Duke Energy can delay the need to build more power plants to meet increasing demand. In order to help commercial office buildings become more efficient, Duke Energy provides two kinds of incentives: prescriptive and custom. Prescriptive incentives are applied after the equipment is purchased. Custom incentives are applied for before the equipment is purchased. Both types of incentives help to offset the costs of investing in technology to help commercial office buildings become more energy efficient. Duke Energy also provides programs for various building owners to help navigate the incentive process, including sharing costs related to engineering and assessments as well as providing data to maximize targeted incentives.

Conclusion

Information from the June 2012 event will be shared with participants in SEN and parties outside of the SEN geography interested in energy use reduction programs. Duke Energy, USGBC Charlotte Region Chapter and IFMA Charlotte are planning a follow up program that will incorporate comments and concerns raised at the June meeting and will take place in Fall 2012.

Of 59 attendees, 16 were organizers and Duke Energy support staff and 43 were targeted SEN participants. 22 surveys were completed which is 37% of the participants. The results were overwhelmingly positive and guests are interested in continuing the discussions, networking and learning at the next meeting.

Capitalizing on Energy Efficiency: Survey results
22 surveys were returned, N/A = no response

Did you find the topic of Capitalizing on Energy Efficiency relevant to your work? **Yes 22/22**

Do you feel like your facility management practices contribute to Charlotte reaching the 20% energy use reduction goal of Smart Energy Now? **Yes 16/22, No 3/22 and N/A 3/22**

Were you motivated by the keynote speaker, Paul Ehrlich? **Yes 19/22, No 2/22 and N/A 1/22**

From today's content, will you implement/recommend any energy efficiency ideas in your facility? **Yes 18/22, No 0/22 and N/A 4/22**

Would you attend a future Smart Energy Now session geared toward facility managers? **Yes 20/22, No 1/22 and N/A 1/22**

What topic or format would you recommend for a future SEN facility manager/property manager session?
Best Practices from SEN Facility/Property Managers: 18
SEN Building Tours: 13
Energy Efficiency Product Fair: 10
Other: Real examples of facility managers success stories & problems, green leases, how to store and access energy data

Presentation Ratings (scale of 1 3 with 3 being the best):

	1	2	3
Energy Accounting and Benchmarking by S. Nault and C. Brown (Primary Track)	2	3	6
Life Cycle Costing by E. Scofield, D. Stephenson, B. Starrette (Primary Track)	2		6
Energy Audits by D. Lempereur (Secondary Track)	1	3	4
Finances, the green light for energy efficiency projects by D. Pinckney (Secondary Track)	1	3	5

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Whitepaper 3

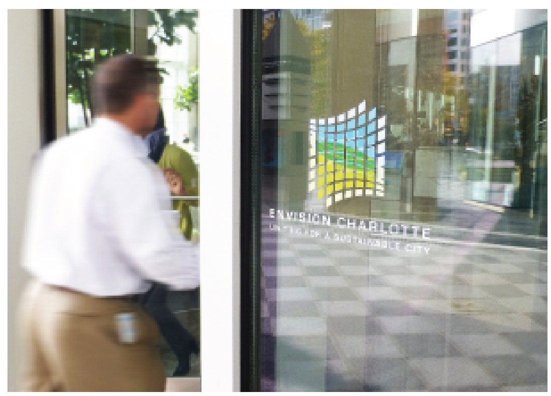
Smart Energy Now® (SEN) is an initiative through Duke Energy and Envision Charlotte that is motivating Charlotte's Center City workforce to conserve energy through small changes in daily routines. Our goal is a 20% reduction by 2016. SEN encourages uptown owners, tenants, employees and Charlotte-area stakeholders and leadership, to invest in Charlotte's future by educating the uptown workforce on what they can do to reduce energy consumption while at work. The goal is for uptown Charlotte to prosper by attracting new businesses, new talent, and other economic development opportunities by becoming the most sustainable urban core in the country.

In partnership with Duke Energy, the USGBC Charlotte Region Chapter has developed a building recognition program to support Smart Energy Now. The objective of this program is to celebrate great work and progress by buildings and facility managers and facility engineers. This is not a competition but simply an acknowledgement of achievements.

Using Compass data from February 2012 through February 2013, USGBC will calculate the Energy Use Index (EUI) kWh/sf to recognize buildings for their improvement. Don't worry, the data will be presented to USGBC with an identifying number and not a building name so your information will remain confidential.

To support facility mangers in making operational and behavioral changes we will be accepting nominations for those who have implemented changes to reduce energy use.

The Building Recognition Program will culminate in a celebration ceremony in March. Your building will be notified of their recognition in advance and will have the option to accept or decline the positive publicity. In the meantime, USGBC will provide monthly updates and share best practices to achieve the energy use reduction goal of Smart Energy Now.



Thank you in advance for your support and please let me know if you have any questions. We look forward to recognizing your impressive work next spring.

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On Thursday, November 8th Duke Energy hosted property management professionals to discuss energy efficiency. The notes from our round table discussions are presented here.

Do you have examples of energy efficiency improvements undertaken in your building?

- Parking Garage:
  - Replace metal halide fixtures with T5 lamps as the old fixtures age out
  - This has been a 3 year transition
  - They are looking into controls as the next improvement to avoid running 24x7
  - REASONS why this was an easy sell:

    Energy savings
    Staff conveniences
    Man hour savings
    Old fixtures cost $450 and new ones cost $100
    Duke incentives on fixture upgrade
    T5 life is 50k hrs vs. metal halide life 20k hrs
- Hines is pushing improvements as tenants up fit spaces & finds this is an easier method than trying to implement requirements while a tenant is settled in a space.
- Began talking with each tenant about Saturday operations. It was in their lease automatically for the building to be operational each Saturday between 8 1. NOW, power is on only if the tenant called ahead for Saturday work. This saves everyone money and reduces wasted energy.
- The property managers are looking at efficient operations and this was an identified area. These conversations started before SEN.
- Working on an HVAC prototype
- Chiller plant optimization aim for 15 30% improved efficiency
- Retrocommissioning revealed fresh air intakes were sized too big so changing to smaller units to increase efficiencies.
- Drop back the static pressure on the air handler to less than 4". Most are set by the installer at 4" but that is typically much more than necessary.
- Quarterly poster for occupants comparing Duke Energy buildings on a 12 month rolling avg. This is a form of education and competition that improves efficiencies and helps occupants understand their role in EE.

Attendees of the Smart Energy Now Town Hall meeting discuss energy saving ideas on November 8.

What is the financial justification for EE improvements?

- Management has pushed by asking, "what else can you do to show savings...additional ECMs?"
- Safety by eliminating space heaters
- Plug load management Smart power strips are only $20 25 and when someone shuts off a computer, the entire plug load powers down.
- Tenant 'green' programs Receive plaques
- Awards for building performance

  Sustainability leaders are awarded
  Results in company savings

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Appendix H: Comparing Program Participation for Residential Smart $aver HVAC and Non-Residential Smart $aver

We compared the participation levels in four Duke Energy efficiency programs (Residential Smart $aver HVAC, Residential Personalized Energy Report, Non-Residential Smart $aver Custom, and Non-Residential Smart $aver Prescriptive) between the Charlotte metro and other Duke Energy territories over the years 2011 and 2012. The results for Residential Personalized Energy Reports (PER) indicate possible effects of the SEN program on participation, and these are included in the main body of this report. The results for Residential Smart $aver HVAC, Non-Residential Smart $aver Prescriptive and Non-Residential Smart $aver Custom do not indicate an effect of the SEN program on participation, and are covered in this appendix.

Comparing Program Participation: Residential Smart $aver HVAC

Figure 36 shows participation in the Residential Smart $aver program for the years 2011 and 2012. While participation during this timeframe declined in Charlotte (-21%) and the surrounding metro area (-26%), the rate of decline was even higher in the rest of the Carolinas (-29%). Across all Duke Energy Territory outside of the Charlotte area, participation fell by a slightly lower -18% during this timeframe.

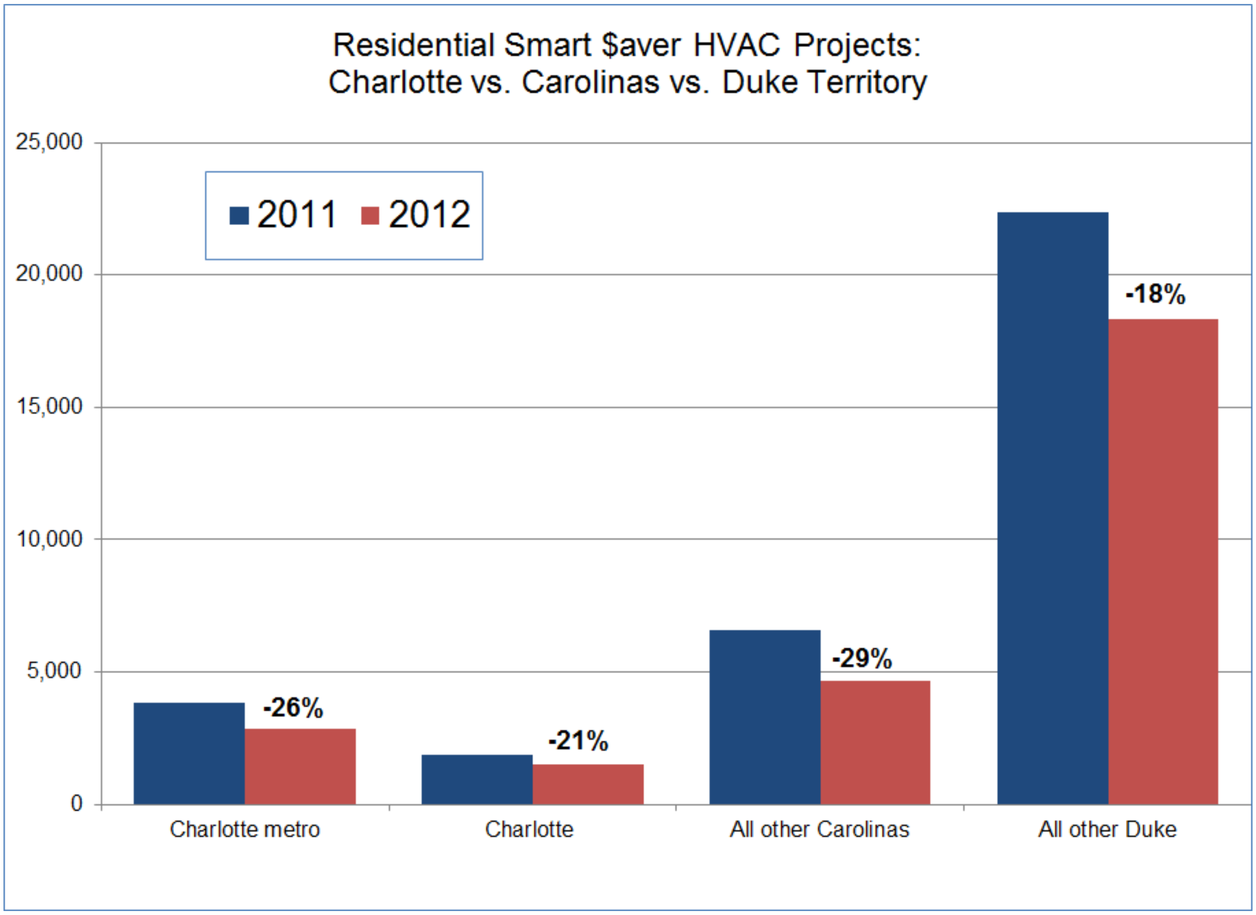

Figure 36. Residential Smart $aver HVAC Projects: Charlotte vs. Carolinas vs. Duke Territory

The next series of charts compares participation in Charlotte and the surrounding metro area with other Duke Energy markets. Figure 37 compares participation in Charlotte with participation in Cincinnati; while the number of projects completed in both of these central cities fell by -21%, the rate of decline was less in the larger Cincinnati metro (-12%) than in the Charlotte metro area (-26%).

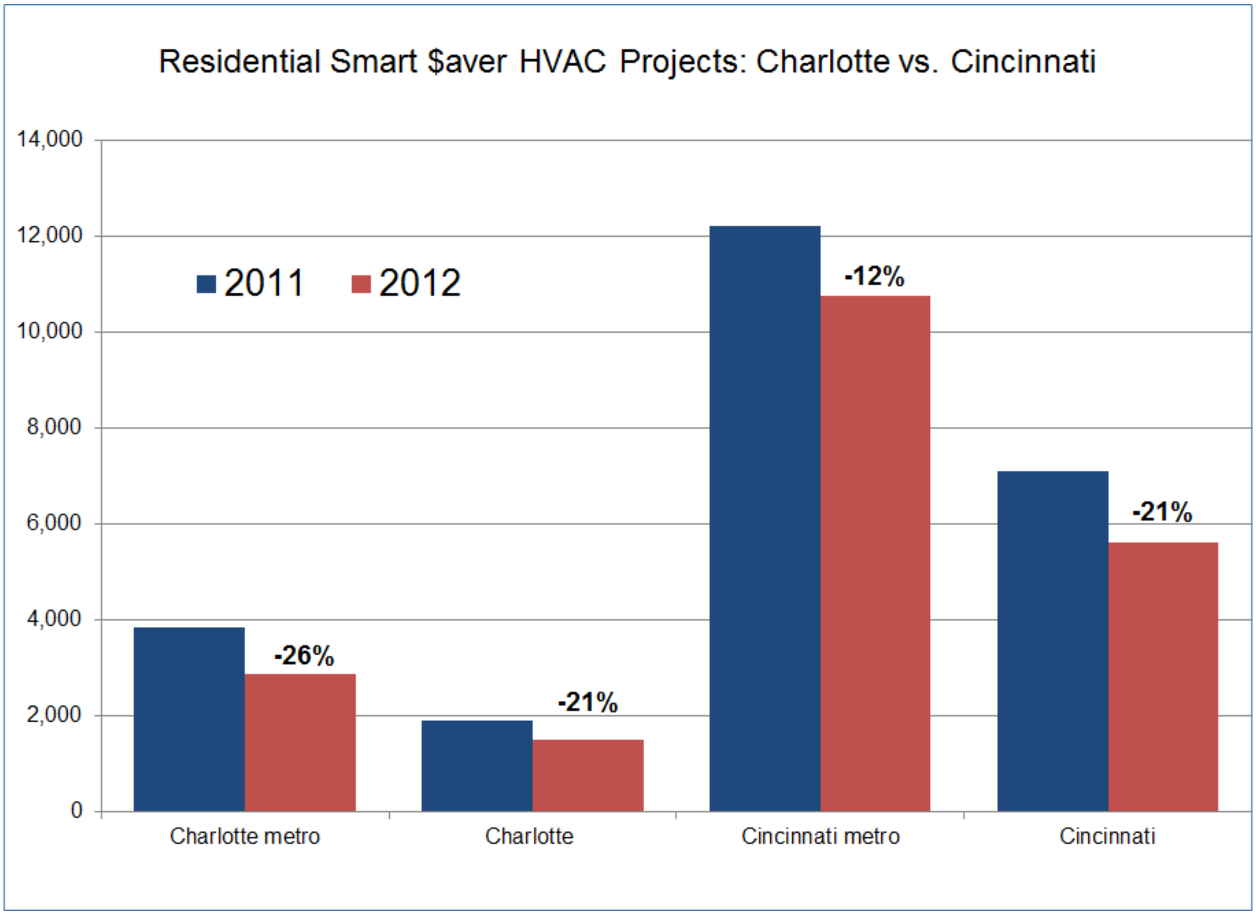

Figure 37. Residential Smart $aver HVAC Projects: Charlotte vs. Cincinnati

Charlotte is compared to the Greensboro/Winston-Salem area in Figure 38. Over the years 2011 and 2012, participation fell faster in Greensboro/Winston-Salem (-36% city, -34% metro) than in Charlotte (-21% city, -26% metro). Across all Duke Energy territory in the Carolinas, the number of projects fell by -28%.

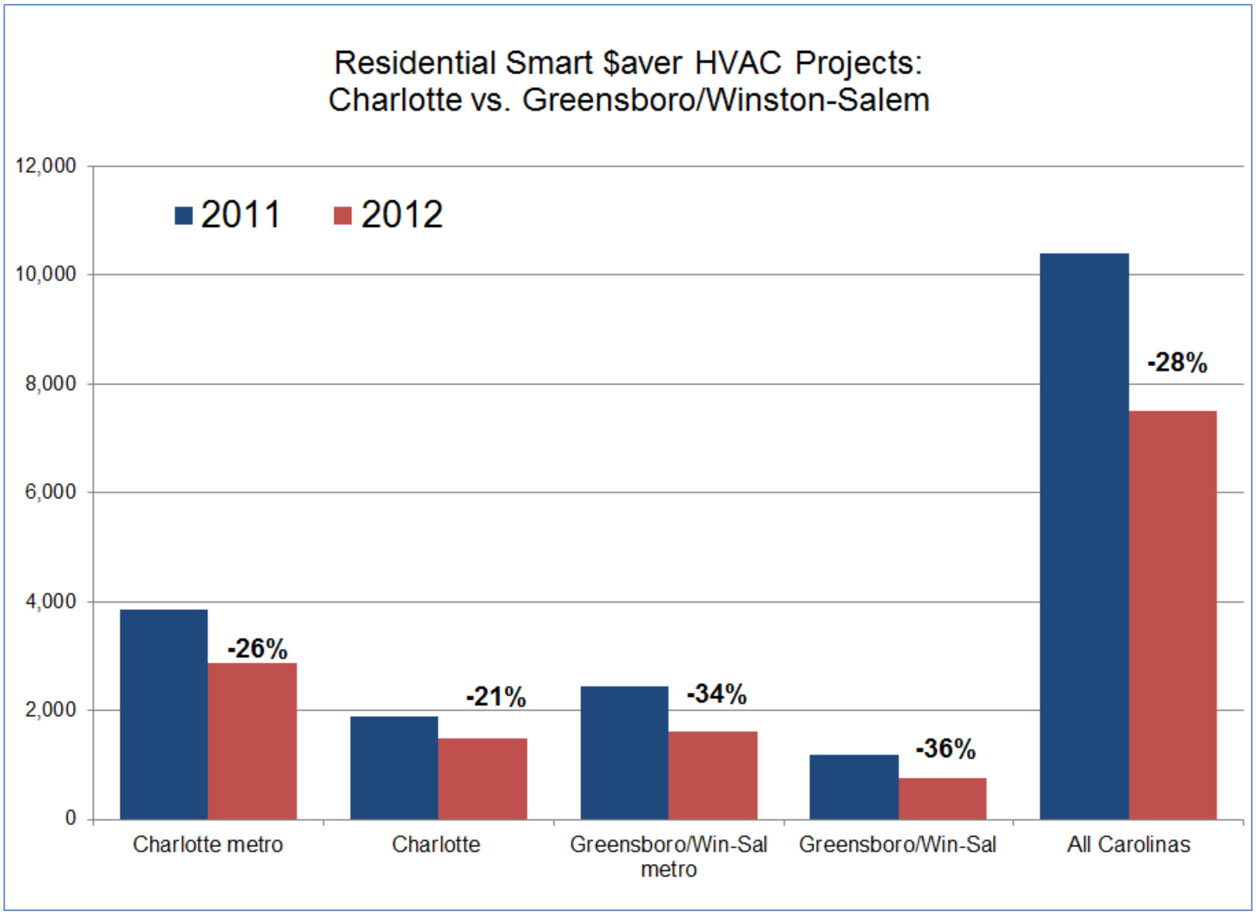

Figure 38. Residential Smart $aver HVAC Projects: Charlotte vs. Greensboro/Winston-Salem

Figure 39 compares participation in Charlotte with Greenville, SC. Participation in Greenville fell at a slower rate (-8% city, -19% metro) than in Charlotte (-21% city, -26% metro) from 2011 to 2012.

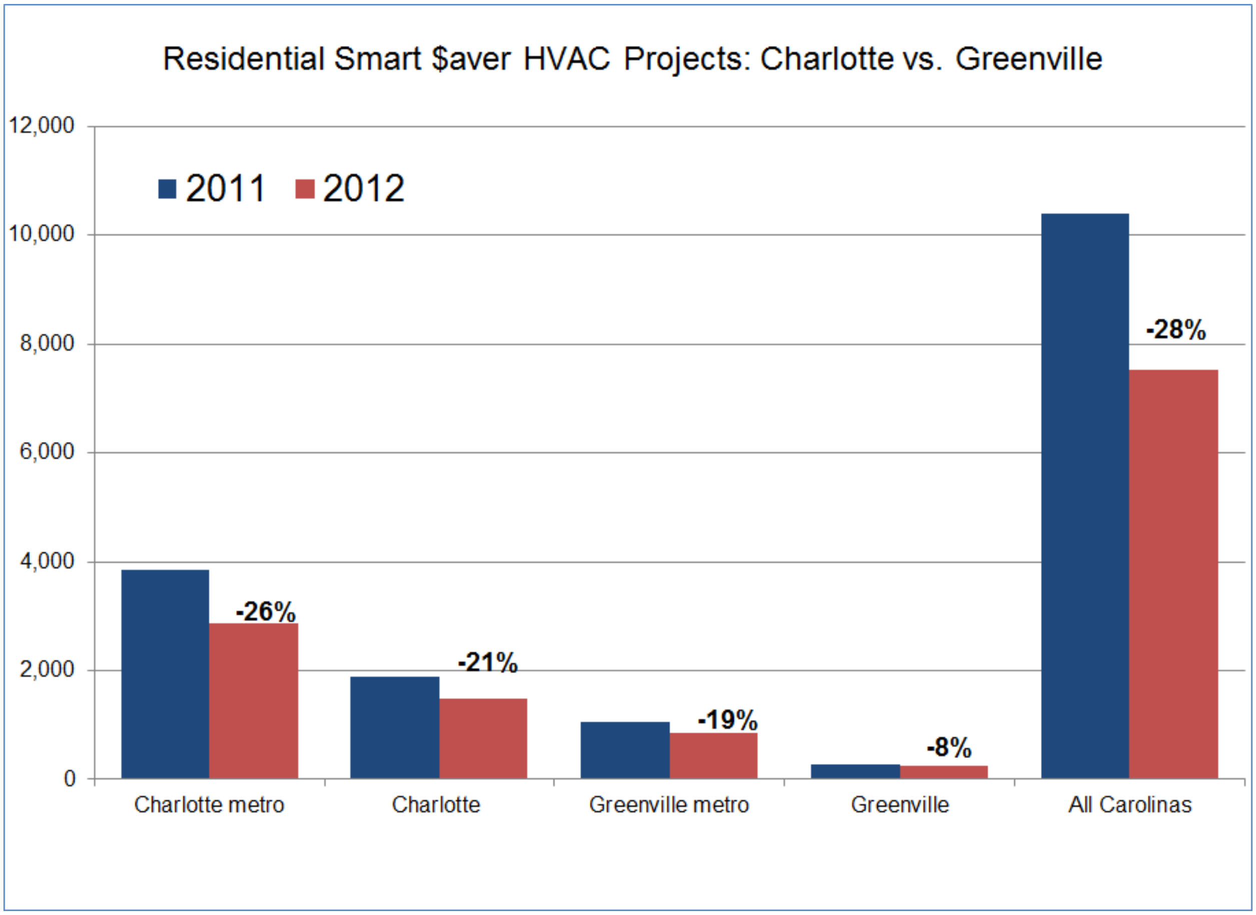

Figure 39. Residential Smart $aver HVAC Projects: Charlotte vs. Greenville

Table 7 shows the statistical significance levels[17] of the rates of change in this program from 2011 to 2012, comparing the Charlotte metropolitan area with the other Duke Energy territories as seen in the preceding charts in this section. The decline in participation in 2012 in the Charlotte area was significantly larger compared to "all other Duke Energy Territory", but not compared to "all other Carolinas". In the market-to-market comparison, Charlotte declined significantly more than Cincinnati, significantly less than Greensboro/Winston-Salem, and the rate of decline was not significantly different from that in Greenville.

This is a mature program in Duke Energy's efficiency program portfolio, which is why participation is trending downward across all territories. In addition, Duke Energy switched vendors for this program during the third quarter of 2012, indicating a program in transition during the period of this evaluation. Thirdly, since this program deals with heating and cooling, climate and temperature (and building type and economic) differences between the Midwest and Southeast may be a confounding factor. The most meaningful comparison for this program (Charlotte Metro vs. "all other Carolinas") is not statistically significant. There is no apparent effect of the Smart Energy Now program on participation in Residential Smart $aver HVAC.

[17] The statistical test used in all tables that compare the rate of change between Charlotte metro and other markets is Pearson's chi-square for 2-way effects (log-linear contingency table analysis).

Table 7. Residential Smart $aver HVAC Projects: Significance Tests

Residential S$ HVAC	Change from 2011 to 2012		
	Comparison market	Charlotte metro	Significance level
All other Duke Energy	-18%	-26%	p<.01
All other Carolinas	-29%	-26%	not significant
Cincinnati metro	-12%	-26%	p<.01
Greensboro/ Winston-Salem metro	-34%	-26%	p<.01
Greenville metro	-19%	-26%	not significant

Complete participation numbers for the Smart $aver HVAC program for all Duke Energy territories can be found in Appendix J: Total Program Participation in Four Duke Energy Programs 2009-2012.

Comparing Program Participation: Non-Residential Smart $aver Prescriptive

The number of Non-Residential Smart $aver Prescriptive projects completed in Charlotte and other Duke Energy territories are shown in Figure 40. The total number of projects completed in the city of Charlotte fell -12% over the years 2011 to 2012, though when the entire Charlotte metro area is included the number of projects completed was up +1%. In the Carolinas excluding the Charlotte metro area, the number of completed projects fell by -8%, and in all Duke Energy territory outside of Charlotte participation was flat (+0%).

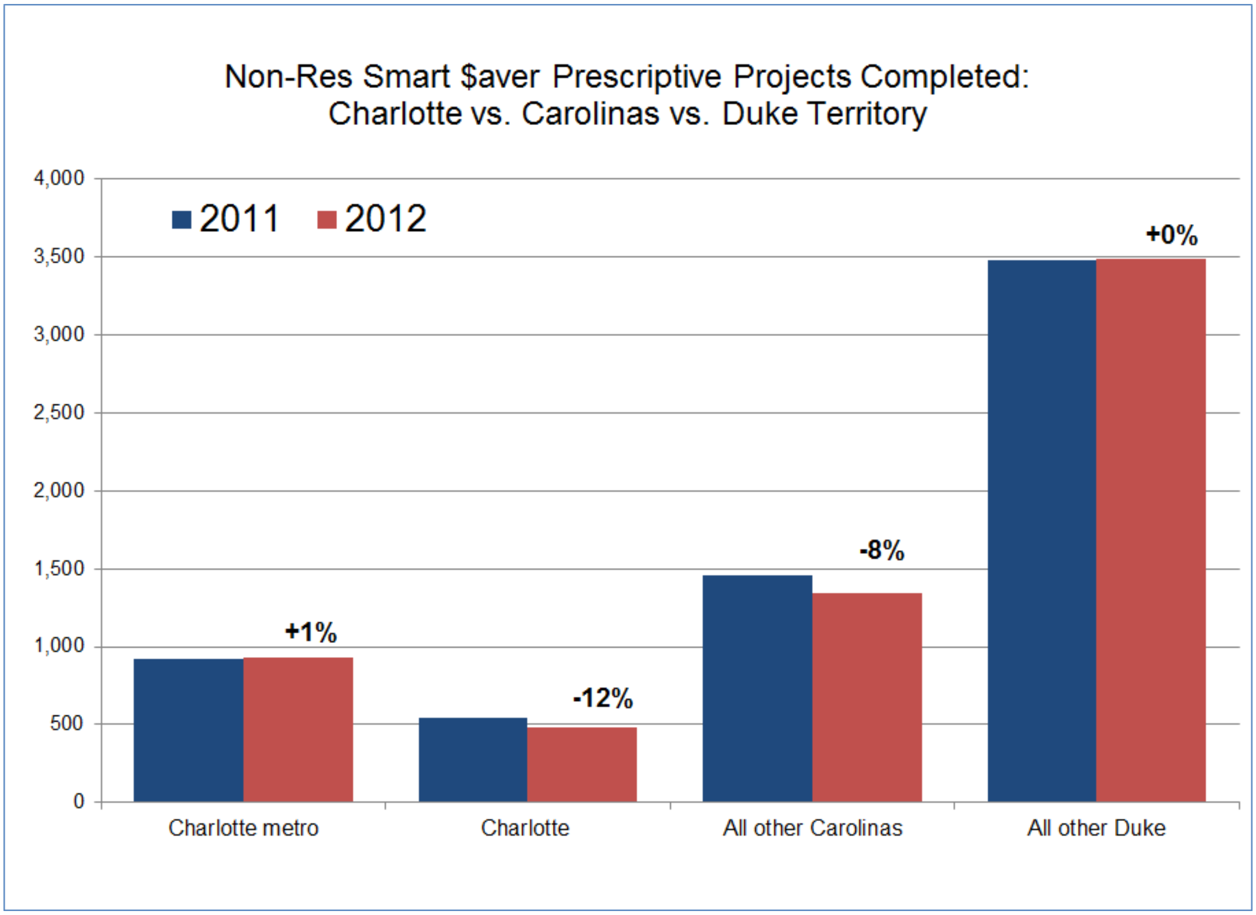

Figure 40. Non-Residential Smart $aver Prescriptive Projects: Charlotte vs. Carolinas vs. Duke Territory

Figure 41 compares Non-Residential Prescriptive projects completed in Charlotte with Cincinnati. While the number of projects completed in the Charlotte metro area was essentially flat (+1%) over the years 2011-2012, the number of projects completed increased in the Cincinnati metro (+28%) as well as in the city of Cincinnati (+32%). According to Duke Energy management, this may partly be due to a larger number of older buildings in the Cincinnati area compared to the Carolinas, thus presenting more opportunities for enrollment. There were also adjustments to program incentives in Ohio during the period of this evaluation which may have driven the increase in participation in the Cincinnati area.

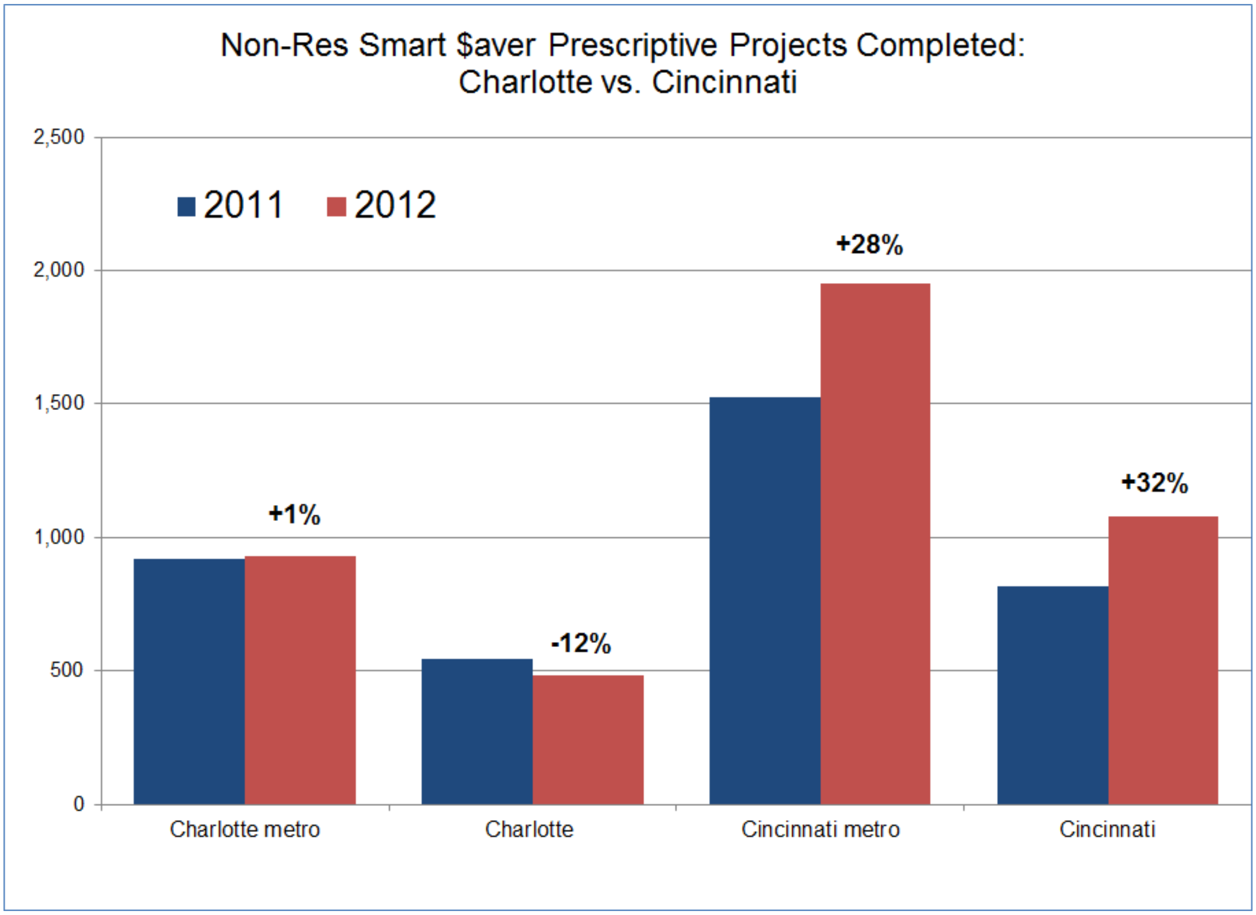

Figure 41. Non-Residential Smart $aver Prescriptive Projects: Charlotte vs. Cincinnati

Greensboro/Winston-Salem has seen moderate growth in this program over the last year (+14% in the city, +15% for the entire metro area), outpacing growth in the Charlotte area (-12% city, +1% metro), as seen in Figure 42. Across all of the Duke Energy Carolinas territory (including Charlotte), the number of completed projects declined -4%.

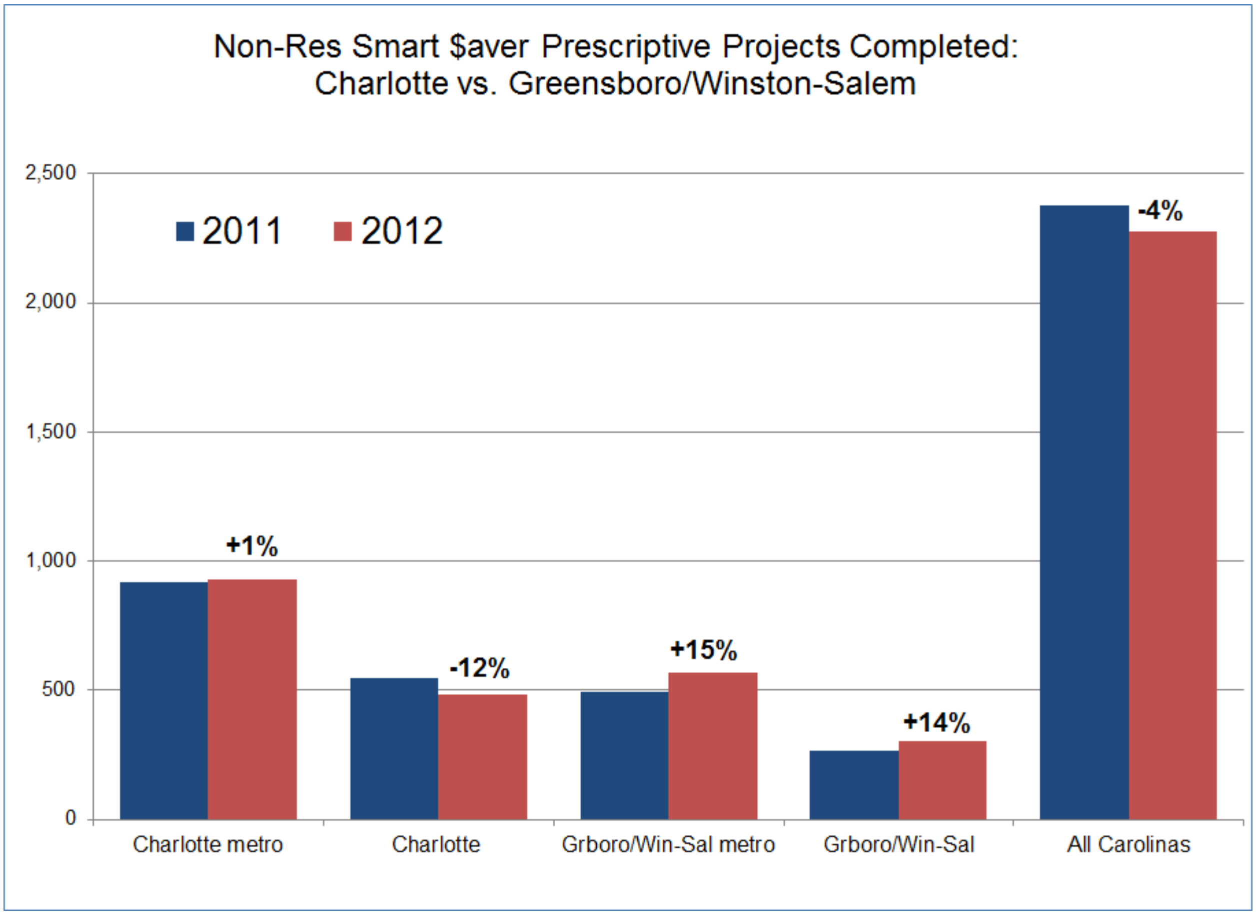

Figure 42. Non-Residential Smart $aver Prescriptive Projects: Charlotte vs. Greensboro/Winston-Salem

Figure 43 compares program participation in Greenville to that in Charlotte. The number of completed projects in the city of Greenville (-22%) fell faster than in the city of Charlotte (-12%), and while participation in the greater Charlotte metro area grew slightly (+1%), it fell in the Greenville metro area (-17%).

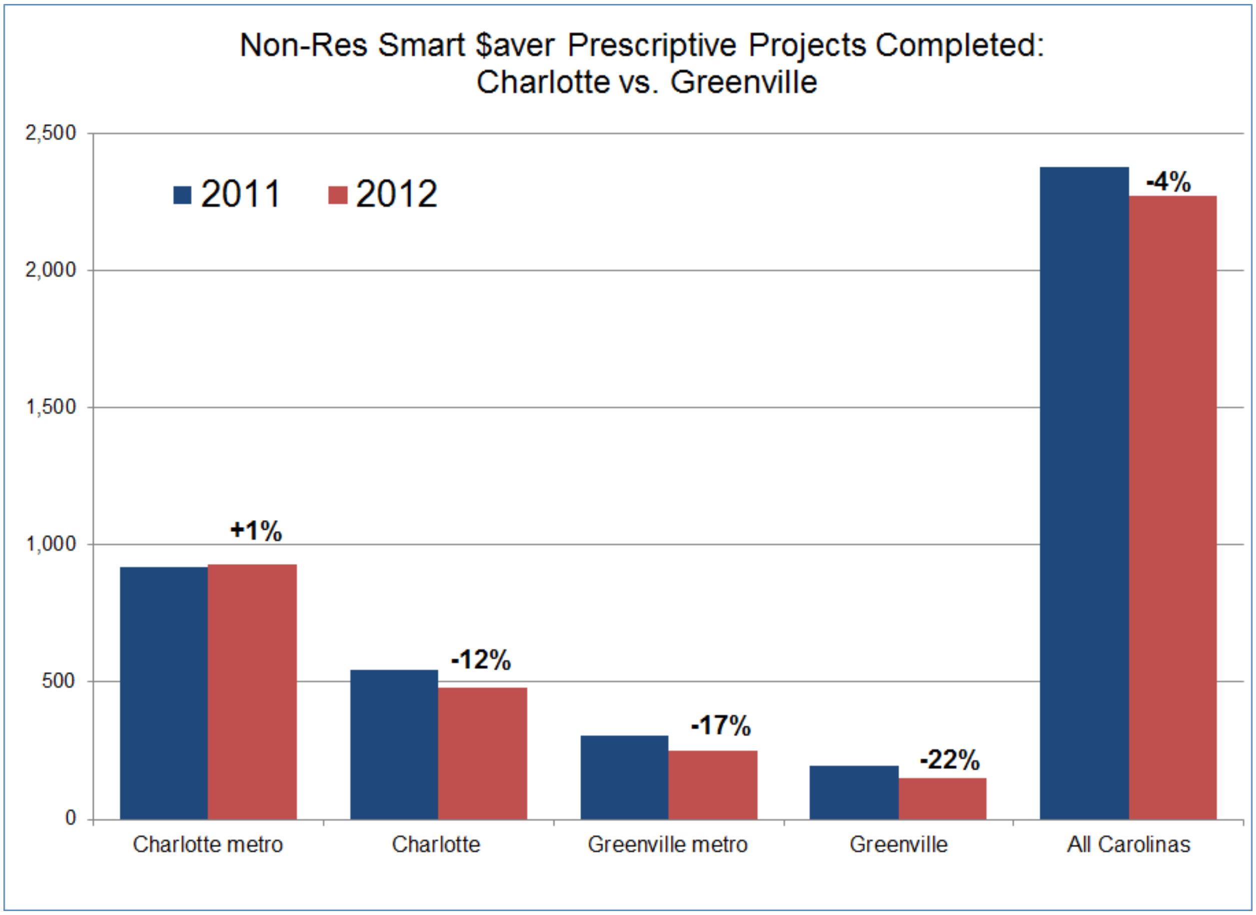

Figure 43. Non-Residential Smart $aver Prescriptive Projects: Charlotte vs. Greenville

Table 8 shows the statistical significance levels of the rates of change in this program from 2011 to 2012, comparing the Charlotte metropolitan area with the other Duke Energy territories as seen in the preceding charts in this section. Growth in this program in the Charlotte area was essentially flat (1%), and was not significantly different from the rate of growth in the “all other Duke” (0%) or “all other Carolinas” (-8%) comparison groups. However, growth was significantly higher in the Cincinnati area (28%) and Greensboro/Winston-Salem (15%) compared to Charlotte, though Greenville had significantly lower (negative) growth (-17%). Although the direct market comparisons to Greenville and Greensboro/Winston-Salem are significant (in different directions), the comparison of the Charlotte metro to “all other Carolinas” is not significant. Although there may be other city or state-level factors not accounted for in this analysis, based on these findings we cannot conclude that Smart Energy Now is driving higher levels of participation in this program.

Table 8. Non-Residential Smart $aver Prescriptive Projects: Significance Tests

Non-Residential S$ Prescriptive - Projects Completed	Change from 2011 to 2012		Significance level
	Comparison market	Charlotte metro	
All other Duke Energy	0%	1%	not significant
All other Carolinas	-8%	1%	not significant

Cincinnati metro	28%	1%	p<.01
Greensboro/ Winston-Salem metro	15%	1%	p<.10
Greenville metro	-17%	1%	p<.05

The total number of Non-Residential Smart $aver Prescriptive projects completed across Duke Energy territories are listed in Appendix J: Total Program Participation in Four Duke Energy Programs 2009-2012.

Comparing Program Participation: Non-Residential Smart $aver Custom

The Non-Residential Smart $aver Custom program differs from some other Duke Energy programs in that the projects and measures are customized for each customer, and involve a fair amount of prospecting on the part of Duke Energy representatives. Since these representatives are assigned to geographical territories, this factor cannot be separated for a geography-based analysis (i.e., if a particular market is doing very well or very poorly, it could be because of local market factors, or it could be due to the effectiveness of different local representatives in getting customers to participate).

Non-Residential Smart $aver Custom: Projects "Closed and Won"

Figure 44 shows the number of projects marked as "closed and won" across Duke Energy territories. There was strong growth in Charlotte (+142%) and the greater Charlotte metro area (+113%), and also the rest of the Carolinas (+85%) and all Duke Energy territory outside of the Charlotte Metro (+111%).

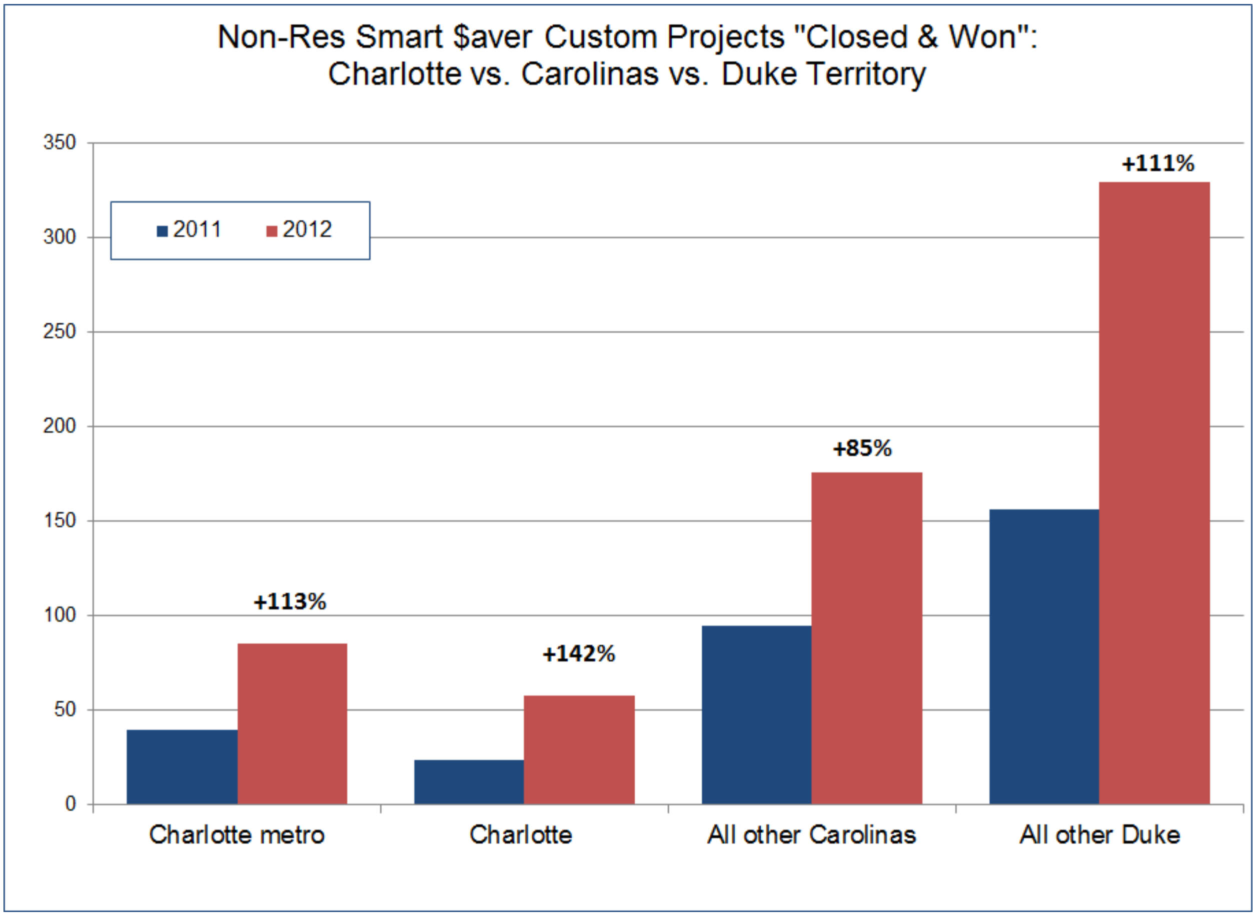

Figure 44. Non-Residential Smart $aver Custom Projects "Closed and Won": Charlotte vs. Carolinas vs. Duke Territory

Participation in this program for Duke Energy's two largest markets, Charlotte and Cincinnati, are compared in Figure 45. The number of projects closed and won more than doubled in both markets in 2012.

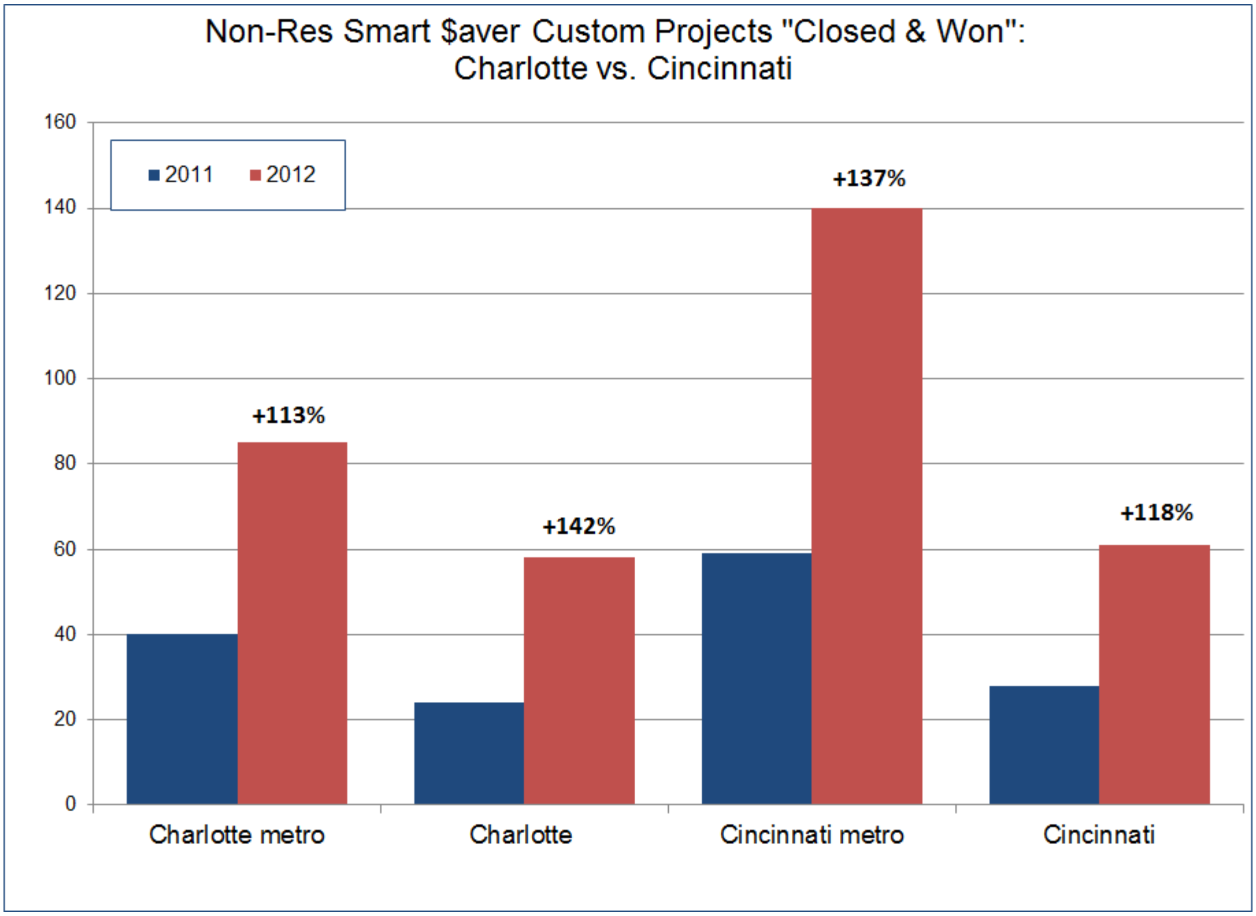

Figure 45. Non-Residential Smart $aver Custom Projects "Closed and Won": Charlotte vs. Cincinnati

Figure 46 compares the number of projects completed in Charlotte with Greensboro/Winston-Salem. Both markets more than doubled the number of projects "closed and won" from 2011 to 2012, but the rate of growth in Greensboro/Winston-Salem (+191% city, +244% metro) was even higher than Charlotte, although Greensboro/Winston-Salem was starting from a lower level of participation.

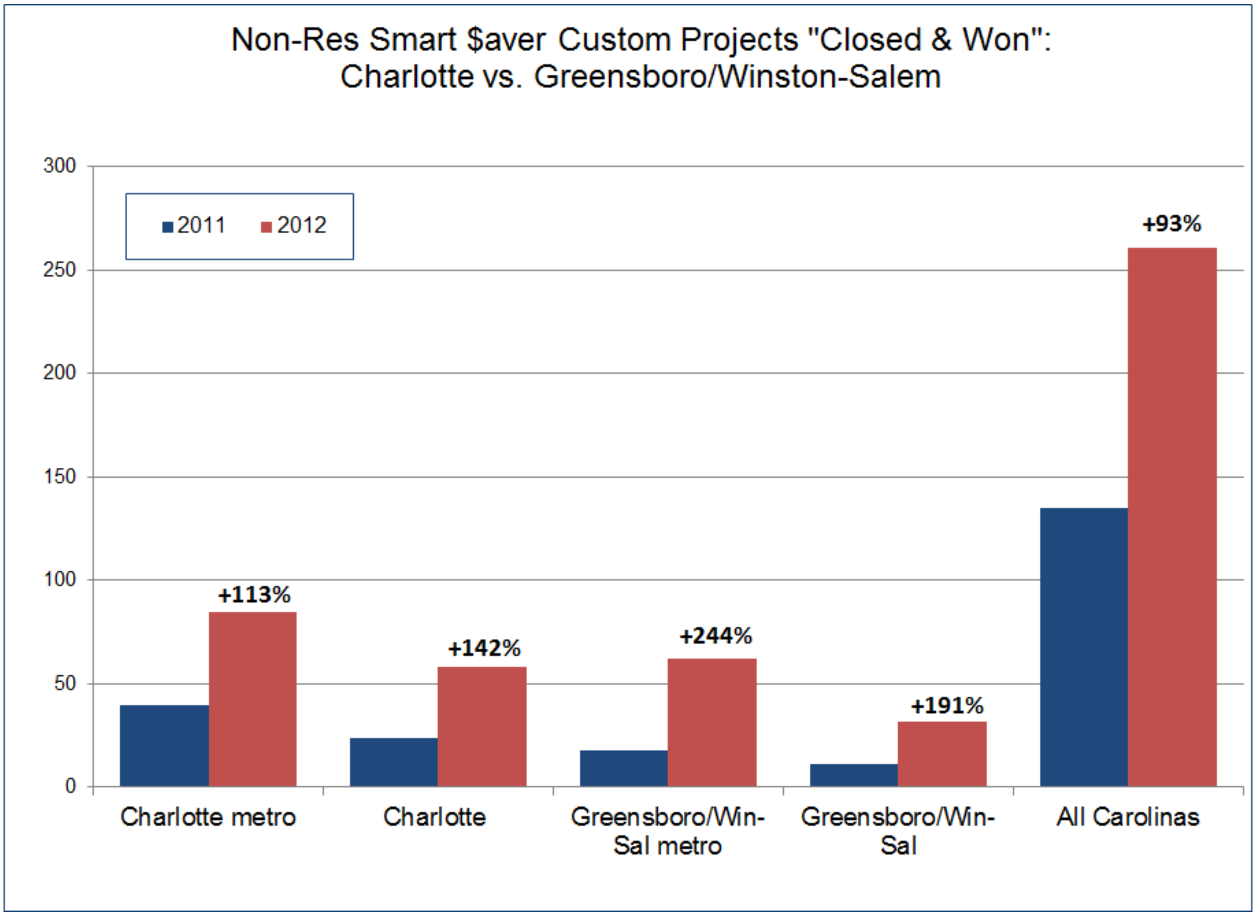

Figure 46. Non-Residential Smart $aver Custom Projects "Closed and Won": Charlotte vs. Greensboro/Winston-Salem

Figure 47 shows projects "closed and won" for Charlotte compared to Greenville. There has not been much participation in this program in the Greenville area to date, with only 11 projects closed and won across the entire Greenville metro area in 2012. However, the number of projects in Greenville for 2012 was substantially higher than for 2011 (+40% city, +57% metro).

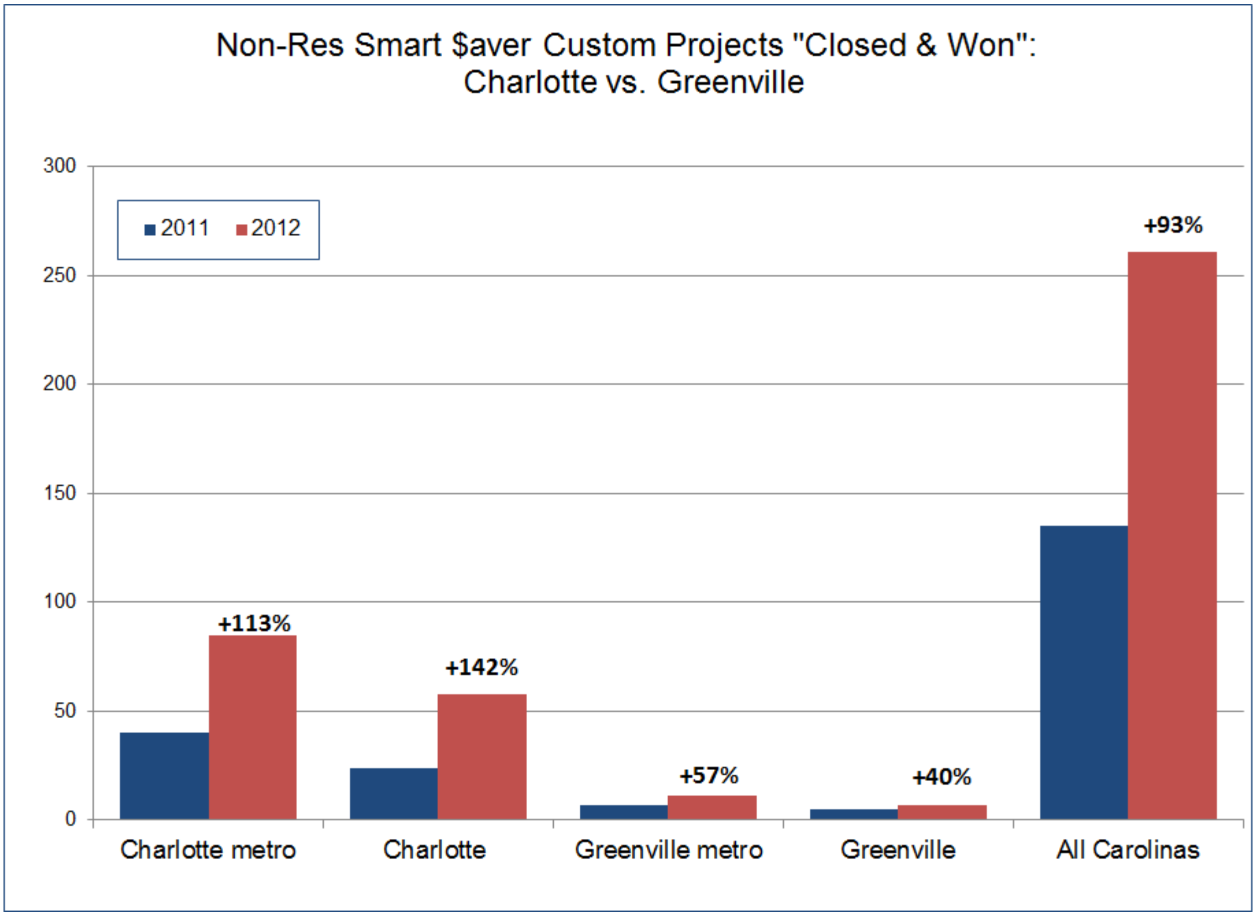

Figure 47. Non-Residential Smart $aver Custom Projects "Closed and Won": Charlotte vs. Greenville

Table 9 shows the statistical significance levels of the rates of change in this program from 2011 to 2012, comparing the Charlotte metropolitan area with the other Duke Energy territories as presented in the preceding charts in this section. None of the differences in the table are statistically significant at p<.10 or better, due in part to smaller sample size (just over 400 projects across all Duke Energy territories in 2012 and only 85 in the Charlotte metro).

Although the rate of projects closed and won increased by 113% in the Charlotte metro and only increased by 85% in "all other Carolinas", based on the small number of projects this difference is not large enough to be statistically significant. Based on these findings, we cannot conclude that Smart Energy Now is driving greater participation in Charlotte relative to other markets.

Table 9. Non-Residential Smart $aver Custom Projects "Closed and Won": Significance Tests

Non-Residential S$ Custom - Projects Closed and Won	Change from 2011 to 2012		Significance level
	Comparison market	Charlotte metro	
All other Duke Energy	111%	113%	not significant
All other Carolinas	85%	113%	not significant

Cincinnati metro	137%	113%	not significant
Greensboro/ Winston-Salem metro	244%	113%	not significant
Greenville metro	57%	113%	not significant

The total number of projects closed and won across all Duke Energy territories can be found in "Appendix J: Total Program Participation in Four Duke Energy Programs 2009-2012".

Non-Residential Smart $aver Custom: Projects "Proposed"

The previous analysis of Non-Residential Custom projects "Closed and Won" only includes projects where an offer was accepted, an installation occurred and the project was completed by the end of 2012. This section will look at all Custom projects for which a proposal was made to the customer to complete an installation in 2012[18], whether the proposal was accepted and the installation occurred or not. This removes customer decision-level factors from the analysis (there are many reasons a company that receives a proposal for a Custom installation might not follow up on the proposal). However, projects that have not reached the proposal stage are not included.

Figure 48 shows that from 2011 to 2012 the number of proposals more than tripled in the city of Charlotte (+238%) and grew nearly as fast across the entire Charlotte metro area (+188%), which was a greater rate of increase than for the rest of the Carolinas (+124%). Across all Duke Energy territory outside of Charlotte, the number of Custom proposals grew by 136%.

[18] Custom projects categorized as "proposed" include projects "closed and won", as well as those in the "contract approval", "proposal to customer" and "qualification" stages. These projects may or may not have been completed, and are categorized by "closed date", for which an expected future date is entered into Salesforce data upon completion of the proposal. The data presented here only includes proposals which were to have been completed by the end of 2012. Projects proposed in 2012 but with closing dates in 2013 are not included in this analysis (these would be considered "2013 projects").

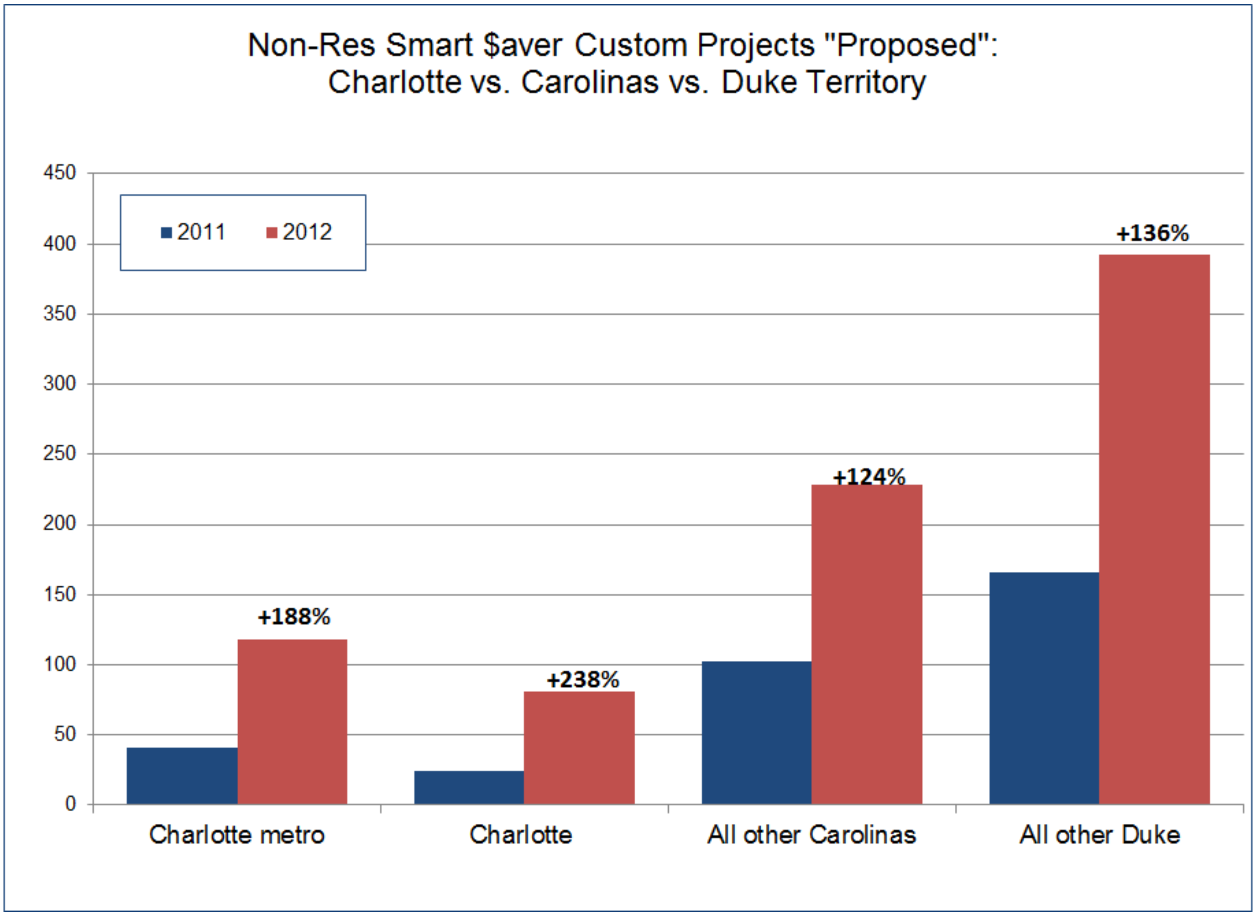

Figure 48. Non-Residential Smart $aver Custom Projects "Proposed": Charlotte vs. Carolinas vs. Duke Territory

Figure 49 shows that the number of projects proposed in the Charlotte metro area (+188%) outpaced growth in the Cincinnati metro area (+139%). This was also true in the central cities, with Charlotte's growth (+238%) doubling the rate of growth in Cincinnati (+120%). In fact, there were more Custom proposals in Charlotte (81) than in Cincinnati (66) during 2012, whereas in 2011 there had been more proposals in Cincinnati (30) than in Charlotte (24).

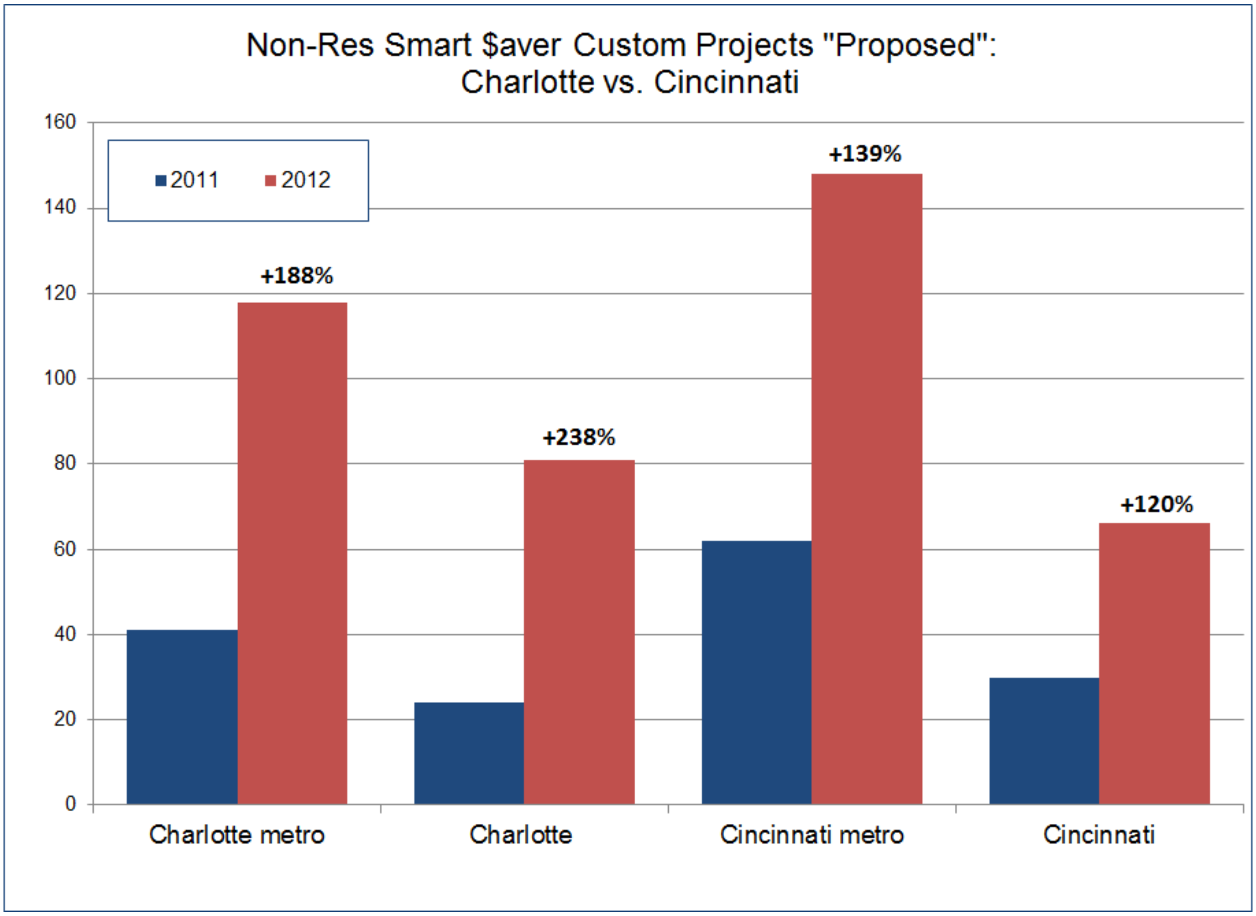

Figure 49. Non-Residential Smart $aver Custom Projects “Proposed”: Charlotte vs. Cincinnati

In Figure 50, the number of proposals in Charlotte is compared to Greensboro/Winston-Salem. Once again, while the Charlotte metro area nearly tripled (+188%), the rate of growth was even higher in Greensboro/Winston-Salem (+280%), although from a smaller base (there were only 20 proposals across the entire Greensboro/Winston-Salem metro in 2011). Both of these markets outpaced the +142% annual growth in proposals across all Duke Energy territory in the Carolinas.

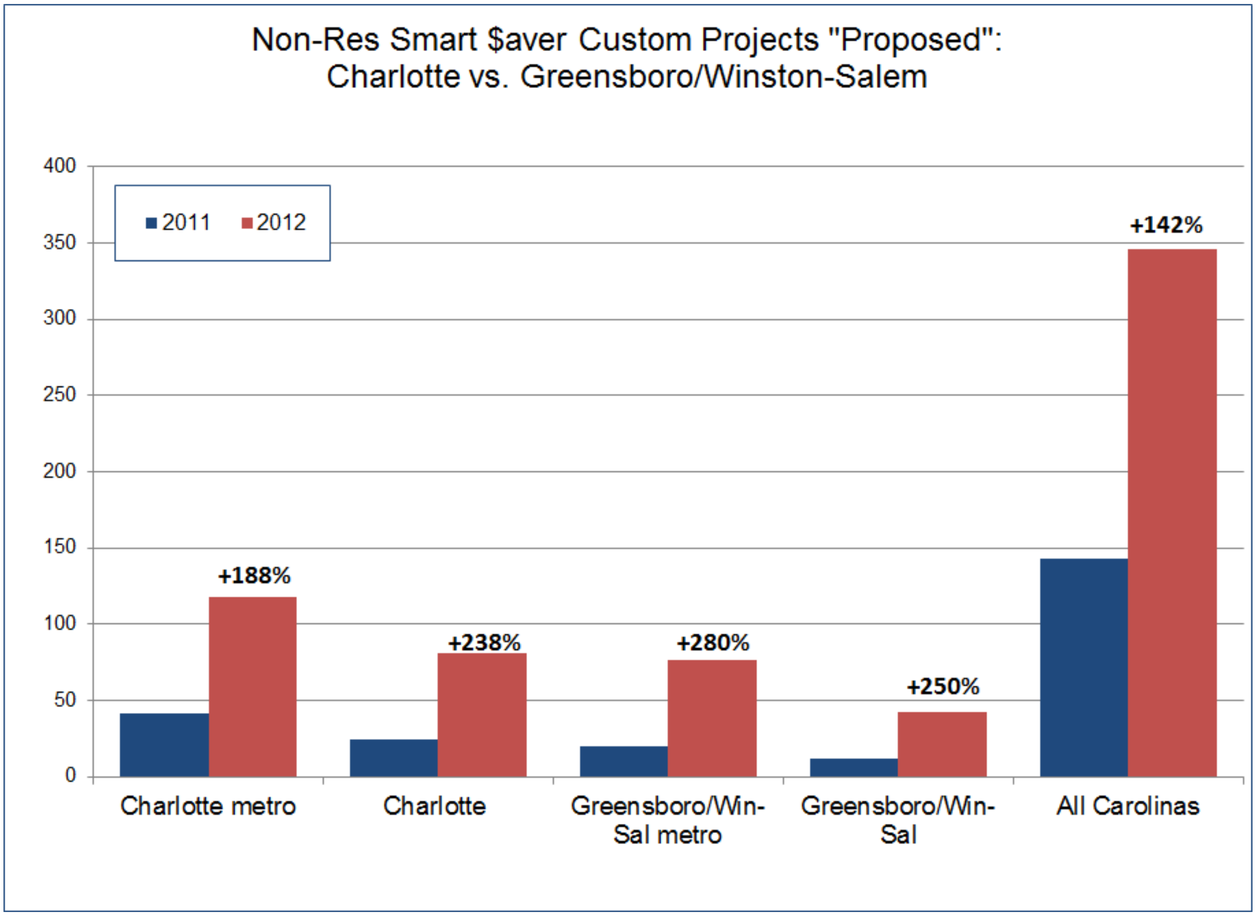

Figure 50. Non-Residential Smart $aver Custom Projects "Proposed": Charlotte vs. Greensboro/Winston-Salem

Figure 51 compares the number of proposals in Greenville to Charlotte. There is little participation in this program in Greenville, with only 15 projects proposed for the entire metro area in 2012. Although this is nearly twice as many proposals as in 2011 (+88%), Greenville lags behind the overall growth rate for proposals across all Duke Energy territory in the Carolinas (+142%).

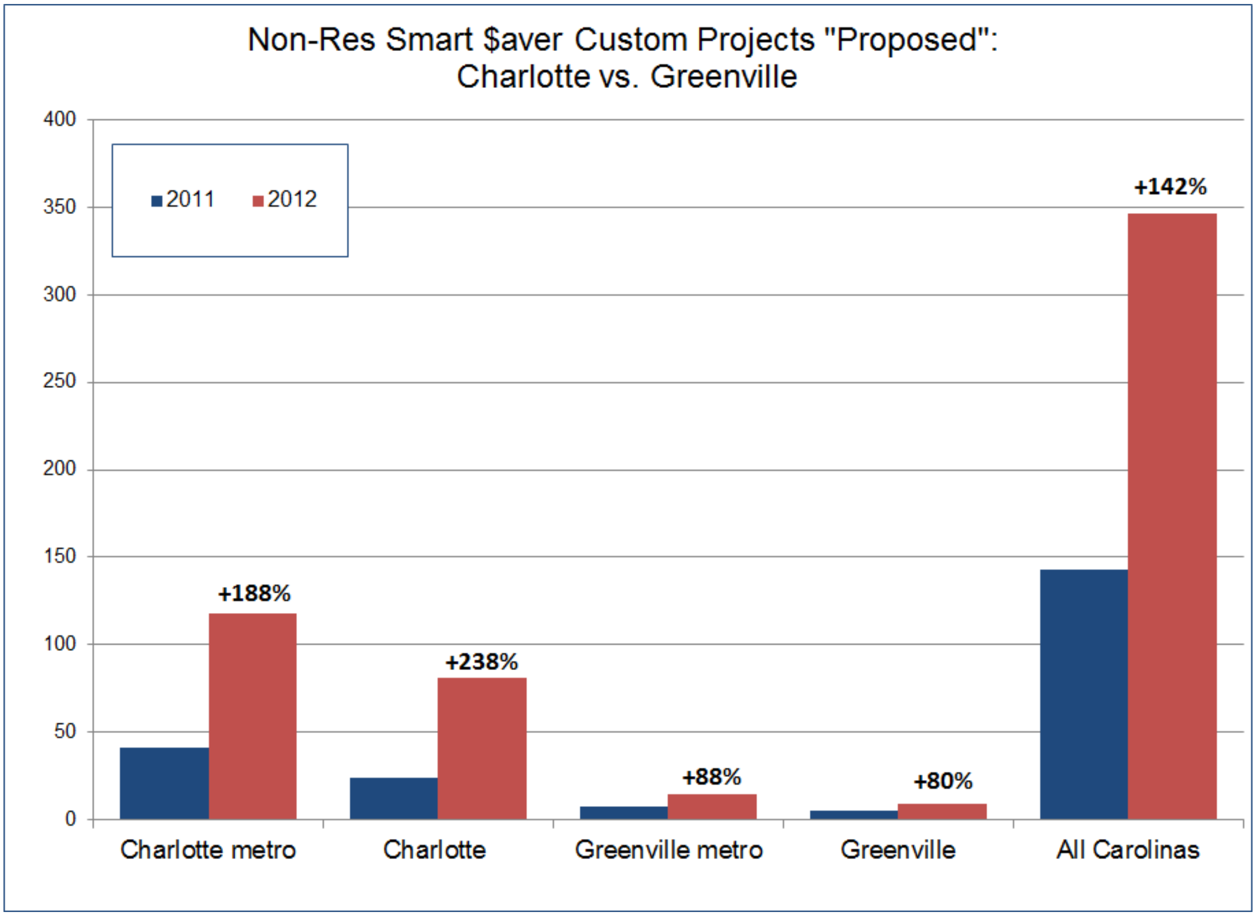

Figure 51. Non-Residential Smart $aver Custom Projects "Proposed": Charlotte vs. Greenville

Table 10 shows the statistical significance levels of the rates of change in this program from 2011 to 2012, comparing the Charlotte metropolitan area with the other Duke Energy territories as seen in the preceding charts in this section. None of the differences in the table are statistically significant at $p<.10$ or better, due in part to smaller sample size (555 proposals across all Duke Energy territories for 2012 and only 118 in the Charlotte metro area).

Although the rate of Custom project proposals grew at an impressive 188% in the Charlotte Metro, this is not significantly higher than the 124% increase in the rest of the Carolinas. Based on these findings, we cannot conclude that Smart Energy Now is driving greater participation in Charlotte.

Table 10. Non-Residential Smart $aver Custom Projects: Significance Tests

Non-Residential S$ Custom - Projects Proposed	Change from 2011 to 2012		Significance level
	Comparison market	Charlotte metro	
All other Duke Energy	136%	188%	not significant
All other Carolinas	124%	188%	not significant
Cincinnati metro	139%	188%	not significant

Greensboro/ Winston-Salem metro	280%	188%	not significant
Greenville metro	88%	188%	not significant

The total number of Non-Residential Smart $aver Custom projects proposed by region and year can be found in "Appendix J: Total Program Participation in Four Duke Energy Programs 2009-2012".

Non-Residential Smart $aver Custom: KWh Impact of Projects Closed and Won

Although the rates of growth of proposals and completed projects between markets do not differ significantly, not all projects have equal impact. Figure 52 shows the total kWh impact of all "closed and won" projects for 2011 and 2012. When analyzed this way, the impact of participation growth in the Cincinnati metro is much larger (+241% kWh impact, but only +137% projects "closed and won"), and the impact of the growth in the Greenville metro actually becomes negative (though projects "closed and won" grew +57%, the kWh impact actually declined -79%). The impact of projects "closed and won" in the Charlotte metro area grew +66%, which is not significantly different from +48% in the rest of the Carolinas or +98% in all Duke Energy territory outside of the Charlotte metro. Differences between Charlotte and the other three comparison market metros were also not statistically significant.

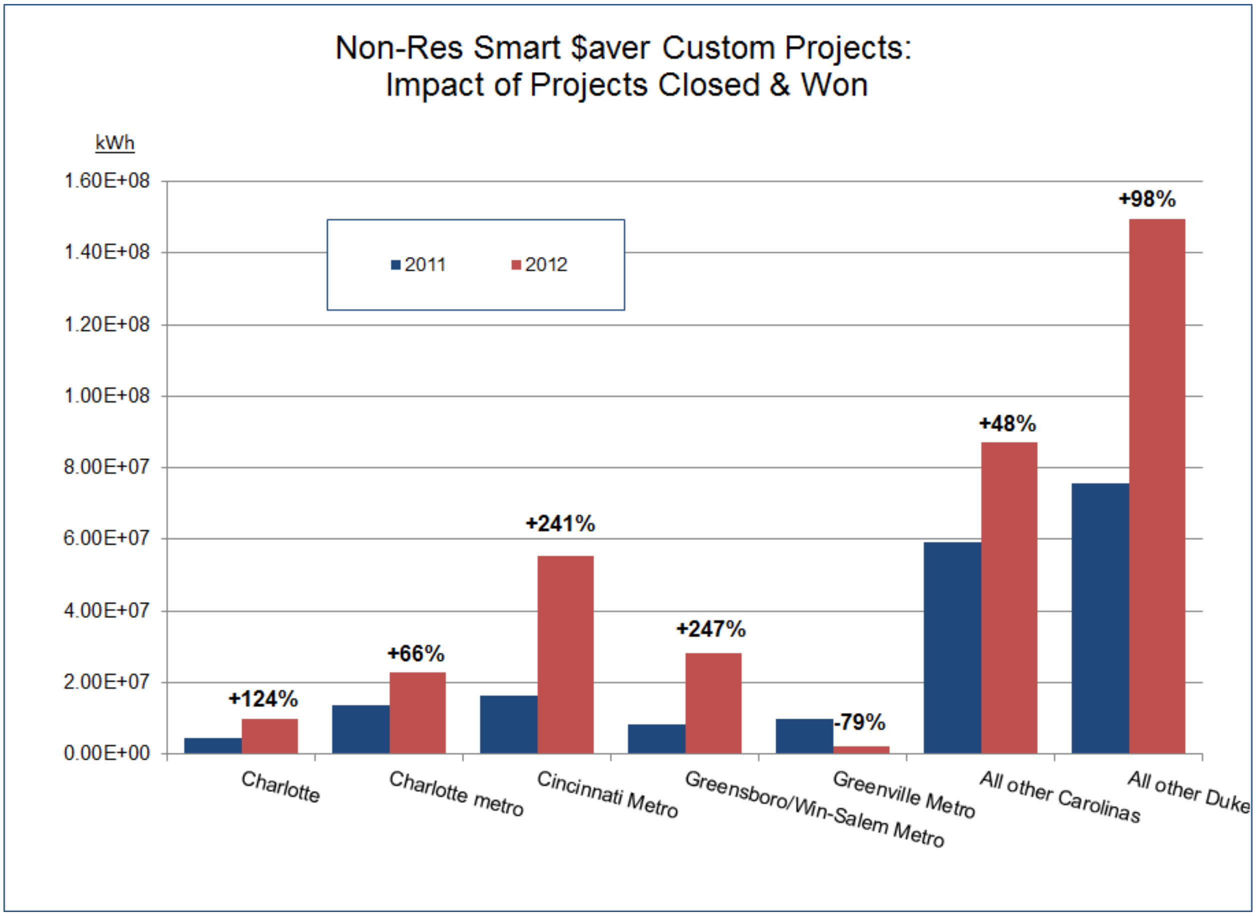

Figure 52. Non-Residential Smart $aver Custom Projects: KWh Impact of Projects Closed and Won

Appendix I: Lists of Cities Used to Define Geographic Comparison Areas

Metropolitan Totals were defined using the lists of cities for each Metropolitan Statistical Area found at Wikipedia, April 2013. These are copied below (along with county and population for Charlotte and Greensboro/Winston Salem). The Cincinnati Metropolitan Total used for this study was defined as all Duke Energy territory in Ohio and Kentucky (which only encompasses Cincinnati and the surrounding area).

Charlotte
Anchor city
Charlotte, Mecklenburg 731,424
Metro *Note: some of these towns are in South Carolina.*
Albemarle, Stanly 15,903
Ansonville, Anson 631
Badin, Stanly 1,974
Belmont, Gaston 10,076
Belwood, Cleveland 950
Bessemer City, Gaston 5,340
Boger City, Lincoln 554
Boiling Springs, Cleveland 4,647
Cherryville, Gaston 5,820
Chester, Chester 6,273
China Grove, Rowan 3,563
Cleveland, Rowan 871
Clover, York 4,054
Concord, Cabarrus County, NC 79,006
Conover, Catawba 8,180
Cornelius, Mecklenburg 24,866
Cramerton, Gaston 4,165
Dallas, Gaston 4,488
Davidson, Mecklenburg & Iredell 8,343
Denver, Lincoln 13,030
Earl, Cleveland 260
East Spencer, Rowan 1,534
Elgin, Lancaster 2,426
Enochville, Rowan 2,851
Eureka Mill, Chester 1,737

Fairview, Union 4,122
Faith, Rowan 807
Fallston, Cleveland 607
Fort Lawn, Chester 844
Fort Mill, York 10,811
Frog Pond, Stanly, 650
Gastonia, Gaston County, NC 71,741
Gayle Mill, Chester 1,094
Granite Quarry, Rowan 2,930
Great Falls, Chester 2,121
Grover, Cleveland 708
Harmony, Iredell 570
Harrisburg, Cabarrus 4,925
Heath Springs, Lancaster 863
Hemby Bridge, Union 1,520
Hickory Grove, York 362
Hickory, Catawba 40,010
High Shoals, Gaston 696
Huntersville, Mecklenburg 46,773
India Hook, York 1,614
Indian Land, Lancaster [Undetermined]
Indian Trail, Union 15,610
Irwin, Lancaster 1,343
JAARS Union 360
Kannapolis, Cabarrus & Rowan 38,547
Kershaw, Lancaster 1,638
Kings Mountain, Cleveland & Gaston 10,634
Kingstown, Cleveland 681
Lake Park, Union 3,422
Lake Wylie, York 3,061
Lancaster Mill, Lancaster 2,109
Lancaster, Lancaster 10,160
Landis, Rowan 3,109
Lattimore, Cleveland 681
Lawndale, Cleveland 606
Lesslie, York 2,268
Light Oak, Cleveland 779
Lilesville, Anson 536
Lincolnton, Lincoln 10,194
Locust, Stanly & Cabarrus 2,930
Love Valley, Iredell 33

Lowell, Gaston 3,526
Lowesville, Lincoln 1,440
Lowrys, Chester 203
Marshville, Union 2,402
Marvin, Union 5,579
Matthews, Mecklenburg 27,198
McAdenville, Gaston 651
McConnells, York 312
McFarlan, Anson 117
Midland, Cabarrus 2,729
Mineral Springs, Union 2,639
Mint Hill, Mecklenburg & Union 22,722
Misenheimer, Stanly 728
Monroe, Union 36,397
Mooresboro, Cleveland 311
Mooresville, Iredell 32,000
Morven, Anson 511
Mount Holly, Gaston 9,336
Mount Pleasant, Cabarrus 1,336
New London, Stanly 600
Newport, York 4,033
Newton, Catawba 12,995
Norwood, Stanly 2,379
Oakboro, Stanly 1,859
Patterson Springs, Cleveland 622
Peachland, Anson 437
Pineville, Mecklenburg 4,479
Polkton, Anson 3,375
Polkville, Cleveland 537
Ranlo, Gaston 3,434
Richburg, Chester 325
Richfield, Stanly 613
Riverview, York 708
Rock Hill, York County, SC 66,154
Rockwell, Rowan 2,108
Salisbury, Rowan 33,662
Sharon, York 434
Shelby, Cleveland 21,275
Smyrna, York 63
South Gastonia, Gaston 5,433
Spencer Mountain, Gaston 37

Spencer, Rowan 3,344
Stallings, Union 13,831
Stanfield, Stanly 1,486
Stanley, Gaston 3,556
Statesville, Iredell 24,489
Tega Cay, York 4,264
Troutman, Iredell 1,677
Unionville, Union 5,929
Waco, Cleveland 321
Wadesboro, Anson 5,813
Waxhaw, Union 9,859
Weddington, Union 9,459
Wesley Chapel, Union 7,463
Westport, Lincoln 2,006
Wingate, Union 3,491
York, York 7,028

Greensboro/Winston-Salem (The Piedmont Triad) *Note: High Point was included in the Metropolitan area total, but not with "Greensboro/Winston-Salem" for city-to-city comparisons.)*
Primary cities
Greensboro Guilford 269,666
Winston-Salem Forsyth 229,617
High Point Guilford, Forsyth, Davidson & Randolph 104,371
Metro
Alamance Alamance 951
Archdale Randolph & Guilford 11,415
Asheboro Randolph 25,012
Bermuda Run Davie 1,725
Bethania Forsyth 328
Boonville Yadkin 1,222
Burlington Alamance & Guilford 49,963
Clemmons Forsyth 18,627
Cooleemee Davie 960
Danbury Stokes 189
Denton Davidson 1,636
Dobson Surry 1,586
East Bend Yadkin 612

Eden Rockingham 15,527
Elkin Surry 4,001
Elon Alamance 9,419
Franklinville Randolph 1,164
Gibsonville Guilford & Alamance 6,410
Glen Raven Alamance 2,750
Graham Alamance 14,153
Green Level Alamance 2,100
Haw River Alamance 2,298
Jamestown Guilford 3,382
Jonesville Yadkin 2,285
Kernersville Forsyth & Guilford 23,123
King Stokes & Forsyth 6,904
Lewisville Forsyth 12,639
Lexington Davidson 18,931
Liberty Randolph 2,656
Madison Rockingham 2,246
Mayodan Rockingham 2,478
Mebane Alamance & Orange 11,393
Midway Davidson 4,783
Mocksville Davie 5,051
Mount Airy Surry 10,388
Oak Ridge Guilford 6,185
Ossipee Alamance 543
Pleasant Garden Guilford 4,489
Ramseur Randolph 1,692
Randleman Randolph 4,113
Reidsville Rockingham 14,520
Rural Hall Forsyth 2,937
Saxapahaw Alamance 1,648
Seagrove Randolph 228
Sedalia Guilford 623
Staley Randolph 393
Stokesdale Guilford 5,047
Stoneville Rockingham 1,056
Summerfield Guilford 10,232
Swepsonville Alamance 1,154
Thomasville Davidson 26,757
Tobaccoville Forsyth 2,441
Trinity Randolph 6,614
Walkertown Forsyth 4,675

Wallburg Davidson 3,047
Walnut Cove Stokes 1,425
Welcome Davidson 4,162
Wentworth Rockingham 2,807
Whitsett Guilford 590
Yadkinville Yadkin 2,959

Greenville–Mauldin–Easley Metropolitan Statistical Area
Places with more than 50,000 inhabitants
Greenville (Principal city)
Metro
Anderson (Principal city)
Arial (census-designated place)
Berea (census-designated place)
Central
City View (census-designated place)
Clemson (partial)
Clinton
Cross Hill
Dunean (census-designated place)
Easley (Principal city; partial)
Five Forks (census-designated place)
Fountain Inn
Gantt (census-designated place)
Golden Grove (census-designated place)
Gray Court
Greer (partial)
Highlands
Jackson Grove
Joanna (census-designated place)
Judson (census-designated place)
Kinards (partial)
Laurens
Liberty
Mauldin (Principal city)
Mountville (census-designated place)
Norris
Parker (census-designated place)

Pickens
Piedmont (census-designated place; partial)
Princeton (census-designated place)
Sans Souci (census-designated place)
Simpsonville
Six Mile
Slater-Marietta (census-designated place)
Taylors (census-designated place)
Tigerville
Travelers Rest
Wade Hampton (census-designated place)
Ware Shoals (partial)
Waterloo
Watts Mills (census-designated place)
Welcome (census-designated place)

Appendix J: Total Program Participation in Four Duke Energy Programs 2009-2012

Participation numbers for the PER program across all Duke Energy territories 2009-2012 are shown in Table 11 below.

Table 11. Residential Personalized Energy Report (PER): Total Participation 2009-2012

	2009	2010	2011	2012
Charlotte	3610	3364	1638	3020
Metro ex. Charlotte	6188	5888	5212	4417
Metro Charlotte total	9798	9252	6850	7437
Cincinnati	3447	2858	1785	1
Metro ex. Cincinnati	3581	11622	13354	362
Metro Cincinnati total	7028	14480	15139	363
Greensboro/Winston-Salem	2837	3311	1936	2264
Metro ex. Greensboro/Winston-Salem	3878	4155	4021	3156
Metro Greensboro/Winston-Salem total	6715	7466	5957	5420
Greenville	768	1015	918	580
Metro ex. Greenville	2237	2413	1485	1397
Metro Greenville total	3005	3428	2403	1977
Remaining Carolinas	7522	8044	7181	6477
Indiana	0	0	0	77943
Total	34068	42670	37530	99617

Table 12 below shows the participation numbers for the Smart $aver HVAC program for all Duke Energy territories during the years 2009-2012.

Table 12. Residential Smart $aver HVAC Projects: Total Participation 2009-2012

	2009	2010	2011	2012
Charlotte	682	2476	1890	1491
Metro ex. Charlotte	698	2727	1955	1372
Metro Charlotte total	1380	5203	3845	2863
Cincinnati	6937	9340	7091	5607
Metro ex. Cincinnati	4483	6503	5137	5161
Metro Cincinnati total	11420	15843	12228	10768
Greensboro/Winston-Salem	438	1573	1186	754
Metro ex. Greensboro/Winston-Salem	430	1830	1262	864
Metro Greensboro/Winston-Salem total	868	3403	2448	1618
Greenville	67	380	266	246
Metro ex. Greenville	189	981	777	598

Metro Greenville total	256	1361	1043	844
Remaining Carolinas	632	3619	3072	2193
Indiana	3283	5593	3574	2921
Total	17839	35022	26210	21207

The total number of Non-Residential Smart $aver Prescriptive projects completed across Duke Energy territories for 2009-2012 are listed below in Table 13.

Table 13. Non-Residential Smart $aver Prescriptive Projects: Total Participation 2009-2012

	2009	2010	2011	2012
Charlotte	280	628	544	481
Metro ex. Charlotte	379	588	376	447
Metro Charlotte total	659	1216	920	928
Cincinnati	1576	1618	817	1078
Metro ex. Cincinnati	782	1131	708	874
Metro Cincinnati total	2358	2749	1525	1952
Greensboro/Winston-Salem	283	466	265	303
Metro ex. Greensboro/Winston-Salem	191	269	228	265
Metro Greensboro/Winston-Salem total	474	735	493	568
Greenville	69	190	193	150
Metro ex. Greenville	78	226	111	101
Metro Greenville total	147	416	304	251
Remaining Carolinas	348	636	660	528
Indiana	464	489	494	188
Total	4450	6241	4396	4415

The total number of Non-Residential Smart $aver Custom projects "closed and won" across all Duke Energy territories for 2009-2012 are listed below in Table 14; the number of projects "proposed" can be found in Table 15.

Table 14. Non-Residential Smart $aver Custom: Projects "Closed and Won" 2009-2012

	2009	2010	2011	2012
Charlotte	0	5	24	58
Metro ex. Charlotte	0	6	16	27
Metro Charlotte total	0	11	40	85
Cincinnati	6	10	28	61
Metro ex. Cincinnati	2	15	31	79
Metro Cincinnati total	8	25	59	140
Greensboro/Winston-Salem	0	4	11	32

Metro ex. Greensboro/Winston-Salem	0	1	7	30
Metro Greensboro/Winston-Salem total	0	5	18	62
Greenville	0	1	5	7
Metro ex-Greenville	0	0	2	4
Metro Greenville total	0	1	7	11
All other Carolinas	0	17	70	103
Indiana	0	0	2	13
Not specified[19]	*0*	*3*	*17*	*32*
Total	8	62	213	446

Table 15. Non-Residential Smart $aver Custom: Projects "Proposed" 2009-2012

	2009	2010	2011	2012
Charlotte	0	7	24	81
Metro ex. Charlotte	0	7	17	37
Metro Charlotte total	0	14	41	118
Cincinnati	6	10	30	66
Metro ex. Cincinnati	2	15	32	82
Metro Cincinnati total	8	25	62	148
Greensboro/Winston-Salem	0	4	12	42
Metro ex. Greensboro/Winston-Salem	0	1	8	34
Metro Greensboro/Winston-Salem total	0	5	20	76
Greenville	0	1	5	9
Metro ex-Greenville	0	0	3	6
Metro Greenville total	0	1	8	15
All other Carolinas	0	17	74	137
Indiana	0	0	2	16
Not specified	*0*	*3*	*21*	*45*
Total	8	65	228	555

[19] Some records did not include the city where the project was completed; these records are listed in this table as "not specified", and are not included in any of the preceding charts.

Final Report

Impact Evaluation of the Energy Efficiency for Schools Program (The National Theatre for Children (NTC)) in the Carolina System

Prepared for

Duke Energy

139 East Fourth Street
Cincinnati, OH 45201

August 21, 2013

Submitted by

Nick Hall, Brian Evans,
David Ladd, and Johna Roth

TecMarket Works
165 West Netherwood Road
Oregon WI 53575
(608) 835-8855

Subcontractors:
May Wu, Michael Ozog
Integral Analytics, Inc.

Pete Jacobs
BuildingMetrics, Inc.

TECMARKET Works

TABLE OF CONTENTS

Executive Summary

Key Findings and Recommendations

This section presents the key findings and recommendations identified through the evaluation of Duke Energy's Energy Efficiency (EE) for Schools Program in the Carolina System. The program evaluation covers the period of time from January, 2012 to August, 2012 (n= 29,220 participants). The table below presents the estimated overall ex post net energy impacts from the billing analysis. The billing analysis approach used to assess energy saving provides a direct net impact estimate by employing quasi-experimental analysis designs.

	Net Savings
Annual Savings Per Participant Per Year	
kWh	236
kW	0.0248

The billing analysis gives the estimated overall net kWh savings per participant but is incapable of estimating coincident kW reduction. As a result, kW was calculated based upon the kWh savings and the kW/kWh ratio from the engineering analysis. Additionally, the billing analysis gives estimated impact of both kit and recommendations together, but is incapable of providing measure level savings. The main goal of the engineering analysis, aside from providing the kW/kWh ratio, is to offer insight into individual measure contributions to overall savings. All official impact results are net savings and are based on the outcome of the billing analysis.

Significant Impact Evaluation Findings: Billing Analysis

Billing data was obtained for all participants with Duke Energy accounts in the EE for Schools program between January, 2012 and August, 2012. After processing, there were a total of 29,220 usable accounts[1]. A panel model was used to determine program impacts, where the dependent variable was daily electricity consumption from September 2010 to August, 2012. The results of the billing analysis are presented in Table 9.

Table 1. Estimated Carolina System EE for Schools Impacts: Billing Analysis

	kWh	t-value[2]
Per Participant Annual Savings (Net)	236	6.34

Significant Impact Evaluation Findings: Engineering Analysis

- Mean wattage of a replaced bulb is 64 watts for the 13-watt CFL and 70 watts for the 18-watt CFL.

[1] In order to maximize the use of the data, a single model was estimated over all states (Ohio, North Carolina and South Carolina). Therefore, the actual sample size in the model included 7,279 households in Ohio; 21,230 in North Carolina and 7,990 in South Carolina for a total sample size of 36,499 households.

[2] The T-value indicates the significance of the savings estimate. If the absolute value of the T-value is greater than 1.96, the savings estimate is significant. In many cases because saving is denoted as negative, and t-value is reported as is instead of absolute value. In such cases, a T-value < -1.96 means the savings are significant.

  - o See Survey Data on page 21.
- An ISR of 88.6% was reported for the 13-watt CFL and 82.6% for the 18-watt CFL.
  - o See Table 14 on page 22.
- Average daily hours of use are 3.24 and 3.11 for the 13-watt and 18-watt CFLs respectively.
  - o See Table 16 on page 23.

Introduction and Purpose of Study

Overview and Objective

This document presents the impact evaluation report for Duke Energy's Energy Efficiency for Schools Program as it was administered in the Carolina System. The evaluation was conducted by TecMarket Works, Integral Analytics, and BuildingMetrics.

Summary of the Evaluation Data

The findings presented in this report were analyzed using participant survey data from student families and the billing data from participants in Table 2 below.

Table 2. Evaluation Date Ranges

Evaluation Component	Dates of Survey	Dates of Analysis
Participant Surveys	Surveys were conducted from 8/18/12 through 9/19/12	October 2012
Billing Analysis	N/A	November - December 2012
Engineering Analysis	N/A	November - December 2012

Duke Energy conducted an online survey with a random[3] sample of 202 participants from the Carolinas between August 18 and October 8, 2012.

Evaluation Objectives

The objective of this evaluation is to determine the effectiveness of Duke Energy's EE for Schools program as it was administered in the Carolina System, and to determine estimated energy impacts.

[3] Email addresses for participating families were selected at random and sent invitations to complete the survey.

Description of Program

Duke Energy has partnered with The National Theatre for Children (NTC) for the Energy Efficiency Education for Schools program. The Energy Efficiency Education program is an energy conservation program available in Ohio, Kentucky, North Carolina and South Carolina and is available to K-12 students enrolled in public and private schools who reside in households served by Duke Energy.

The Energy Efficiency Education Program for Schools provides principals and teachers with an innovative math and science related curriculum that educates students about energy, resources, electricity, ways in which energy is wasted, and how to use our resources wisely. Education materials focus on concepts such as energy, renewable fuels, and energy conservation through classroom and take home assignments to engage student's families. Curriculum materials are enhanced with a live 25 minute theatrical production for elementary students and a live 40 minute theatrical production for middle school students, both performed by two professional actors. The current program is developed to educate students in kindergarten through eighth grade. School principals are the main point of contact and NTC schedules the performance at their convenience for the entire school.

Once the principal has confirmed the performance date and time, two weeks prior to the performance, all curriculum materials are delivered to the principal's attention for teacher distribution. Materials include school posters, teacher guides, and classroom and family activity books. Students are encouraged to complete a home energy survey with their family (found in their activity book), to receive an Energy Efficiency Starter Kit that contains specific energy efficiency measures to reduce home energy consumption. Duke Energy customers at the participating schools can receive a Duke Energy Energy Efficiency Starter Kit and non-Duke Energy customers at the participating schools can receive a non-Duke Energy Energy Efficiency Starter Kit.

Duke Energy Customers received:

- 1.5 GPM low flow shower head
- 1.5 GPM kitchen faucet aerator with swivel and flip valve
- Water flow meter bag
- Water temperature gauge card (Hot Water Temp Card)
- 13 watt Energy Star rated mini compact fluorescent (60 watt incandescent equivalent), with 12,000 hour life
- 18 watt Energy Star rated mini compact fluorescent (75 watt incandescent equivalent), with 12,000 hour life
- 1.0 GPM needle spray bathroom faucet aerator
- Combination Pack of switch and outlet gasket insulators: 8 outlets and 4 socket gaskets
- Energy Efficient Limelight style night light
- Duke Energy labeled DOE "Energy Savers" booklet
- Roll of Teflon tape for showerhead
- Product information and instruction sheet
- Glow Ring Toy

Non-Duke Energy Customers received:

- Water flow meter bag
- Water temperature gauge card (Hot Water Temp Card)
- 13 watt Energy Star rated mini compact fluorescent (60 watt incandescent equivalent), with 12,000 hour life
- 8 outlet gasket insulators
- Duke Energy labeled DOE "Energy Savers" booklet
- Glow Ring Toy

Methodology

Overview of the Evaluation Approach

This process evaluation had three components: management interviews, performance reviews, and participant surveys.

Study Methodology

Participant Surveys

This survey was conducted online with participating students' families that, according to program tracking records, received an energy efficiency kit from Duke Energy.

Billing Analysis

Billing data was obtained for all participants in the K-12 program between September 21, 2011 and August 16, 2012 and that had accounts with Duke Energy. After processing, there were a total of 29,220 usable accounts[4]. A panel model was used to determine program impacts, where the dependent variable was daily electricity consumption from September 2010 to August, 2012. The model included terms to control for the effect of weather on usage, the effect of impacts from other Duke Energy offers, the effect of normal non-program induced energy use changes, as well as a complete set of monthly indicator variables to capture the effects of non-measureable factors that vary over time (such as economic conditions and season loads).

Engineering Analysis

Engineering algorithms taken from the Draft Ohio Technical Resource Manual (TRM) were used to estimate savings. These unit energy savings values were applied to customers in the engineering analysis sample.

Data collection methods, sample sizes, and sampling methodology

Participant Surveys

A list of 14,220 Duke Energy participant records and 9,328 non-Duke Energy participant records (between the dates of November 11, 2011 and June 30, 2012) were randomly sorted by TecMarket Works. Email invitations were sent to a few hundred participants at a time until the target for completed surveys was reached. Surveys were conducted online.

Billing Analysis

The billing analysis used consumption data from all complete data provided for the EE for Schools participants in the Carolina System that participated between January, 2012 and August, 2012.

[4] In order to maximize the use of the data, a single model was estimated over all states (Ohio, North Carolina and South Carolina). Therefore, the actual sample size in the model included 7,279 households in Ohio; 21,230 in North Carolina and 7,990 in South Carolina for a total sample size of 36,499 households.

Engineering Analysis

Online surveys were completed by a sample of 202 participants.

Number of completes and sample disposition for each data collection effort

Participant Surveys

From the participant list of 14,220 Duke Energy customer records, students' families were invited to complete the survey online between August 18, 2012 and October 8, 2012, and a total of 202 usable surveys were completed by Duke Energy customers. Of the 202 completed interviews, 102 were conducted for homes in North Carolina and 100 were conducted for South Carolina homes.

From the participant list of 9,328 non-Duke Energy participant records, student families were invited to complete the survey online between August 18, 2012 and October 8, 2012, and a total of 177 usable surveys were completed by non-Duke Energy customers. Of the 177 completed interviews, 100 were conducted for homes in North Carolina and 77 were conducted for South Carolina homes.

Billing Analysis

N/A (all participants included, sampling was not used)

Engineering Analysis

A total of 202 participants responded to the online survey.

Expected and achieved precision

Participant Surveys

Duke Energy Customers: The survey sample methodology had an expected precision of 90% +/- 6.5% and an achieved precision of 90% +/- 5.7%.

Billing Analysis

All savings estimates from the billing analysis were statistically significant at the 95% confidence level.

Engineering Analysis

Engineering estimates rely on participant survey responses. Sampling procedures for the participant survey had an expected precision of 90% +/- 6.5% confidence and an achieved precision of 90% +/- 5.7%.

Description of baseline assumptions, methods and data sources

Baseline assumptions were determined through online surveys with customers providing self-reported values of impact relevant data. Robust data concerning HVAC system fuel and type was available from Duke Energy's Home Profile Database (appliance saturation survey type data) in the Carolina System. Interaction factors derived from this data were used in favor of deemed values from secondary sources as they recognize only Duke Energy customers and, therefore, more accurately represent the participant population. A breakdown of these factors by system and fuel type can be seen in Appendix D: Impact Algorithms.

Description of measures and selection of methods by measure(s) or market(s)

Duke Energy Customers received:

- 1.5 GPM low flow shower head
- 1.5 GPM kitchen faucet aerator with swivel and flip valve
- Water flow meter bag
- Water temperature gauge card (Hot Water Temp Card)
- 13 watt Energy Star rated mini compact fluorescent (60 watt incandescent equivalent), with 12,000 hour life
- 18 watt Energy Star rated mini compact fluorescent (75 watt incandescent equivalent), with 12,000 hour life
- 1.0 GPM needle spray bathroom faucet aerator
- Combination Pack of switch and outlet gasket insulators: 8 outlets and 4 socket gaskets
- Energy Efficient Limelight style night light
- Duke Energy labeled DOE "Energy Savers" booklet
- Roll of Teflon tape for showerhead
- Product information and instruction sheet
- Glow Ring Toy

Non-Duke Energy Customers received:

- Water flow meter bag
- Water temperature gauge card (Hot Water Temp Card)
- 13 watt Energy Star rated mini compact fluorescent (60 watt incandescent equivalent), with 12,000 hour life
- 8 outlet gasket insulators
- Duke Energy labeled DOE "Energy Savers" booklet
- Glow Ring Toy

Threats to validity, sources of bias and how those were addressed

Billing Analysis

The specification of the model used in the billing analysis was designed specifically to avoid the potential of omitted variable bias by including monthly variables that capture any non-program effects that affect energy usage, as well as other Duke Energy offers. The model did not correct for self-selection bias because there is no reason to as long as the program remains voluntary.

Engineering Analysis

The participant responses are self-reports and therefore may be affected by self-selection bias, false response bias or positive result bias. If these biases are present, the savings achieved can be expected to be higher than those reported in the impact evaluation.

Net to Gross Analysis

Showerhead, Aerator and Gasket Freeridership and Spillover for Duke Energy Customers

Freeridership and spillover were calculated for each set of measures in the EE for Schools Energy Efficiency Kit. The presentation of freeridership and spillover is provided for informational purposes only and is not used to adjust gross energy impacts to report net savings. Because the impact analysis approach compares the customer's electric meter readings before and after the program the impact findings are already net savings and do not need to be further adjusted. The freeridership and spillover analysis is provided to allow stakeholders to understand the degree of these influences that are already included in the net savings reported.

For low-flow showerheads, faucet aerators and insulator gaskets, the level of freeridership was determined by using the responses to three questions in the survey (found in Appendix A: Participant Survey Instruments). The three questions and the level of freeridership and/or spillover that was applied to the energy savings are presented in Table 3 below, using the low-flow showerhead as an example measure. All other possible combinations of answers to the series of questions resulted in 0% freeridership and 0% spillover (not shown in table).

Table 3. Freeridership and Spillover Factors for Energy Efficiency Kit Measures

24h: Did you have any low-flow showerheads installed before you got the kit?	24i: Were you planning on buying <additional> low-flow showerheads before you got the kit?	24j: Have you purchased any low-flow showerheads since you got the kit?	% Free-ridership	% Spillover
yes	yes	yes	100	
yes	yes	no	100	
yes	no	yes		75
no	no	yes		100
no	yes	no	50	
no	yes	yes	50	50
don't know	yes	yes	75	25
don't know	yes	no	50	
don't know	no	yes		100

24h: Did you have any low-flow showerheads installed before you got the kit?	24i: Were you planning on buying <additional> low-flow showerheads before you got the kit?	24j: Have you purchased any low-flow showerheads since you got the kit?	% Free-ridership	% Spillover
yes	already installed in all available sockets	yes	100	
yes	already installed in all available sockets	no	100	
yes	already installed in all available sockets	don't know	100	
don't know	maybe	yes	25	50
yes	maybe	yes		25
yes	maybe	no	25	
no	maybe	yes		50
yes	don't know	yes		75
no	don't know	yes		100
yes	yes	don't know	100	
don't know	yes	don't know	50	
no	yes	don't know	50	

Applying the scores from Table 3 to participants' responses to questions about low-flow showerheads, faucet aerators (combined) and gasket insulators (combined) yields the overall freeridership and spillover scores for each measure, shown in Table 4.

Table 4. Freeridership and Spillover for Showerheads, Aerators and Gaskets

Measure (N=number of kit installations)	Number of participants with free-ridership	Number of participants with spillover	Free-ridership percentage	Spillover Percentage
Low-flow showerhead (N=92)	24	4	17.4%	3.5%
Faucet aerators (N=115)	11	3	5.9%	1.5%
Gaskets insulators (N=83)	21	4	18.7%	4.5%

CFL Freeridership for Duke Energy Customers

TecMarket Works utilized two questions[5] from the student family survey to estimate CFL freeridership. The first question asked survey respondents whether or not they had installed CFLs prior to participating in the program, and if so, how many they had installed. The second question asked respondents if they had planned on buying any CFLs before participating in the program.

Quantities of pre-installed CFLs in the Carolinas range from 1 to 35 among the 73.9% (139 out of 188) of Duke Energy customers who installed the kit-provided CFLs and indicated that they also previously had CFLs installed.

Freeridership ratios for each customer are based on survey responses and are assigned using a Bass curve based on diffusion of innovation product adoption concepts. Zero pre-installed CFLs correspond to an assigned freeridership score of zero percent, and fourteen or more CFLs correspond to a freeridership level of 100 percent. This allows higher credit for savings to participants with the lowest pre-existing use of CFLs and lower savings to those with a history of CFLs. The curve reflects the condition that if a customer has never used a CFL in the past, they are not historic CFL users and all CFLs they acquire through the program are net energy bulbs. That is, all the energy savings from those bulbs are net savings that would not have occurred without the program. Likewise, if a customer has already purchased and installed 14 or more bulbs, they are committed CFL users and the program's bulbs are providing no net energy savings. These customers are all freeriders. Between these two extremes are people who are at various levels within the Bass adoption process. These customers are assigned NTG ratios in accordance with the degree of pre-program behaviors. This distributes very little savings to the customers who are already using CFLs in many of their fixtures, but who have not fully converted to CFL use in most fixtures. Likewise the Bass curve provides higher levels of NTG savings (but not full savings) to those customers who have tried a few CFLs or who have partially adopted their use. Both of these adoption concepts represent the dominate theories with the product adoption literature and provide similar results within a net energy impact analysis framework. In this analysis the inflection point of the Bass curve is seven CFLs, which is the typical level of CFL penetration among these participants. This inflection point means that there is little impact on net energy savings if the adoption process is faster or slower than projected in a typical Bass curve. That is, a shorter adoption period will give more savings to people with less than average adoption rates, but less savings to those with longer adoption periods, which

[5] Going forward an expanded approach will be used that employs three or more questions per agreement with Commission suggestions.

act cancel each other and provide the same net analysis results. Thus, we are confident that this net analysis represents a reliable method of crediting net program impacts for multiple adoption products such as light bulbs.

A graph of this curve is shown in Figure 1, with the corresponding freeridership levels by CFL count shown in Table 5. This approach to estimating freeridership is consistent with the field of product adoption and diffusion research and represents a standard approach within the field of product adoption research. It also recognizes that the more CFLs a home has, the less likely the addition of new Duke Energy CFLs will have an impact on product adoption and use behaviors.

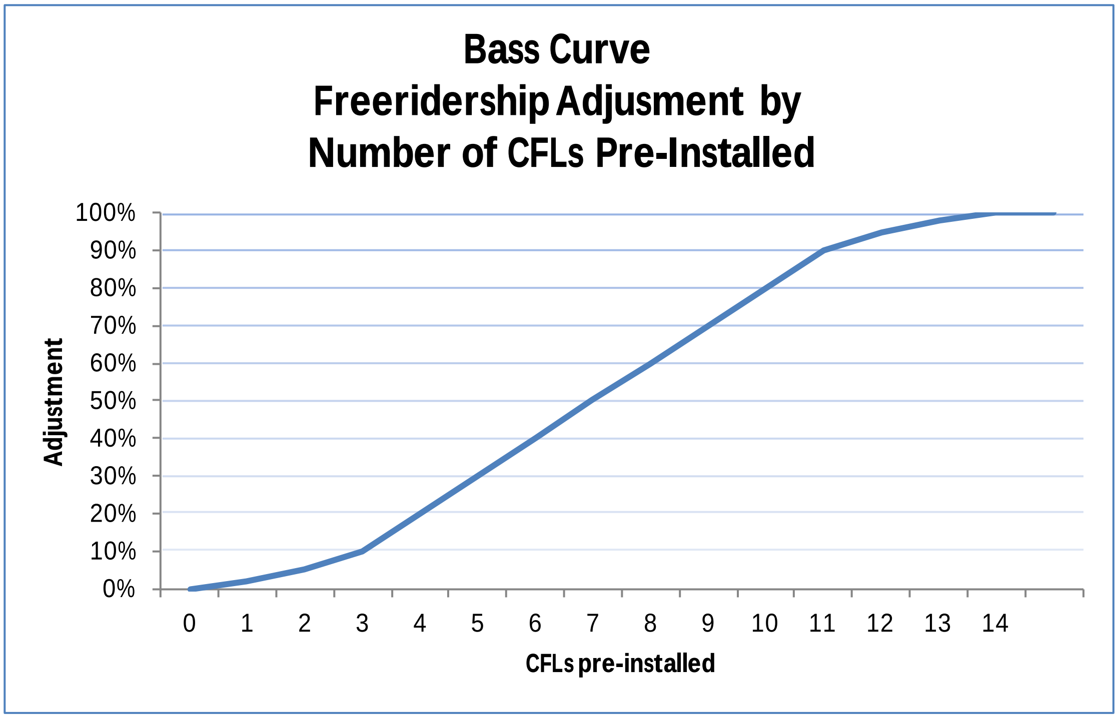

Figure 1. Bass Curve Freeridership Adjustment by Number of CFLs Pre-Installed

Table 5. CFL Freeridership Adjustment Determined by S Curve

Number of CFLs pre-installed	Freeridership Pre-installation adjustment factor	Number of customers with number of pre-installed CFLs
0	0%	49
1	2%	5
2	5%	14
3	10%	12
4	20%	20
5	30%	17
6	40%	10
7	50%	3
8	60%	5
9	70%	4
10	80%	15
11	90%	0

12	95%	8
13	98%	0
14 or more	100%	26

In addition to the pre-installation adjustment factor, TecMarket Works applied a freeridership multiplier based on whether or not respondents indicated they had planned on purchasing the measure (CFLs) before receiving the energy efficiency kit. These multipliers are shown in Table 6.

Table 6. Freeridership Multiplier Based on Measure Purchasing Plans

Did you plan on purchasing <measure> before receiving the K12 kit?	Freeridership multiplier[6]
Yes	1.25 (result cannot exceed 100%) (reduces program savings)
Maybe	1
Don't Know	1
No	0.25 (results cannot be lower than 0%) (increases program savings)
No, already installed in all possible places	Automatic 100% freeridership score

Combining Table 5 with Table 6 produces Table 7.

Table 7. Number of Participants Cross-Referenced by Freeridership Adjustment and Multiplier

Number of CFLs pre-installed	Freeridership Pre-installation adjustment factor	Number of Participants per Freeridership Multiplier				
		1.25	1	0.25	Automatic 0%	Automatic 100%
0 (N=47)	0%	NA	NA	NA	47	
1 (N=5)	2%	2	3			
2 (N=14)	5%	6	4	3		1
3 (N=12)	10%	6	3	1		2
4 (N=20)	20%	10	6	1		3
5 (N=17)	30%	8	4	3		2
6 (N=10)	40%	5	2	2		1
7 (N=3)	50%		2			1
8 (N=5)	60%	4				1
9 (N=4)	70%	3	1			
10 (N=15)	80%	9	3	1		2
11 (N=0)	90%					
12 (N=8)	95%	6	1			1
13 (N=0)	98%					

[6] Note: the .25 and 1.25 are behaviorally balanced adjustments that account for the degree of bias associated with a "yes" response compared to a "no" response. TecMarket Works estimates that the socially-acceptable response bias in this question, made after the program has educated the participant on the value of the energy savings, is more likely to be biased than a no response. This adjustment accounts for a less than 1% difference in the results. Research conducted by TecMarket Works shows that customers are about 3 times more likely to respond with a "yes" than a "no" following a program intervention when other conditions are equal.

14 or more (N=26)	100%	20		1		5

TecMarket Works then multiplied the freeridership adjustment factor by the freeridership multiplier for each survey respondent. An average of the resulting freeridership percentage across 186 respondents[7] who installed the kit-provided CFLs produced an average freeridership level of 42.3%.

This level of freeridership is higher than what we have seen in the past from these types of programs and reflects the movement of the market toward higher levels of CFL use over time. While the program is doing an excellent job of getting these CFLs in the sockets of customers who do not typically use high levels of CFLs without the program, it is becoming clear that Duke Energy will need to carefully monitor the CFL use market for the various types of targeted customer segments on which the program focuses and determine the point at which net savings will fall below cost effective program expenditures. TecMarket Works does not project when or if this condition will be experienced by different types of programs because net to gross analysis is not a technology factor, but rather is a target market adoption purchase behavior factor. Thus the value of a freeridership estimates is a program targeting metric rather than a technology metric or building code metric. Effective program targeting is established through the marketing, outreach and implementation design consideration, rather than the technology being pushed by a program.

CFL Spillover

The level of spillover for CFL bulbs was computed using the same factor scores found in Table 3, and the result is shown in Table 8.

Table 8. Freeridership and Spillover for CFL Bulbs

Measure (N=number of kit installations)	Number of participants with freeridership	Number of participants with spillover	Freeridership percentage (computed using Bass curve)	Spillover Percentage
CFL bulbs (N=188)	139	22	42.3%	7.4%

The resulting net to gross adjustment for the CFL component of this program is 65.1% (1-.423 + .074=.651). Again, this value is for informational purposes only. The energy impacts reported in this evaluation are already adjusted for freeridership and spillover as a direct result of the use of a net savings billing analysis approach for estimating savings.

[7] Two respondents were withheld from this analysis because they gave contradictory answers to the questions (indicating that they did not have any CFLs installed before the program, but also that they did not intend to purchase CFLs because they “already have them installed in every socket”).

Impact Estimates: Billing Analysis

This section of the report presents the results of a billing analysis conducted over the participants in the EE for Schools program in the Carolina System. Billing data was obtained for all participants in the EE for Schools program between January, 2012 and August, 2012 and that had accounts with Duke Energy. After processing, there were a total of 29,220 usable accounts[8]. A panel model was used to determine program impacts, where the dependent variable was daily electricity consumption from September 2010 to August, 2012. The results of the billing analysis are presented in Table 9. This table shows that the EE for Schools program produced statistically significant savings for participants in Carolinas.

Table 9. Estimated Carolinas EE for Schools Impacts: Billing Analysis

	kWh	t-value
Per Participant Annual Savings (Net)	236	6.34

For this analysis, data were available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of data, known as "panel" data, it becomes possible to control, simultaneously, for differences across households as well as differences across periods in time through the use of a "fixed-effects" panel model specification. The fixed-effect refers to the model specification aspect that differences across homes that do not vary over the estimation period (such as square footage, heating system, etc.) can be explained, in large part, by customer-specific intercept terms that capture the net change in consumption due to the program, controlling for other factors that do change with time (e.g., the weather).

Because the consumption data in the panel model includes months before and after the installation of measures through the program, the period of program participation (or the participation window) may be defined specifically for each customer. This feature of the panel model allows for the pre-installation months of consumption to effectively act as controls for post-participation months. In addition, this model specification, unlike annual pre/post-participation models such as annual change models, does not require a full year of post-participation data. Effectively, the participant becomes their own control group, thus eliminating the need for a non-participant group. We know the exact month of participation in the program for each participant, and are able to construct customer specific models that measure the change in usage consumption immediately before and after the date of program participation, controlling for weather and customer characteristics such as other Duke offers.

The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household.

[8] In order to maximize the use of the data, a single model was estimated over all states (Ohio, North Carolina and South Carolina). Therefore, the actual sample size in the model included 7,279 households in Ohio; 21,230 in North Carolina and 7,990 in South Carolina for a total sample size of 36,499 households.

Algebraically, the fixed-effect panel data model is described as follows:

$$y_{it} = a_i + bx_{it} + e_{it},$$

where:

y_{it} = energy consumption for home *i* during month *t*
a_I = constant term for site *i*
ß = vector of coefficients
x = vector of variables that represent factors causing changes in energy consumption for home *i* during month *t* (i.e., weather and participation)
e = error term for home *i* during month *t.*

With this specification, the only information necessary for estimation is those factors that vary month to month for each customer, and that will affect energy use, which effectively are weather conditions and program participation. Other non-measurable factors can be captured through the use of monthly indicator variables (e.g., to capture the effect of potentially seasonal energy loads).

The effect of the EE for Schools program is captured by including a variable which is equal to one for all months after the household participated in the program. The coefficient on this variable is the savings associated with the program. In order to account for differences in billing days, the usage was normalized by days in the billing cycle. The estimated electric model is presented in Table 10[9].

Table 10. Estimated Savings Model – dependent variable is daily kWh usage, September 2010 through August 2012 (savings are negative)

Independent Variable	Coefficient (daily kWh)	Equivalent Percentage (%)	t-value
K-12 participation – Ohio	-0.65	1.5%	-3.44
K-12 participation – Carolinas	-0.646	1.3%	-6.34
Sample Size	597,215 observations (36,497 homes)		
R-Squared	74%		

Note that in this table, the dependent variable is the daily energy use. To derive the annual kWh savings, the coefficient in the table was multiplied by 365 to give the 235.9 kWh/year savings estimate for Carolinas. The equivalent percentage is calculated as the coefficient (daily kWh) divided by average pre-program usage of each state. Equivalent percentage saving of OH is calculated as 0.65 divided by OH average pre-program usage of 44.2 kWh /day. Equivalent percentage saving of Carolinas is calculated as 0.646 divided by Carolinas average pre-program usage of 47.9 kWh / day. The complete estimate model, showing the weather and time factors, is presented in Appendix B: Estimated Statistical Model.

[9] As stated previously, a single model was estimated over participants in all states. Thus, this table presents the impacts for the Carolinas in addition to the impacts for Ohio.

Impact Estimates: Engineering Analysis

Savings values in this section are not official and are provided only for program's management information and their use to better understand the per measure adoption and use characteristics. The net savings claimed by this program should be taken from the billing analysis results. These engineering estimates provide, for the billing analysis, a ratio of coincident kW reduction to kWh savings as it is incapable of analyzing kW. Additionally, the engineering estimates offer insight into individual measure contributions to overall savings.

Table 11 shows the estimated energy savings per unit distributed to Duke Energy customers adjusted downward for the ISR and accounting for the freeridership and spillover percentages computed from participants' survey responses. CFL savings also incorporate the self-reporting bias applied to the hours of use.

Table 11. Duke Energy Kit Savings: kWh and Coincident kW per Unit Distributed

Metric	13W CFL	18W CFL	Low-flow showerhead	Faucet Aerators[10]	Outlet Gaskets[11]	Hot Water TempCard	Night Light	Entire Kit
Units	Bulb	Bulb	Showerhead	Aerator	Gasket	Change	Light	Kit
Amount Distributed*	202	202	202	404	2424	202	202	202
In Service Rate	88.6%	82.6%	45.5%	31.2%	6.4%	11.9%	78.7%	
Gross kW per unit	0.00727	0.00750	0.00872	0.00006	0.00015	0.00086	0.0000003	0.02631
Gross kWh per unit	50.99	47.18	79.55	5.21	0.31	7.56	5.40	205
Freeridership rate	42.3%	42.3%	17.4%	5.9%	18.7%	0.0%	0.0%	
Spillover rate	7.4%	7.4%	3.5%	1.5%	4.5%	0.0%	0.0%	
NTG ratio	62.0%	62.0%	85.5%	95.5%	85.0%	100.0%	100.0%	75.6%
Net kW per unit	0.00451	0.00465	0.00745	0.00006	0.00013	0.00086	0.0000003	0.01631
Net kWh per unit	31.60	29.23	68.01	4.98	0.27	7.56	5.40	155
Measure Life (years)*	5	5	10	10	20	3	8	7
EUL net kWh per unit	157.98	146.17	680.10	49.80	5.31	22.68	43.23	1085

*This is the amount distributed to the online survey sample population of Duke Energy customers (n=202 kits).
**Overall measure life is a weighted average derived from the effective useful lives of the individual kit items. The weights were assigned based on each item's contribution to gross kWh savings.

Table 12. Non-Duke Energy Kit Savings: kWh and Coincident kW per Unit Distributed

Metric	13W CFL	Outlet Gaskets	***Hot Water TempCard	Entire kit
Units	Bulb	Gasket	Change	Kit
Amount Distributed*	177	1416	177	177
In Service Rate	89.2%	13.1%	11.9%	
Gross kW per unit	0.00721	0.00031	0.00086	0.01057
Gross kWh per unit	48.54	0.64	7.56	61
Freeridership rate	42.3%	18.7%	0.0%	
Spillover rate	7.4%	4.5%	0.0%	
NTG ratio	62.0%	85.0%	100.0%	68.6%
Net kW per unit	0.00447	0.00027	0.00086	0.00725
Net kWh per unit	30.08	0.54	7.56	42
Measure Life (years)*	5	20	3	6
EUL net kWh per unit	150.41	10.88	22.68	252

*This is the amount distributed to the online survey sample population of non-Duke Energy customers (n=177 kits).

[10] There are 2 faucet aerators in the kit.
[11] There are 12 gaskets in a package in the kit.

**Overall measure life is a weighted average derived from the effective useful lives of the individual kit items. The weights were assigned based on each item's contribution to gross kWh savings.
***Non-Duke Energy customers were not surveyed about the hot water tempcard. Behaviors are assumed to mirror Duke Energy customers.

Survey Data

Participants were asked how many of the measures distributed through Duke Energy's EE for Schools program they had installed. Additional, more specific information was collected for each measure, including the type and wattage of the bulb that the CFLs replaced, the average hours per day that they are in use, and the average number of showers taken per week using the low-flow showerhead. Duke Energy conducted the online survey with a random sample of 379 participants from the Carolina System between August 18 and August 30, 2012, which included 202 Duke Energy customers and 177 non-Duke Energy customers. The compilation of this data for Duke Energy customers is presented in Table 13 in its unadjusted form; that is before the self-reporting bias is applied to the CFLs' hours of use. The adjusted values appear in Table 16.

Table 13. Duke Energy Customers: Unadjusted Survey Data

Measure	Number of Installations	Average Wattage/GPM of Unit Removed	Average Daily Hours of Use/Showers per week
13W CFL	177	64	5.33
18W CFL	156	70	4.90
Low-flow showerhead	92	3.1	9.58
Faucet aerators*	126	2.2	
Outlet gaskets**	155		
Hot water tempcard***	24	Average 13 degree change	
Night light	159	2.21	8 old / 24 new

*Only aerators that did not replace an existing aerator are counted
**Only outlet gaskets installed in exterior walls are counted
***Only participants that both used the card and made a change are counted

Impact Estimates

CFLs

The Energy Efficiency Starter Kit distributed to Duke Energy customers included one 13-watt CFL and one 18-watt CFL. A total of 404 CFLs were given to Duke Energy customers that participated in the online survey, 202 each of the 13-watt and 18-watt CFLs. Impact estimates associated with these CFLs can be seen in Table 14. The kit distributed to non-Duke Energy customers contained only one 13-watt CFL. A total of 177 13-watt CFLs were given to non-Duke Energy customers that participated in the online survey. Impact estimates associated with these CFLs can be seen in Table 15.

Table 14. Savings Estimates per CFL Distributed to Duke Energy Customers

Bulb Type	Number Distributed	In Service Rate	Average Wattage of Bulb Removed	Average Adjusted Daily Hours of Use	Gross kWh per Bulb	Gross kW per Bulb	Net kWh per Bulb	Net kW per Bulb
13-watt	202	88.6%	64	3.24	50.99	0.0073	31.60	0.00451
18-watt	202	82.6%	70	3.11	47.18	0.0075	29.23	0.00465

Table 15. Savings Estimates per CFL Distributed to Non-Duke Energy Customers

Bulb Type	Number Distributed	In Service Rate	Average Wattage of Bulb Removed	Average Adjusted Daily Hours of Use	Gross kWh per Bulb	Gross kW per Bulb	Net kWh per Bulb	Net kW per Bulb
13-watt	177	89.2%	63	3.09	48.54	0.0072	30.08	0.00447

In Service Rate (ISR) Calculation

Survey participants were asked to report whether or not they used the CFLs in the energy efficiency kit. Respondents were also asked if they had subsequently removed any of the CFLs provided by the program. Their responses indicate that 5.45% of the CFLs that were initially installed have since been uninstalled. This percentage has been subtracted from the first year ISR.

Using 18-watt CFLs as an example, a total of 202 bulbs were distributed to survey participants in the energy efficiency kits. Respondents reported that 156 of them were used, a first year ISR of 77.2%. Subtracting the aforementioned 5.45% of bulbs removed from use yields a first year ISR of 71.8%. The ISR is calculated to be 82.6% using the following formula:

ISR = first year ISR + (43% * remainder) = **71.8% + (43% * 25.2%) = 82.6%**

The remainder is the percentage of bulbs that are not installed in the first year (100% - 71.8% = 28.2%) less 3% for the 97% lifetime ISR[12]. In this case, the remainder is 25.2%. The 43% represents the percentage of the remainder that will replace an incandescent bulb rather than a CFL[13].

Self-Reporting Bias

Previous CFL studies that have included both customer surveys and lighting loggers have shown that, comparing customers' self-reported hours of operation to the actual hours of operation, customers responding to the survey overestimated their lighting usage by 27%[14]. As this study

[12] As established in the Nexus Market Research, RLW Analytics, and GDS Associates study, dated January 20, 2009: "New England Residential Lighting Markdown Impact Evaluation".
[13] As established in the Nexus Market Research, RLW Analytics, dated October 2004: "Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs", table 6-4 where 24 out of 56 respondents indicated that they did not purchase the CFLs as spares.
[14] TecMarket Works and Building Metrics. "Duke Residential Smart $aver® CFL Program in North Carolina and South Carolina". February 15, 2011. Pg. 35.

did not employ lighting loggers, there is no data with which to make a comparison for this program specifically. Consequently, the self-reported hours of use obtained from the survey were reduced by the 27% established through the collection of data from previous programs. This bias applies to CFLs only.

Table 16 shows the average of the unadjusted hours of use values along with the updated average values after the self-reporting bias is applied for both Duke Energy and non-Duke Energy customers. The final value for the average daily hours of use for a Duke Energy customer is 3.24 and 3.11 for 13-watt and18-watt CFLs respectively. For non-Duke Energy customers, the final value for the average daily hours of use is 3.09.

Table 16. Adjusted Average Daily Hours of Use

Adjustment	Magnitude of Adjustment	Average Daily Hours of Use (13-watt Duke)	Average Daily Hours of Use (18-watt Duke)	Average Daily Hours of Use (13-watt Non-Duke)
Unadjusted	N/A	4.43	4.26	4.23
Self-Reporting Bias	27%	3.24	3.11	3.09

Low-Flow Showerhead

Each energy efficiency kit distributed to a Duke Energy customer contained one low-flow showerhead. Low-flow showerheads were not provided to non-Duke Energy customers. Out of the 202 showerheads distributed to survey participants, 45.5%, or 92, were installed. This information can be seen in Table 17 along with gross and net savings estimates per unit distributed. Approximately 41% of households in the Carolina System use electric water heaters. This measure produces zero kW or kWh savings in households that use gas water heaters.

Table 17. Savings Estimates per Showerhead Distributed

Number Distributed	In Service Rate	Average Showers per Week	Electric Water Heating	Gross kWh per Head	Gross kW per Head	Net kWh per Head	Net kW per Head
202	45.5%	12.31	41%	79.55	0.00872	68.01	0.00745

Faucet Aerators

One kitchen and one bathroom faucet aerator were given out in each kit that was distributed to a Duke Energy customer. Faucet aerators were not provided to non-Duke Energy customers. Out of the 404 aerators distributed to survey participants, 31.2%, or 126, were installed. This information can be seen in Table 18 along with gross and net savings estimates per unit distributed. This figure includes only those aerators that were installed on faucets that did not already have one. Aerators that replaced an existing aerator are ascribed zero savings. Approximately 41% of households in the Carolina System use electric water heaters. This measure produces zero kW or kWh savings in households that use gas water heaters.

Table 18. Savings Estimates per Aerator Distributed

Number Distributed	In Service Rate	Electric Water Heating	Gross kWh per Aerator	Gross kW per Aerator	Net kWh per Aerator	Net kW per Aerator
404	31.2%	41%	5.21	0.00006	4.98	0.00006

Outlet and Switch Gaskets

Four kitchen and eight outlet gaskets were given out in each kit that was distributed to a Duke Energy customer. Non-Duke Energy customers were provided only with the eight outlet gaskets. Out of the 2,424 gaskets distributed to Duke Energy survey participants, 6.4%, or 155, were installed. This information can be seen in Table 19 along with gross and net savings estimates per unit distributed. This figure includes only those gaskets that were installed in exterior walls. Gaskets installed in interior walls are ascribed zero savings. The same information is presented in Table 20 for non-Duke Energy customers.

Table 19. Savings Estimates per Gasket Distributed to Duke Energy Customers

Number Distributed	In Service Rate	Gross kWh per Gasket	Gross kW per Gasket	Net kWh per Gasket	Net kW per Gasket
2,424	6.4%	0.31	0.00015	0.27	0.00013

Table 20. Savings Estimates per Gasket Distributed to Non-Duke Energy Customers

Number Distributed	In Service Rate	Gross kWh per Gasket	Gross kW per Gasket	Net kWh per Gasket	Net kW per Gasket
1,416	13.1%	0.64	0.00031	0.54	0.00027

Hot Water TempCard

Each energy efficiency kit, for both Duke Energy and non-Duke Energy customers, contained one hot water tempcard. Non-Duke Energy customers were not surveyed about the hot water tempcard. All behavioral data collected from the Duke Energy customer survey has been mirrored to the non-Duke Energy customer participants. Therefore, savings per unit distributed is identical for both populations. Out of the 202 cards distributed to Duke Energy survey participants, 11.9%, or 24 people, both used the card and made a change to their water temperature based on what they learned. The average change was -13 degrees Fahrenheit. This information can be seen in Table 21 along with gross and net savings estimates per unit distributed. The net-to-gross ratio for this measure is 1.0, so gross and net savings are equivalent.

Table 21. Savings Estimates per Hot Water TempCard Distributed

Amount Distributed	In Service Rate	Average Temperature Adjustment (°F)	Gross and Net kWh per Card	Gross and Net kW per Card
202	11.9%	-13	7.56	0.00086

Night Light

Out of the 202 Duke Energy participants, 78.7%, or 159, installed the night light. Night lights were not provided to non-Duke Energy customers. About half of these installations, however, were new installations. That is they did not replace an existing light. This is reflected in the average wattage of a replaced unit where such installations are considered zeroes. While the base unit wattage is five watts, the average replaced wattage after factoring in new installations drops to 2.53 watts. Table 22 shows this information along with gross and net savings estimates per unit distributed. The net-to-gross ratio for this measure is 1.0, so gross and net savings are equivalent.

Table 22. Savings Estimates per Night Light Distributed

Number Distributed	In Service Rate	Average Wattage Light Removed	Average Daily Hours of Use Base	Average Daily Hours of Use EE	Gross and Net kWh per Light	Gross and Net kW per Light
202	78.7%	2.53	8	24	5.40	0.0000003

The base unit wattage and average daily hours of use, along with the coincidence factor were taken from the *FES-L6a LED and Specialty Lighting-Residential* workpaper. Values for these metrics can be seen in Appendix D: Impact Algorithms.

Lifetime Kit Impacts

Figure 2 shows the estimated energy impacts over the lifetime of the kit measures. The graph's shape can be roughly described as having three distinct plateaus. The small drop in kWh savings seen after three years in the first plateau occurs at the end of the effective useful life (EUL) of the hot water tempcard. The steep drop off seen at year five from the first to the second plateau occurs at the end of the effective useful life of the CFLs. At this point, no further savings is accrued from those measures, however, because behavior taken is the best predictor of future actions, it is very likely that these savings continue well beyond these estimates as participants continue to use a lower hot water temperature and burnt out bulbs are replaced with additional CFLs. Again, our approach of counting savings for the actions taken directly as a result of the program, without adding market effects savings, provides a conservative estimate of savings. Since CFLs are the single largest contributor to overall electrical program savings, there is a significant drop in savings as the installed units burn out at the end of their EUL.

The small drop in the second plateau occurs at eight years, the end of the effective useful life of the night light. The second plateau ends at the ten year mark, when the low-flow showerheads reach the end of their effective useful lives. A smaller drop off occurs at the end of the effective useful life of the faucet aerators and the low-flow showerheads. The third and final plateau begins at year eleven. From year eleven onward, the savings is comprised of outlet gaskets exclusively.

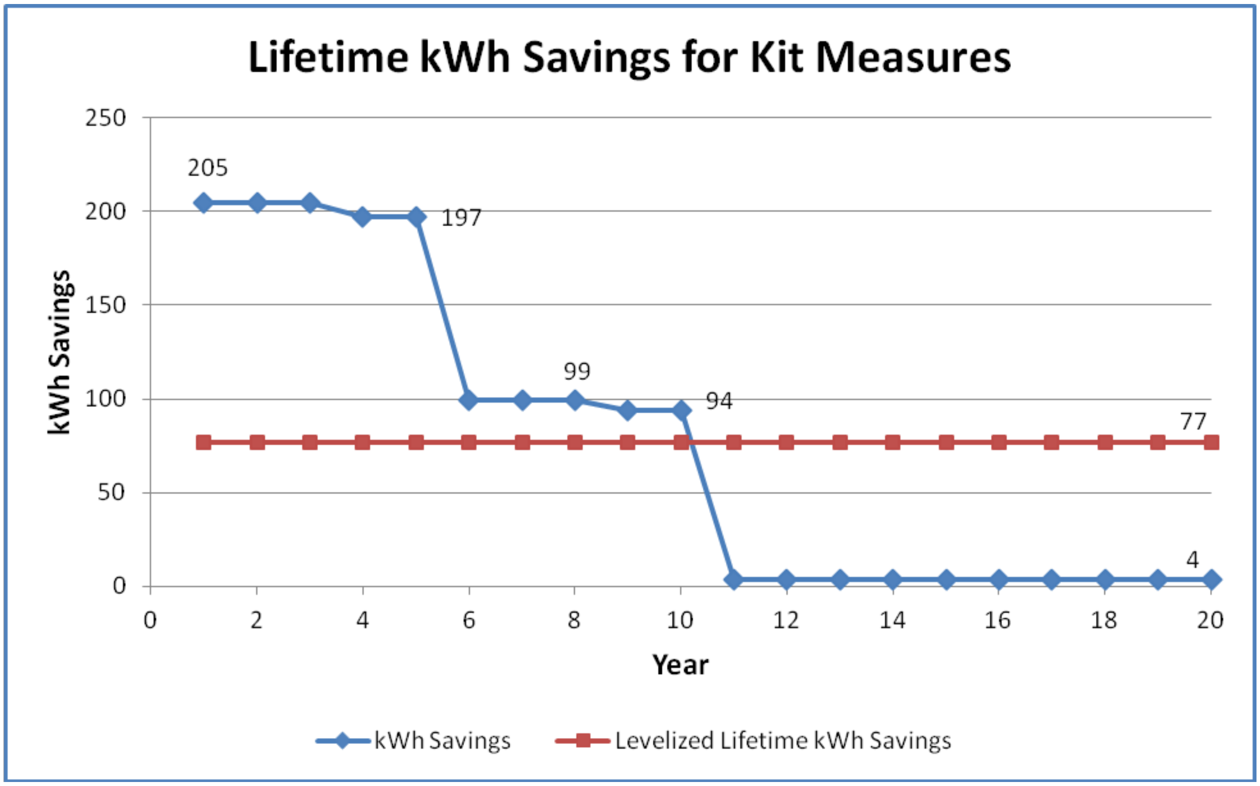

Figure 2. Lifetime kWh Savings of Kit Measures

Total Program Savings Extrapolation

There were a total of 29,220 Duke Energy participants that each received an energy efficiency kit from January, 2012 through August, 2012. This information is presented in Table 23. Multiplying the count for each measure by the savings/unit for that measure from Table 11 and Table 12 produces the total annual program kW and kWh savings.

Table 23. Total Program Gross Savings Extrapolation

Measure	Count	Gross kWh	Gross kW
Duke Energy Kit	29,220	5,990,100	769

Appendix A: Participant Survey Instruments

Duke Customer Survey:

Duke Customer Survey

Non-Duke Customer Survey:

Non-Duke Customer Survey

Appendix B: Estimated Statistical Model

Number of Observations Read	597232
Number of Observations Used	597215

Dependent Variable: kwhd

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	36552	278162463.2	7610.0	42.99	<.0001
Error	560662	99251210.5	177.0		
Corrected Total	597214	377413673.6			

R-Square	Coeff Var	Root MSE	kwhd Mean
0.737023	29.19946	13.30508	45.56617

Source	DF	Type I SS	Mean Square	F Value	Pr > F
acct_id	36497	226475378.4	6205.3	35.05	<.0001
yearmonth*state	42	50793893.2	1209378.4	6831.68	<.0001
avg_temp*premstate	3	705888.9	235296.3	1329.17	<.0001
avg_humi*premstate	3	154542.6	51514.2	291.00	<.0001
HEHC	1	212.4	212.4	1.20	0.2733
PER	1	3643.4	3643.4	20.58	<.0001
LowInc	1	395.2	395.2	2.23	0.1351
SS	1	18760.0	18760.0	105.97	<.0001
CFL	1	535.7	535.7	3.03	0.0819
part*state	2	9213.1	4606.6	26.02	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
yearmonth*state	42	37254203.81	887004.85	5010.62	<.0001
avg_temp*premstate	3	539186.18	179728.73	1015.27	<.0001
avg_humi*premstate	3	154928.30	51642.77	291.73	<.0001
HEHC	1	189.35	189.35	1.07	0.3010
PER	1	3604.65	3604.65	20.36	<.0001
LowInc	1	399.24	399.24	2.26	0.1332
SS	1	18731.67	18731.67	105.81	<.0001
CFL	1	500.58	500.58	2.83	0.0926
part*state	2	9213.13	4606.57	26.02	<.0001

Parameter			Estimate	Standard Error	t Value	Pr > |t|
yearmonth*state	201010	OH	8.848918	9.653526	0.92	0.3593
yearmonth*state	201011	OH	-26.8365	9.657353	-2.78	0.0055
yearmonth*state	201012	OH	-23.8305	9.665848	-2.47	0.0137
yearmonth*state	201101	OH	-17.1092	9.673437	-1.77	0.0769
yearmonth*state	201102	Carolina	14.90816	0.442001	33.73	<.0001
yearmonth*state	201102	OH	0.221421	0.759482	0.29	0.7706
yearmonth*state	201103	Carolina	-5.07392	0.377985	-13.42	<.0001
yearmonth*state	201103	OH	-8.55015	0.605761	-14.11	<.0001

yearmonth*state	201104	Carolina	-10.7392	0.286299	-37.51	<.0001
yearmonth*state	201104	OH	-15.4134	0.494516	-31.17	<.0001
yearmonth*state	201105	Carolina	-13.7401	0.219655	-62.55	<.0001
yearmonth*state	201105	OH	-17.8747	0.389633	-45.88	<.0001
yearmonth*state	201106	Carolina	-1.66328	0.196765	-8.45	<.0001
yearmonth*state	201106	OH	-7.06547	0.341439	-20.69	<.0001
yearmonth*state	201107	Carolina	4.222143	0.196617	21.47	<.0001
yearmonth*state	201107	OH	0.906266	0.342405	2.65	0.0081
yearmonth*state	201108	Carolina	8.450564	0.201456	41.95	<.0001
yearmonth*state	201108	OH	11.23771	0.35257	31.87	<.0001
yearmonth*state	201109	Carolina	-1.64002	0.191112	-8.58	<.0001
yearmonth*state	201109	OH	-3.79566	0.337632	-11.24	<.0001
yearmonth*state	201110	Carolina	-13.2573	0.207335	-63.94	<.0001
yearmonth*state	201110	OH	-17.3686	0.377473	-46.01	<.0001
yearmonth*state	201111	Carolina	-9.15328	0.262489	-34.87	<.0001
yearmonth*state	201111	OH	-16.6972	0.444965	-37.52	<.0001
yearmonth*state	201112	Carolina	-1.23942	0.284664	-4.35	<.0001
yearmonth*state	201112	OH	-9.34439	0.518209	-18.03	<.0001
yearmonth*state	201201	Carolina	6.117962	0.318128	19.23	<.0001
yearmonth*state	201201	OH	13.81801	0.589907	23.42	<.0001
yearmonth*state	201202	Carolina	4.276666	0.319351	13.39	<.0001
yearmonth*state	201202	OH	-3.45697	0.588742	-5.87	<.0001
yearmonth*state	201203	Carolina	-4.804	0.276687	-17.36	<.0001
yearmonth*state	201203	OH	-10.2919	0.497634	-20.68	<.0001
yearmonth*state	201204	Carolina	-15.2302	0.218548	-69.69	<.0001
yearmonth*state	201204	OH	-18.7674	0.377451	-49.72	<.0001
yearmonth*state	201205	Carolina	-11.2122	0.183785	-61.01	<.0001
yearmonth*state	201205	OH	-16.1013	0.333677	-48.25	<.0001
yearmonth*state	201206	Carolina	-6.37043	0.162415	-39.22	<.0001
yearmonth*state	201206	OH	-7.94024	0.286963	-27.67	<.0001
yearmonth*state	201207	Carolina	4.252702	0.167524	25.39	<.0001
yearmonth*state	201207	OH	6.723126	0.304679	22.07	<.0001
yearmonth*state	201208	Carolina	5.287277	0.1488	35.53	<.0001
yearmonth*state	201208	OH	6.428205	0.279652	22.99	<.0001
avg_temp*premstate NC			0.277307	0.008599	32.25	<.0001
avg_temp*premstate OH			0.071776	0.014158	5.07	<.0001
avg_temp*premstate SC			0.434798	0.009129	47.63	<.0001
avg_humi*premstate NC			-0.22591	0.008218	-27.49	<.0001
avg_humi*premstate OH			-0.11002	0.014782	-7.44	<.0001
avg_humi*premstate SC			-0.03141	0.011422	-2.75	0.006
HEHC			-1.03577	1.001495	-1.03	0.301

PER		2.392527	0.530203	4.51	<.0001
LowInc		-2.24866	1.497345	-1.5	0.1332
SS		-4.65227	0.452266	-10.29	<.0001
CFL		-0.12483	0.074231	-1.68	0.0926
part*state	Carolina	-0.64638	0.101958	-6.34	<.0001
part*state	OH	-0.6504	0.188908	-3.44	0.0006

Appendix C: Participant Counts

This appendix presents the counts of participants and non-participants in each month. The first row is always the last month before the first participant, such that for Carolina the first participant showed up in Jan. 2012 with the first row started in Dec. 2011. The last row is the last month of billing data included in the billing analysis, and it may not be the last month of participation cut-off for this analysis. For example the cut-off month for participation is August 2012 (i.e. all homes included in this analysis were active in August 2012) whereas the billing data goes through September 2012 such that the last month with a non-participant count is zero.

state	yearmonth	Participant_count	Non_participant_count
Carolinas	201112	0	28071
	201201	2674	25725
	201202	3812	24708
	201203	11244	17480
	201204	21043	7276
	201205	26363	1821
	201206	27258	595
	201207	27559	145
	201208	27324	15
	201209	12335	0

Appendix D: Impact Algorithms

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW = ISR \times units \times \left[\frac{Watts_{base} - Watts_{ee}}{1000}\right] \times CF \times (1 + HVAC_d)$$

Gross Annual Energy Savings

$$\Delta kWh = ISR \times units \times \left[\frac{(Watts \times HOU)_{base} - (Watts \times HOU)_{ee}}{1000}\right] \times 365 \times (1 + HVAC_c)$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of units installed under the program
$Watts_{ee}$	= connected load of energy-efficient unit
$Watts_{base}$	= connected (nameplate) load of baseline unit(s) displaced
HOU	= Average daily hours of use (based on connected load)
CF	= coincidence factor = 0.123
$HVAC_c$	= HVAC system interaction factor for annual electricity consumption = -0.037
$HVAC_d$	= HVAC system interaction factor for demand = 0.168

The coincidence factor for this analysis was taken from Duke Energy's Residential Smart $aver lighting logger study performed in North Carolina with participants from the 2010 CFL campaigns.

$HVAC_c$ - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The weights were determined through appliance saturation data from the Home Profile Database supplied by Duke Energy.

$HVAC_d$ - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Charlotte, NC

Heating Fuel	Heating System	Cooling System	Weight	HVACc	HVACd
Other	Any except Heat Pump	Any except Heat Pump	0.0042	0.069	0.17
		None	0.0004	0	0
Any	Heat Pump	Heat Pump	0.2782	-0.1	0.17
Gas Propane Oil	Central Furnace	None	0.0067	0	0
		Room/Window	0.5508	0.069	0.17
		Central AC		0.069	0.17
Electricity	Electric baseboard/ central furnace	None	0.0030	-0.43	0
		Room/Window	0.1493	-0.31	0.17
		Central AC		-0.31	0.17
None	None	Any	0.0074	0	0.17
Total Weighted Average			1	-0.037	0.168

Outlet Gaskets

Gross Summer Coincident Demand Savings

$\Delta kW_S = \text{units} \times (\Delta cfm/unit) \times (kW/cfm) \times DF_S \times CF_S$

Gross Annual Energy Savings

$\Delta kWh = \text{units} \times (\Delta cfm/unit) \times (kWh/cfm)$

$\Delta therm = units \times (\Delta cfm/unit) \times (therm/cfm)$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
units = number of buildings sealed under the program
$\Delta cfm/unit$ = unit infiltration airflow rate (ft^3/min) reduction for each measure
DF = demand diversity factor = 0.8
CF = coincidence factor = 1.0
kW/cfm = demand savings per unit cfm reduction
kWh/cfm = electricity savings per unit cfm reduction
therm/cfm = gas savings per unit cfm reduction

Unit cfm savings per measure

The cfm reductions for each measure were estimated from equivalent leakage area (ELA) change data taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001). The equivalent leakage area changes were converted to infiltration rate changes using the Sherman-Grimsrud equation:

$$Q = ELA \text{ x } \sqrt{A \times \Delta T + B \times v^2}$$

where:

A = stack coefficient (ft^3/min-in^4-°F)
= 0.015 for one-story house

DT = average indoor/outdoor temperature difference over the time interval of interest (°F)

B = wind coefficient (ft^3/min-in^4-mph^2)
= 0.0065 (moderate shielding)

v = average wind speed over the time interval of interest measured at a local weather station at a height of 20 ft (mph)

The location specific data are shown below:

Location	Average outdoor temp	Average indoor/outdoor temp difference	Average wind speed (mph)	Specific infiltration rate (cfm/in^2)
Charlotte	60	8	19	1.57

Measure ELA impact and cfm reductions are as follows:

Measure	Unit	ELA change (in^2/unit)	ΔCfm/unit (NC)
Outlet gaskets	Each	0.357	0.56
Weather strip	Foot	0.089	0.14

Unit energy and demand savings

The energy and peak demand impacts of reducing infiltration rates were calculated from infiltration rate parametric studies conducted using the DOE-2 residential building prototype models, as described at the end of this Appendix. The savings per cfm reduction by heating and cooling system type are shown below:

Heating Fuel	Heating System	Cooling System	kWh/cfm	kW/cfm	therm/cfm
Other	Any except Heat Pump	Any except Heat Pump	2.48	0.00248	0
Any	Heat Pump	Heat Pump	10.37	0.00248	0
Gas Propane Oil	Central Furnace	None	0	0	0.0743
		Room/Window	2.48	0.00248	0.0743
		Central AC	2.48	0.00248	0.0743
	Other	None	0	0	0.0743
		Room/Window	2.48	0.00248	0.0743
		Central AC	2.48	0.00248	0.0743
Electricity	Central furnace	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000

		Central AC	18.54	0.01485	0.000
	Electric baseboard	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000
	Other	None	17.01	0.00990	0.000
		Room/Window	18.54	0.01485	0.000
		Central AC	18.54	0.01485	0.000

Low-Flow Showerhead

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413_s} \times DF_x \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = \text{units} \times \frac{(\text{GPD}_{\text{base}} - \text{GPD}_{\text{ee}}) \times 8.33 \times \overline{\Delta T}}{3413} \times 365$$

$$\Delta therm = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{365}{100000}$$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
units = number of units installed under the program
GPD_{base} = daily hot water consumption before installation
GPD_{ee} = daily hot water consumption after flow reducing measure installation
ΔT = average difference between entering cold water temperature and the shower use temperature
DF = demand diversity factor for electric water heating
CF = coincidence factor
8.33 = conversion factor (Btu/gal-°F)
3413 = conversion factor (Btu/kWh)
24 = conversion factor (hr/day)
365 = conversion factor (days/yr)
100000 = conversion factor (Btu/therm)

Showerhead

GPD_{base} = showers/week / 7 x 3.1 gpm x 5 minutes/shower

GPD_{ee} = showers/week / 7 x 1.5 gpm x 5 minutes/shower

ΔT

City	Average cold water temperature	Shower use temperature	Average ΔT
Charlotte	60.3 °F	100°F	39.7°F

Water heater efficiency

Combustion efficiency for residential gas water heater = 0.70

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Faucet Aerators

This measure used the Efficiency Vermont deemed savings (Efficiency Vermont, 2003) adjusted for entering water temperature:

Demand Savings
DkW = 0.0171 kW x DT / DT_{VT} x DF x CF

Energy Savings
$DkWh_i$ = 57 kWh x DT / DT_{VT}
Dtherms = 2.0 x DT / $DT_{VT\,i}$

City	Average cold water temperature	Hot water use temperature	Average ΔT
Charlotte	60.3 °F	100°F	39.7°F
Burlington VT	44.5	100°F	55.5

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Water Temperature Card

Gross Summer Coincident Demand Savings

$$\Delta kW_S = \text{units} \times \frac{(UA_{base} - UA_{ee}) \times \Delta T_s}{3413} \times DF_s \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = \text{units} \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{3413} \times 8760$$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
units = number of water heaters installed under the program
UA_{base} = overall heat transfer coefficient of base water heater (Btu/hr-°F) =4.6817
UA_{ee} = overall heat transfer coefficient of improved water heater (Btu/hr-°F) =1.9217
ΔT = temperature difference between the tank and the ambient air (°F)
DF = demand diversity factor
CF = coincidence factor
3413 = conversion factor (Btu/kWh)
8760 = conversion factor (hr/yr)
100000 = conversion factor (Btu/therm)
$\eta_{waterheater}$ = water heater efficiency

Water heater tank UA

Water heater size (gal)	Electric		Gas	
	UAbase	UAee	UAbase	UAee
30	3.84	1.69	4.21	1.76
50	4.67	1.83	5.13	1.91
60	4.13	2.06	4.54	2.14

75	5.00	2.42	5.50	2.52
80+	5.72	2.53	6.28	2.64

ΔT = 140°F water setpoint temp – 65°F room temp = 75°F

DF = 1.0
CF= 1.0
$\eta_{waterheater} = 0.7$

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential water heaters meeting standby losses.

Night Lights

$Watts_{ee} = 0.03$
$Watts_{base} = 5$
HOUee = 24
HOUbase = 8

CF = 0.0001
HVACc = -0.0058
HVACd = 0.167

$\Delta kWh = units \times (Watts_{base} * HOUbase - Watts_{ee} * HOUee) / 1000 \times 365 * (1+HVACc)$
$\Delta kW = units \times (Wattsbase - Wattsee) / 1000 \times CF * (1+HVACd)$

The Wattsbase, HOUbase, and CF were taken from the *FES-L6a LED and Specialty Lighting-Residential* workpaper.

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 3.

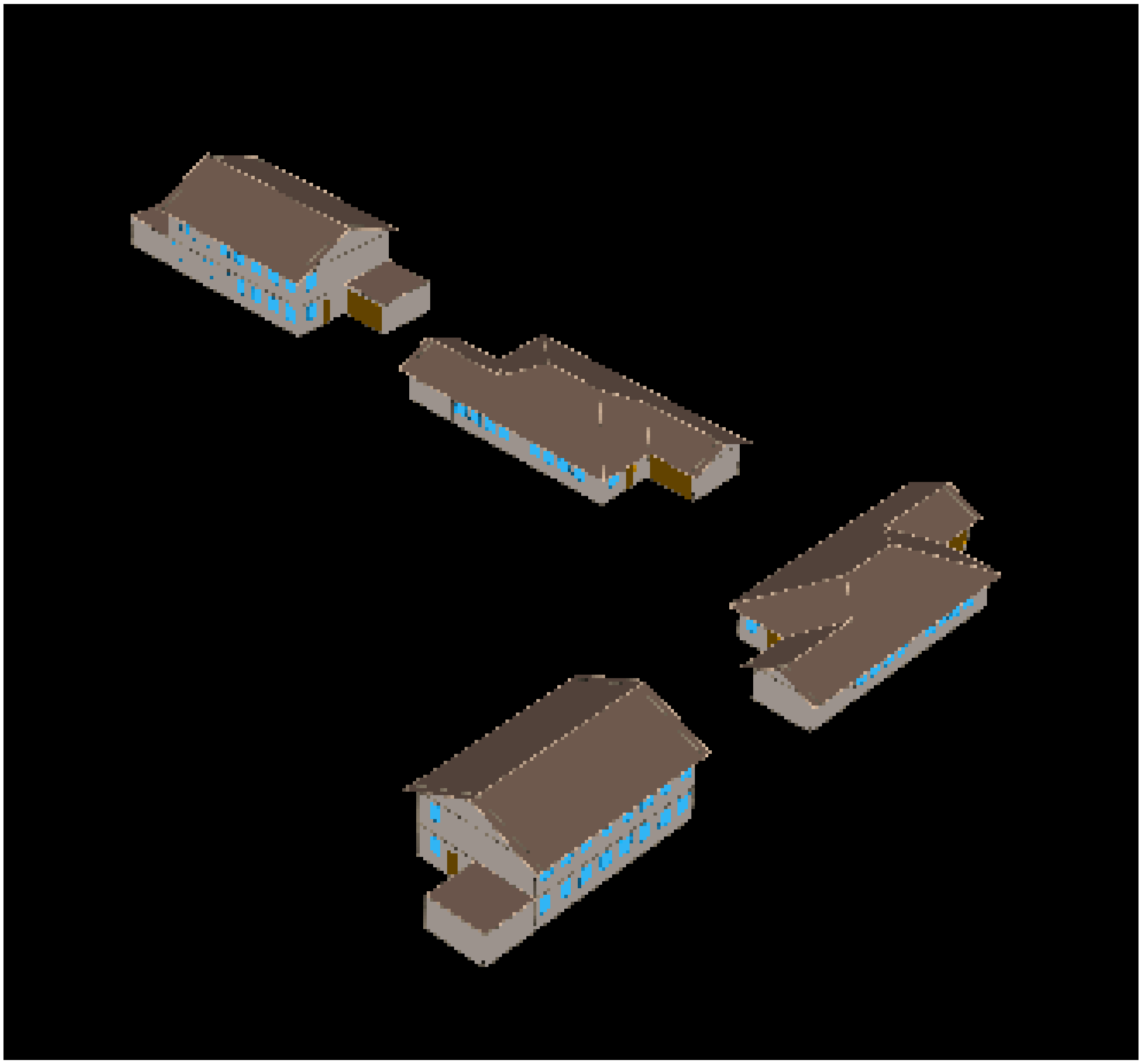

Figure 3. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F

Characteristic	Value
Duct location	Attic (unconditioned space)
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	26%; evenly distributed between supply and return
Cooling season	Charlotte – April 17 to October 6
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix E: DSMore Table

Per Measure Impacts Summary for EE for Schools

Impacts ⇨ / Technology ⇩	Product code	State	EM&V gross savings (kWh/unit)	EM&V gross kW (customer peak/unit)	EM&V gross kW (coincident peak/unit)	Unit of measure	Combined spillover less freeridership adjustment	EM&V net savings (kWh/unit)	EM&V net kW (customer peak/unit)	EM&V net kW (coincident peak/unit)	EM&V load shape (yes/no)	EUL (whole number)
EE for Schools		Carolinas	236	0.2016	0.0248	home		236	0.2016	0.0248	no	7
Program wide		**Carolinas**	**236**	**0.2016**	**0.0248**	**home**		**236**	**0.2016**	**0.0248**	**no**	**7**

*The evaluation methodology provided net savings only. By design, gross savings are excluded from this methodological approach. The controlled quasi-experimental design approach was selected to increase the reliability of the energy savings estimates. This approach provides net savings as the analytical output.

**There is no Freeridership value provided in this table due to the evaluation methodology employed

Final Report without M&V Site Reports

Evaluation of the Smart $aver Non-Residential Custom Incentive Program in the Carolina System

Results of an Impact and Process Evaluation

Prepared for
Duke Energy
139 East Fourth Street
Cincinnati, OH 45201

November 20, 2013
Revised December 19, 2013

Submitted by

Nick Hall, Brian Evans
and Johna Roth
TecMarket Works
165 West Netherwood Road
2nd Floor, Suite A
Oregon, Wisconsin 53575

Stuart Waterbury
Architectural Energy Corporation

Pete Jacobs
BuildingMetrics, Inc.

Carol Yin
Yinsight, Inc.

Table of Contents

December 19, 2013 Revisions: After finalization of this report, it was discovered that the population savings by project type needed to be updated with the final 2013 participation data.

This resulted in changes to the population savings values in Tables 5-7 and 21-23.

Executive Summary

Key Findings and Recommendations

The key findings and recommendations identified through this evaluation are presented below.

Process Evaluation: Key Findings

The Smart $aver Custom program was designed to complement the Smart $aver Prescriptive program by offering greater flexibility in choice of equipment, but requires pre-approval through a detailed application process. Interviews with 41 program participants found they generally appreciate the flexibility that the Custom program affords them, but may be uncomfortable committing resources to the detailed application process because the incentive cannot be estimated easily. Despite the uncertainty about the incentive amount, the Custom program participants seem to have weighed the costs and benefits successfully. Customers report that they sometimes choose not to submit a Custom application if their project can be justified on its own financial merits. Others report that the Custom incentive played a critical role in lowering the payback on projects that would have not otherwise received their management's support. These characteristics of the program and the market's reaction are all well-understood by the Duke Energy program manager. Few recommendations for program improvement are warranted, due to the program managers' existing plans for improvement.

WECC reports that for the period of April – December of 2011, the Carolinas Custom program had an energy savings objective of 15,608,500 kWh combined. For 2012, that objective was 46,782,996 kWh for North Carolina and 17,303,300 in South Carolina.

Process Evaluation: Recommendations

- The Smart $aver website allows customers to search for participating trade allies, but the search tool uses search options that do not seem to be defined. Duke Energy should add explanations of the program website search options that may be unclear, and vet future website changes with a small group of customers (approximately 5-10) to get feedback website usability.

- If not already doing so, Duke Energy should consider analyzing the sources from which applicants first learned of the Custom program. If a sizeable proportion in the population also learns about the program through word of mouth or through referrals from colleagues, this knowledge may allow Duke Energy to reduce or reallocate marketing resources among their different target audiences.

- Duke Energy should compare the participant suggestions for improvement with other suggestions they have heard in the past. For any recurring suggestions that reflect a misunderstanding of the current program, Duke Energy should consider addressing those issues in the Frequently Asked Questions section of the Smart $aver website. If that information is made widely available, it may help decrease the recurrence of these suggestions in the future.

- In the incentive application that is submitted with the project invoices, Duke Energy should consider asking customers to answer an optional question about additional measures included in the project. This data may help Duke Energy determine whether the participant-reported spillover is easily quantified. Even if savings are not easily quantified, qualitative data on spillover measures may help Duke Energy show the full benefits of the Custom program.

Engineering Impact Estimates: Key Findings

1. The overall realization rate across all sampled projects was 0.74. On an individual project basis, the realization rates ranged from 0.00 to 8.8, indicating a wide variation in the evaluated vs. expected kWh savings on any individual project.
2. Projecting the sample realization rate into the program population, the overall program realization rate is 0.94. The realization rate for lighting projects was 1.21, the realization rate for HVAC projects was 0.74 and the realization rate for process projects was 0.49.
3. About 40% of the total program savings come from lighting. Based on our review, it appears there is enough data to support moving some lighting measures to the Prescriptive Program by expanding the list of eligible fixtures. This will reduce application burden on customers and reduce the application review burden on Duke Energy staff. Candidates for inclusion in the prescriptive lighting program include interior and exterior induction lighting fixtures, high-bay fluorescent lighting in refrigerated spaces, exterior LED fixtures, and exterior metal halide fixtures.
4. Realization rates for HVAC and process projects are below 1.0. If the program moves most of the lighting projects to the Prescriptive program, the overall program realization rate may drop as HVAC and process projects become a greater fraction of the total program savings. Savings variation for the Custom Incentive program will likely increase, since HVAC and process projects tend to be less predictable than lighting projects.
5. Poor installation quality and non- or partially-functioning measures affected some sites. Both small and large projects were affected. Post installation inspections by the administrator and/or commissioning may be appropriate.
6. One of the HVAC sites involved installing a centrifugal chiller with a variable frequency drive (VFD) on the compressor. The minimum condenser water setpoint temperature influences the ability of the VFD to reduce the speed of the compressor. At this site, the minimum condenser water temperature was set fairly high, limiting the VFD chiller savings. The program should consider implementing a requirement on minimum condenser water setpoint temperature for VFD chiller projects.
7. Another HVAC site was a hotel that installed guest room occupancy controls. The savings at this site was limited by high occupancy rates. Proposals for guest room occupancy control projects should review the occupancy rate assumptions used in the analysis, and compare the assumptions to historical occupancy rates at the project location.
8. Several projects were whole-building new construction projects that used DOE-2 modeling to project energy savings. Several DOE-2 modeling errors concerning data entry, modeling approach and interpretation of ASHRAE 90.1 were encountered when

reviewing these projects. Consider outside review by experienced modelers of the DOE-2 models submitted for commercial new construction projects.

9. The cool roof project did not perform to program expectations. The calculations done for the project application used roofing system vendor estimates that overstated savings. Future cool roof projects should be more thoroughly screened. Project savings estimates prepared with vendor-supplied software should be independently verified, including comparisons to unit savings estimates (kWh/SF and kW/SF) from independent sources. Projects with pre-existing roof insulation levels at or near code should be carefully reviewed.

Table 1: Evaluated Savings Estimate Breakdown by Customer[1]

	Customer	Facility Type	kWh	NCP kW[2]	CP kW[3]	MMBtu[4]
1	[redacted]	Multiple Bank Branch Office	248,891	54.0	8.7	N/A
2	[redacted]	Manufacturing	1,234,631	-5.0	-5.0	N/A
3	[redacted]	Manufacturing	208,279	23.0	23.0	N/A
4	[redacted]	Office	16,253	29.5	29.5	N/A
5	[redacted]	Manufacturing	0	0.0	0.0	N/A
6	[redacted]	Manufacturing	118,688	0.0	0.0	N/A
7	[redacted]	Wastewater	156,666	31.0	77.0	N/A
8	[redacted]	Warehouse	1,645,455	62.0	87.4	N/A
9	[redacted]	Parking Structure	699,285	80.0	80.0	N/A
10	[redacted]	TV studio	241,512	43.0	45.0	N/A
11	[redacted]	Parking Structure	91,980	25.0	25.0	N/A
12	[redacted]	Office	51,642	16.0	16.0	N/A
13	[redacted]	Service Station	36,695	6.8	0.0	N/A
14	[redacted]	Office	416,346	47.0	47.0	N/A
15	[redacted]	Data Center	5,293,436	276.0	284.0	N/A
16	[redacted]	Data Center	3,065,196	580.0	543.0	N/A
17	[redacted]	Office	791,017	-125.0	-45.9	N/A
18	[redacted]	Data Center	1,895,128	216.3	216.3	N/A
19	[redacted]	Office	6,347	23.3	-1.8	N/A
20	[redacted]	Warehouse	1,759,560	170.0	103.5	N/A
21	[redacted]	Office	35,606	0.9	0.0	N/A
22	[redacted]	Office	151,374	7.9	-48.8	N/A
23	[redacted]	Office	119,013	-2.0	-0.7	N/A
24	[redacted]	Office	4,072,566	719.0	684.0	N/A
25	[redacted]	Office	3,229,589	1001.0	548.0	N/A
26	[redacted]	Hotel	42,591	15.4	7.4	N/A
27	[redacted]	Parking Structure	56,965	6.6	6.5	N/A
28	[redacted]	Water treatment plant	949,380	202.0	202.0	N/A
29	[redacted]	Industrial	87,808	-42.5	-24.6	N/A

[1] Engineering sample is separate from the process evaluation sample.
[2] NCP kW is an abbreviation for non-coincident peak kW
[3] CP kW is an abbreviation for coincident peak kW
[4] The study evaluated electricity savings only.

	Customer	Facility Type	kWh	NCP kW[2]	CP kW[3]	MMBtu[4]
30	[redacted]	Office	43,960	11.3	0.0	N/A
31	[redacted]	Retail	54,103	12.8	12.7	N/A
32	[redacted]	Office and Industrial	2,747,160	30.2	30.2	N/A
33	[redacted]	Grocery	33,039	9.4	9.0	N/A
34	[redacted]	Technical College	18,148	217.0	189.0	N/A
35	[redacted]	Big Box Retail	854,373	933.0	933.0	N/A
36	[redacted]	Industrial	375,910	-10.7	2.3	N/A
37	[redacted]	Courthouse	1,414,900	79.0	74.0	N/A
38	[redacted]	Police Station	102,530	32.0	21.0	N/A
39	[redacted]	Assembly	70,907	14.0	6.3	N/A
40	[redacted]	Poultry Production	147,130	18.2	8.7	N/A
41	[redacted]	Warehouse	182,561	24.9	24.6	N/A
42	[redacted]	Retail	148,845	5.6	-4.4	N/A
43	[redacted]	Industrial	143,781	14.4	16.6	N/A
44	[redacted]	Office	660,451	156.9	151.9	N/A

Table 2. Summary of Sample Ex Ante Savings by Measure Type

Measure Type	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit NCP kW impact	Ex Ante Per unit CP kW impact	Ex Ante kWh Savings	Ex Ante NCP kW Savings	Ex Ante CP kW Savings
Lighting	13	322,729	40	39	4,195,482	526	504
HVAC	23	1,467,090	226	114	33,743,073	5,206	2,626
Process	8	959,022	136	130	7,672,172	1,091	1,038

Table 3. Summary of Sample Evaluated Gross Savings by Measure Type

Measure Type	Partici-pation Count	Evaluated Per unit kWh impact	Evaluated Per unit NCP kW impact	Evaluated Per unit CP kW impact	Evaluated kWh Savings	Evaluated NCP kW Savings	Evaluated CP kW Savings
Lighting	13	390,904	38	32	5,081,755	491	416
HVAC	23	1,083,069	179	151	24,910,581	4,108	3,476
Process	8	465,920	51	61	3,727,361	411	490

Table 4. Ex-Ante Savings Estimates by Customer[5]

	Project	Facility Type	Ex Ante kWh Savings	Ex Ante NCP kW Savings	Ex Ante CP kW Savings
1	[redacted]	Multiple Bank Branch Office	1,161,979	319	104
2	[redacted]	Manufacturing	507,450	107	95

[5] Savings shown for entire project as unit savings are not applicable for custom projects.

	Project	Facility Type	Ex Ante kWh Savings	Ex Ante NCP kW Savings	Ex Ante CP kW Savings
3	[redacted]	Manufacturing	214,596	35	36
4	[redacted]	Office	38,108	15	13
5	[redacted]	Manufacturing	782,308	134	131
6	[redacted]	Manufacturing	1,630,774	343	306
7	[redacted]	Wastewater	637,882	73	119
8	[redacted]	Warehouse	944,175	108	108
9	[redacted]	Parking Structure	634,479	72	72
10	[redacted]	TV studio	298,686	54	47
11	[redacted]	Parking Structure	89,241	25	25
12	[redacted]	Office	53,538	15	0
13	[redacted]	Service Station	27,505	0	0
14	[redacted]	Office	217,763	54	34
15	[redacted]	Data Center	11,460,000	1,840	949
16	[redacted]	Data Center	10,300,000	900	293
17	[redacted]	Office	1,326,557	121	121
18	[redacted]	Data Center	2,325,225	265	266
19	[redacted]	Office	32,237	7	6
20	[redacted]	Warehouse	1,530,886	175	175
21	[redacted]	Office	318,009	117	0
22	[redacted]	Office	307,821	15	10
23	[redacted]	Office	188,251	35	29
24	[redacted]	Office	3,895,980	841	555
25	[redacted]	Office	368,392	105	57
26	[redacted]	Hotel	231,779	1	1
27	[redacted]	Parking Structure	56,659	6	6
28	[redacted]	Water treatment plant	929,177	106	106
29	[redacted]	Industrial	408,652	55	51
30	[redacted]	Office	44,110	0	0
31	[redacted]	Retail	59,876	11	11
32	[redacted]	Office and Industrial	600,449	144	40
33	[redacted]	Grocery	320,792	101	49
34	[redacted]	Technical College	257,170	70	52
35	[redacted]	Big Box Retail	944,175	108	108
36	[redacted]	Industrial	804,345	92	36
37	[redacted]	Courthouse	542,970	101	0
38	[redacted]	Police Station	72,311	40	11
39	[redacted]	Assembly	108,439	7	7
40	[redacted]	Poultry Production	165,885	32	32
41	[redacted]	Warehouse	182,003	21	21
42	[redacted]	Retail	61,269	20	10
43	[redacted]	Industrial	153,809	23	23
44	[redacted]	Office	375,015	110	53

The realization rates by project type for the sampled projects were calculated; and the savings were expanded to the full participant population. The results are shown in Table 5 through Table 7.

Table 5. Program kWh Savings by Project Type

Project Type	Sample kWh Savings			Population kWh Savings		
	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	5,081,755	4,195,482	1.21	137,546,332	113,557,847	1.21
HVAC	24,910,581	33,743,073	0.74	50,009,419	67,741,153	0.74
Process	3,727,361	7,672,172	0.49	19,380,064	39,890,738	0.49
				206,935,814	221,189,738	0.94

Table 6. Program NCP kW Savings by Project Type

Project Type	Sample NCP kW Savings			Population NCP kW Savings		
	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	491	526	0.93	17,339	18,590	0.93
HVAC	4,108	5,206	0.79	10,868	13,773	0.79
Process	411	1,091	0.38	1,904	5,061	0.38
				30,111	37,424	0.80

Table 7. Program CP kW Savings by Project Type

Project Type	Sample CP kW Savings			Population CP kW Savings		
	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	416	504	0.82	14,302	17,340	0.82
HVAC	3,476	2,626	1.32	7,720	5,832	1.32
Process	490	1,038	0.47	2,039	4,323	0.47
				24,062	27,495	0.88

Overall, the program achieved gross savings realization rates of 0.94 for kWh, 0.80 for NCP kW and 0.88 for CP kW.

Introduction and Purpose of Study

Summary of the Evaluation

This report presents the results of a process and impact evaluation of the Smart $aver Non-Residential Custom Incentive Program, herein referred to as the "Custom Program", in the Carolina System.

Table 8. Evaluation Date Ranges

Evaluation Component	Sample Pull: Start Date of Participation	Sample Pull: End Date of Participation	Dates of Analysis
Participant Surveys	June 10, 2009[6]	Nov 5, 2012[7]	Surveys conducted from November, 2012 through January, 2013.
Engineering Estimates	Application Received: June 16, 2009 Project Closed: January 19, 2010	Application Received: Nov 11, 2011 Project Closed: Dec 17, 2012	Field M&V work conducted from September 2009 through December 2012

TecMarket Works conducted a phone survey with a random sample of 41 participants from the Carolina System from November of 2012 through January of 2013. Field M&V activities were conducted between September 2009 and December 2012.

Evaluation Objectives

The process evaluation is intended to document the program's design and operations, and evaluate whether improvements can be made in the design of future programs. To do this, the evaluation team conducted guided interviews with 41 participants, the Duke Energy program manager, and a WECC project manager. All interviews were guided by interview instruments that allowed open-ended exploration of issues (See Appendix A: Program Manager Interview Protocol and Appendix B: Participant Interview Guide.)

An impact analysis was performed utilizing an M&V plan that was developed following the International Performance Measurement and Verification Protocol (IPMVP)[8]. The projects were separated into lighting, HVAC and process categories, and samples were drawn from each category. The goal of the impact analysis was to estimate a savings realization rate for each category that can be projected into the full program participant population, and then could be applied to each new application Duke Energy receives by category.

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[6] Date on which Duke Energy began tracking a project; this may not correspond to the application submission date.
[7] Date on which participant data were provided to the evaluation team; the data included projects at all stages of completion including those with projected end dates of January 2014.
[8] International Performance Measurement and Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Volume 1. Prepared by Efficiency Valuation Organization. www.evo-world.org. September, 2010. EVO 10000 – 1:2010.

This report is structured to provide program energy savings impact estimations via the engineering analysis. The impact tables reporting total savings are based on the savings identified from 44 evaluated participants extrapolated to the program's total participants through December 31, 2012.

Researchable Issues

The evaluation issues researched in this study are listed below:

1. Estimate kWh , non-coincident peak (NCP) kW and coincident peak (CP) kW savings for each project in the sample
2. Calculate kW and kWh realization rates for each project
3. Calculate average kW and kWh realization rates by lighting, HVAC and process projects
4. Calculate confidence intervals around the realization rates
5. Identify causes for differences between evaluated savings and ex-ante savings estimates
6. Identify any gaps in participant's experience of gathering information about the Custom program
7. Identify participant's motivations for proposing a Custom project
8. Gather participants' suggestions for improvements that could be made to the Custom program
9. Determine participants' satisfaction with key aspects of the Custom program

Description of Program

Duke Energy's Custom program complements the Smart $aver Prescriptive program by providing incentives for Duke Energy's non-residential customers whose projects require measures that fall outside the scope of the Prescriptive program. The Smart $aver Prescriptive program provides a list of frequently-installed measures for which incentives have been predetermined, for which customers may apply after the project has been completed. The Smart $aver Custom program allows customers to receive incentives for measures that do not appear on the list of Prescriptive pre-approved incentives, but still meet the program requirements for energy efficiency and where energy savings can be substantiated through acceptable engineering calculations. However, these Custom incentives must be individually calculated for each application, and customers must receive approval for these incentives prior to initiating a project. The Custom program helps customers with specialized needs undertake energy efficiency projects that might not otherwise be financially feasible. The number of project applications that were reviewed and approved; and the number of completed and paid projects is shown below.

Table 9. Program Participation Count

Program	Participation Count for June 2009 through March 2012
Smart $aver Non-Residential Custom Incentive Program	329 Reviewed and Approved 276 Completed and Paid

Methodology

Overview of the Evaluation Approach

Process

The evaluation team conducted guided interviews with 41 participants, the Duke Energy program manager, and a WECC project manager.

Impacts

This impact evaluation was performed using an engineering analysis of a sample of 44 out of 329 projected[9] total program participants.

Study Methodology

Process

All interviews were guided by interview instruments that allowed open-ended exploration of issues (See Appendix A: Program Manager Interview Protocol and Appendix B: Participant Interview Guide.)

Impacts

The impact methodology consisted of engineering analysis following the International Performance Measurement and Verification Protocol (IPMVP)[10]. The projects were separated into lighting, HVAC and process categories, and samples were drawn from each category. An M&V plan was developed following the IPMVP. Site surveys and metering equipment were installed to gather data according to the M&V plan. Pre and post installation measurements were taken whenever possible. Energy and demand savings estimates were developed for each sampled project. The goal of the impact analysis was to estimate a savings realization rate for each category that can be prospectively projected into the full program participant population.

Data collection methods, sample sizes, and sampling methodology

Process

The evaluation team conducted guided interviews with 41 participants, the Duke Energy program manager, and a WECC project manager.

Impacts

Based on the projected participation of 329 projects, an initial sample of 40 projects was chosen to meet a sampling error of +/- 10% at 90% confidence.

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[9] Projected participation included projects at the contract approval stage (where the incentive offer was accepted by the customer), along with projects that were completed and paid. It was possible that some of the projects at the contract approval stage may not be completed, hence the total participation count was a projection.

[10] International Performance Measurement and Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Volume 1. Prepared by Efficiency Valuation Organization. www.evo-world.org. September, 2010. EVO 10000 – 1:2010.

Site surveys were conducted and metering equipment was installed to gather data according to the M&V plan. Pre and post installation measurements were taken whenever possible. Energy and demand savings estimates were developed for each sampled project.

Number of completes and sample disposition for each data collection effort

Process

The evaluation team conducted guided interviews with 41 participants, the Duke Energy program manager, and a WECC project manager. The sample disposition can be found in Appendix C: Process Evaluation Sample Disposition.

Impacts

The sample disposition for the impact study is shown in Table 10.

Table 10. Status of 2009-2011 Sample

Group	Sample Size	Completed	Notes
Lighting	12	13	One additional site completed
HVAC	21	23	Two additional sites completed
Process	7	8	One additional site completed
Total	40	44	

Expected and achieved precision

The sample design was expected to return a sampling error of +/- 10% at 90% confidence. Although each category was oversampled slightly, the sample variability was higher than expected. The achieved precision at the program level was +/- 13.9% at 90% confidence.

Description of baseline assumptions, methods and data sources

For early replacement projects, the baseline assumption was the existing equipment. For normal replacement projects where the equipment is covered by state or federal energy standards, the minimally code compliant efficiency is the baseline. For normal replacement projects not covered by state or federal energy standards, industry common practice is the baseline.

Description of measures and selection of methods by measure(s) or market(s)

The custom program encompasses a wide variety of measures. Current applications include a variety of lighting, HVAC and industrial process projects. Lighting projects include fixture types not currently covered under the Smart $aver™ Non-residential Prescriptive Incentive Program. HVAC projects include HVAC controls, equipment upgrades, and new construction projects. Process projects include compressed air, process cooling, water and wastewater pumping, and data center server upgrades. All projects were evaluated in compliance with the IPMVP.

Use of TRM values and explanation if TRM values not used

The study relied on primary data collection, engineering algorithms, building energy simulation modeling, and statistical regression modeling. Since this is a custom program, TRM algorithms and values do not apply.

Threats to validity, sources of bias and how those were addressed

The study utilized a pre/post M&V protocol when feasible. Due to project timing, post-only measurements were made for some projects. The use of post-only measurements for these projects is not expected to significantly bias the results. Early sites were studied systematically before moving to a random selection process. The systematic selection of early projects could introduce some bias in the sample, but the project selection seems representative of the overall program participation. State of the art engineering modeling techniques, including building energy simulation modeling were employed to reduce engineering bias.

Snapback and Persistence

The theoretical additional energy and capacity used by customers that may occur from implementing an energy efficiency product, often called “snapback” is not factored into this evaluation. In addition, TecMarket Works does not believe that snapback is an issue in evaluations of Custom programs. This is because of two key reasons: First, customers participating in the Custom Programs do not typically base energy-intensive investment decisions on the degree of savings being achieved from previous installed energy efficiency measures. Instead, these customers tend to base energy efficient investment decisions on the benefits and costs associated with a single project requiring an investment decision. Second, the very concept of snapback is theoretical in nature. There has yet to be an evaluation conducted of an energy efficiency program that has reliably documented a snapback effect. Studies of snapback based on the last 20-plus years of California’s well-funded and aggressive energy efficiency portfolio demonstrate that snapback does not exist. California’s per person energy consumption has remained flat for 20 years with energy efficiency programs; while other states not offering aggressive portfolios of energy efficiency programs over that period (more than 20 years) have increased per-person energy consumption. If snapback existed to any degree, per-person energy consumption in California would have increased at the same rate as states that have not offered a long history of energy efficiency programs. TecMarket Works does not believe that snapback exists for the Duke Energy Custom program and does not incorporate approaches to adjust savings for theoretical and unproven concepts.

The evaluation did not address how long these savings are likely to persist over time because the time span of the available data was not sufficient to address this issue.

Process Evaluation Findings

Program Operations: Marketing and Outreach

Throughout the course of the interviews, we asked the program and project managers to describe the design and operations of the program, including marketing and outreach.

The marketing and outreach of the Smart $aver Custom program uses several channels. Customers may learn about the Smart $aver program either directly from Duke Energy through their account representatives and website, or through a third party vendor, contractor, or distributor that is participating in the Smart $aver Custom program as a “trade ally”.

Account Representatives. Duke Energy’s large commercial and industrial customers have an assigned account manager and generally will hear directly about the Custom program from their account managers. Most of the energy savings for the Smart $aver Custom program come from these large customers, due to both the larger number of opportunities they have for energy improvements and due to the fact that large customers are also active in pursuing incentives.

While each account manager takes a slightly different approach, in general the account manager will reach out to the customer and ask if they are planning equipment upgrades or equipment investments. In most cases, these conversations are part of the ongoing relationship that a Duke account manager has with a customer to monitor their energy needs proactively.

Once customers have identified their future equipment needs, the account manager is able to help the customers assess whether their projects are eligible for any Smart $aver incentives, whether Prescriptive or Custom. In some cases, a project may include some measures that are eligible for a Prescriptive incentive and others that are eligible for a Custom incentive. This early identification of needs also helps the customers maintain their eligibility for the Custom program, which requires that project applications be approved for a Custom incentive prior to the start of the project.

Trade Allies. Customers that are not assigned to account representatives usually learn about the Smart $aver program from “trade allies”: contractors, vendors, or equipment dealers who are kept updated on the Smart $aver program’s requirements. As part of the overall Smart $aver program design, Duke Energy has cultivated a large network of trade allies who help promote the incentive opportunities.

The trade allies play a critical role in informing and helping un-assigned customers elect to go with energy efficiency equipment choices. These trade allies often provide the cost assessments and technical information and energy savings calculations that are required for the Custom applications, because the customers do not have the expertise to do so.

Third Party Implementer. The trade ally network is managed by a third party implementer, the Wisconsin Energy Conservation Corps. WECC, as they are known, is responsible for outreach to the trade allies. At the time of these interviews in August of 2012, WECC, who was contracted through the end of December of 2012, had recently undergone staffing changes; the program manager responsible for Smart $aver Custom had been at her position for less than one year.

WECC's outreach efforts are conducted by three "trade ally representatives" in the Carolina Systems. Their duties include making presentations at trade shows and working with the trade allies on a one-to-one basis. WECC reports they developed a sample application for lighting, which was very well received. "That is very helpful to have tools for our trade allies to use." WECC reports that they developed the tools after seeing "a lot" of applications submitted without a cost quote. WECC says, "We can continuously look to upgrade and modify." All tools developed by WECC are reviewed by Duke Energy program managers for approval before use with trade allies.

WECC reports that they conduct targeted marketing of the Custom program to the trade allies. This targeting is based upon several factors, including the size of the trade allies and their past volume of application submissions. WECC classifies the trade allies into three categories: "A" trade allies do not need "hand holding", "B" trade allies that need help in some situations, and "C" trade allies are those who do not participate very often and would have the most trouble with an application. WECC reports that the list of participating trade allies and their categorizations are available to Duke Energy via WECC's report portal.

WECC reports that prospective trade allies sometimes are hesitant to participate in the Custom program because the incentive is uncertain, "The only kind of feedback or pushback [we received] is they would like a better idea of what their incentive is before they do this work." In response to this, WECC reports that they tell the prospective trade ally that each application is different, and that WECC can work with the trade allies in answering questions about applications.

WECC identifies the uncertainty about incentive levels as one of the biggest discussion points with prospective trade allies, but that they have not conducted any data analysis to see if that has affected trade ally participation rates. Overall, WECC believes that the Smart $aver Custom program's biggest strength is its communications with program participants, which has resulted in "good submittals". The WECC program manager estimates that only 10-15% of the applications are filled out by the unassigned customers without vendor assistance.

WECC reports that while they do provide Duke Energy with quarterly reports on the number of participating trade allies and the types of technology end uses they are targeting, they do not have any service-level agreements for their trade ally outreach efforts. The Duke Energy program manager reports that WECC had an objective of converting "C" allies to "B" allies, and "B" allies to "A" allies. However, the outreach strategy was either inconsistent in its design, or inconsistent in implementation, because the Duke Energy program manager reports "The strategy seemed like it changed a lot. That's what stuck in my mind." WECC does not market to Duke Energy customers, only to the trade allies.

Website. Duke Energy also markets the program through their website and the program manager reports that Duke Energy has made some upgrades to the Smart $aver website. The new website has separate pages for customers and for trade allies. Customers can access separate pages on key end-use measures such as lighting, HVAC, chillers, motors, VFDs, pumps, food service and process equipment. The pages vary in their content. At minimum, the page for a key end-use measure includes:

- Physical mailing address for the completed application
- Link to a complete application form, in either Word or PDF format
- Link to the Smart $aver Custom program
- Links to the other end use measures
- Link to frequently asked questions
- Link to contact information

The trade ally pages contain much of the same information, with the exception that their pages have a link to join the trade ally network instead of a link for finding a trade ally. To join the trade ally network, a vendor only needs to provide contact information and their technology sector on an application form that can then be faxed or mailed to Duke Energy. There are no other requirements to join the trade ally network, nor is there a list of trade allies that are approved or endorsed by Duke Energy.

A quick review of the trade ally search tool shows that there are some search options that have not been explained, such as the option to sort by "activity level". In addition, the search results include a field "Ranking" that lists dollar signs ($).

- RECOMMENDATION: At the next opportunity to update the website, Duke Energy should add explanations of the program website search options that may be unclear, and vet future website changes with a small group of customers (approximately 5-10) to get feedback on website usability.

In addition to this basic information, the Smart $aver website contains additional information for some of the more popular measures. The web pages for lighting, HVAC, and VFDs also include a savings calculator appropriate for that end-use measure. Duke Energy has also provided whitepapers for lighting and HVAC, video advertisements for HVAC and VFDs, and a 4-part video of a webinar for VFDs.

The evaluation team finds that these are all significant improvements since the previous process evaluation (completed in 2011) of the Carolina System Smart $aver Custom program. As the website is further developed and more resources are added to the remaining measure-specific pages, we believe this website will serve to help customers better understand the benefits and requirements of participating in this program.

Other Marketing Channels

Duke Energy uses various channels to encourage prospective customers to participate in the Smart $aver Prescriptive and Custom programs. Of note are Duke Energy's Energy Assessments and SmartBuilding Advantage. The Energy Assessment program provides non-residential customers with three levels of assessments, ranging from an online self-administered assessment, to a phone assessment, to an on-site assessment where Duke Energy shares the cost of the assessment with the customer. The program manager says that the Energy Assessment program holds great promise. "The conversion rate [from an Energy Assessment participant to a Smart $aver participant] is smaller than we like, but the ones we do see converted are great projects." The program manager reports that Duke Energy is considering some ideas for changing the Energy Assessment program in the future, to help increase the conversion rate.

SmartBuilding Advantage is designed to provide Duke Energy customers a whole-building integrated approach through on-site assessments of customers who meet specific criteria. This approach led participants to the Smart $aver programs.

For these types of marketing channels, a higher conversion rate may be only part of the benefit. We encourage Duke Energy to explore ways to identify the other benefits of these two marketing channels, such as increasing customers' capacity to identify and take on larger projects in the future, thus strengthening Duke Energy's role as the customers' trusted energy partner.

Application and Application process

Application Contents. In 2011, Duke Energy revised the Custom application so that it now consists of two parts. The first part contains general administrative questions and the second part consists of a worksheet with technical questions that are specific to the type of technologies to be used in the proposed projects. Currently there are five worksheets, for compressed air, energy management systems, lighting, variable frequency drives (VFD), and a general worksheet for projects using other technologies or combinations or technologies.

Application Review. WECC conducts the initial administrative and technical review of each Custom application. WECC's review consists of determining whether a customer is on an electric rate that allows them to be eligible to participate in the Custom program and obtaining that customer's billing history. WECC also reviews the technical information to make sure that the specifications, quotes and calculations are reasonable, using the billing history to make sure the savings potential are there.

The time for the technical review depends upon the complexity of the project, with applications for simpler projects taking a few days. Applications for more complex projects that include multiple measures may take up to two weeks if WECC has questions about the application. WECC reports that their service level agreement is to complete their review of small project applications (up to 25,000 kWh) in an average of 8 days, and large project applications (over 25,000 kWh) in an average of 12 days. WECC reports that they communicate closely with Duke Energy; if they are experiencing unusual difficulty with an application, or if a customer does not respond to queries for more information, WECC can request an exception for a particular application. The Duke Energy program manager reports that she was "happy with the technical ability of the team".

The Duke Energy program manager reports that in approximately 10% of cases, the customer revises their project plans, which necessitates the submission of a revised Custom application.

Determining Incentives. After WECC's review, Duke Energy calculates the incentive that can be given based upon the projects' net energy savings and demand reduction. This may require modeling the value of the project with DSMore, a cost/benefit modeling tool. Depending on the project, an incentive may also need to be approved by upper management. Net savings are estimated as a result of a series of freerider questions incorporated into the application process. This aspect is considered by the evaluation contractor (TecMarket Works) as a national best practice because it helps assure that only net savings are incented by program resources, thereby substantially improving the benefit cost of this program compared to other Custom programs offered outside of Duke Energy's territory that incent gross savings.

A Duke Energy program manager reports that Duke Energy believes the incentives currently are high enough to motivate customers to upgrade equipment, even though the incentives may seem low to some customers. The program manager explains "Our incentives are related to the generation that we don't have to build." If a project includes on-peak demand reduction, it provides greater value to Duke Energy than a project that does not, and the incentive will reflect that added value. However, many lighting projects do not include peak demand reduction, so the lighting incentives may be perceived to be low to some customers. The program manager reports that if Duke Energy has the opportunity to explain the need for peak demand reduction, customers generally understand and accept the level of the incentives.

> RECOMMENDATION: Duke Energy should consider whether there are additional methods of alerting applicants to the fact that Custom incentives are calculated based upon both kW and kWh savings. This may help manage customers' expectations, save some time for the program manager, and potentially lead to greater satisfaction with the incentive levels. A quick review of the Duke Energy website suggests that demand reduction may not be clearly presented as an incentive calculation criteria, as most descriptions seem to only refer to "energy savings".

Payment. A Duke Energy program manager reports that after the application review and incentive determination is completed, Duke Energy sends out the incentive offer letter to the customer. Upon receiving the letter, the customer may proceed with project implementation. The customer notifies Duke Energy after the project has been completed by remittance of the project invoices with a formal payment request. Duke Energy checks the project, reviews the invoices and sends WECC a payment request form. WECC then issues a check for the incentive amount to the customer. The customer must send invoices within 90 days of the installation date of the new equipment.

Timeline. The Duke Energy program manager reports that time for the entire review process, from application submission to incentive offer, takes an average of 30 days. Duke Energy has a goal of bringing this time down to below 30 days.

The program manager also estimates that the average time from application submission to incentive payment is approximately five months. In many cases, Duke Energy reports they do not hear from the applicants until the invoices are submitted for the incentive payment. In other cases, Duke Energy tries to track the project status, and reaches out to customers or trade allies to see how the projects are progressing. "For those that have very large impacts, I stay in very close contact with the account managers to find out what is going on with the projects." The program manager reports that they plan to conduct more frequent reviews of the program tracking database in order to identify projects that have not reported progress.

Complexity and Short Cuts

Duke Energy is aware of the complexity of the Custom application, and is actively seeking ways in which the application can be simplified while still providing the level of accuracy necessary to support a rigorous impact evaluation that can help maximize the benefits of the program relative to its cost. "We are always looking for ways to provide shortcuts that don't compromise accuracy".

Currently, there are at least two types of Custom applications for which the customer must provide a full building energy model: most commonly energy management systems (EMS) projects and roof replacement projects. For a time, applicants were able to use a roof savings calculator available to the public by Lawrence Berkeley National Laboratory, but that tool is currently undergoing validation due to discrepancies with recent studies. The program manager reports that they are actively working to find a way to help customers develop the necessary calculations for roofs, as "there is no cool roof project that would justify the thousands that would be needed for a model." The program manager acknowledges that some trade allies do not want to apply because they do not want to build an energy model.

Past Recommendations

The last evaluation study contained three recommendations. The first recommendation was for Duke Energy to decide whether it was cost-effective to include the smaller project applications, when a few large projects per year would enable the Custom program to meet its objectives. The Duke Energy program manager reports that the Smart $aver Custom program has since decided that they did want to continue offering incentives on all size projects, with the rationale that sometimes a customer may submit an application for a small project before they have a larger project. "We don't want to turn that away and miss out on a bigger opportunity." In order to reduce costs of processing smaller applications, Duke Energy has continued to try to identify areas where smaller applications could take a short cut. However, because small projects sometimes turn into large projects and because of concerns of how an application process with fewer requirements may lead customers to understate a project's savings, Duke Energy has decided to maintain the same requirements for all applications. The evaluation team notes that Duke Energy could decrease the internal costs of reviewing the small applications, by only reviewing a subset of the key elements of the smaller applications. This would allow Duke Energy to reduce program costs without changing documentation requirements or changing existing customer behavior.

A second recommendation from the last evaluation study was for Duke Energy to provide more technical resources for the smaller customers. Since that time, Duke Energy has made significant improvements to the program by providing more tools to help Custom applicants develop accurate energy savings estimates. The program manager reports they have developed a list of preferred modeling tools for use in estimating energy savings. Customers now have access to application worksheets that are designed for specific technologies.

The third recommendation from the last evaluation study was for Duke Energy to better manage the customers' expectations about the application process. Since that time, Duke Energy has been able to provide potential applicants with an estimate of how long it takes for Duke Energy to provide a response on the application, based upon the complexity of the application and the application reviewers' current workload. Providing customers with a better idea about the incentive level, however, remains an intractable problem. The incentive calculation depends on a number of variables, including the total resource cost, the net avoided cost and the costs of administering the program, as well as the level of confidence in the savings estimates of the project. The Duke Energy program manager reports that they have been trying to find ways to provide a range of incentives, or a minimum incentive estimate, and may have found that they could provide reasonable estimates for some end uses in certain applications, such as interior lighting.

The evaluation team believes that Duke Energy has thoughtfully considered and implemented ways to address the issues underlying the recommendations. The participants' satisfaction ratings we report below support the usefulness of the improvements.

Program Successes and Challenges

The Smart $aver Custom program faces some challenges in responding to the unpredictable flow of applications and in responding to changing technology standards. These challenges are well-known to the program managers, who have been monitoring and addressing these throughout the program period. These challenges may also be related to the program's successes, as discussed below.

Flow of Applications. Fluctuations in processing time occur normally, driven by the flow of applications. A Duke Energy program manager reports that in June of 2012, there was a particularly large increase in the flow of applications, and this significantly slowed the speed at which WECC was able to conduct the technical reviews.

WECC reports that Smart $aver Custom had been successful in the Carolina System in the last year, with increased participation and larger projects. The trade ally network's recent entry into the data center market resulted in some large projects, requiring more time for review. Along with the increased participation came the challenge of completing application reviews on time. WECC reports, "That's one thing we're working on right now, how to continue to have a high quality of service while meeting the need."

Technology. The Smart $aver Custom and Prescriptive programs both faced the challenges posed by the change in federal standards for fluorescent lighting, which halts the production and import of standard T12 fluorescent lamps as of July 14, 2012. The Smart $aver program alerted Duke Energy customers that incentives for standard and high output T8s and all T5 lamps would end on December 31, 2012. However, due to language of the federal standard, the program manager reports that some higher wattage T12 lamps are still technically legal, even though they are less efficient. Customer comments during the participant interviews have generally confirmed that many lighting projects were submitted to take advantage of the incentive before the T8s became ineligible.

In addition to this change, Duke Energy has been working to add LEDs to the Smart $aver Prescriptive program in the Carolina System. Duke Energy had been successful in adding LEDs to the measure list for their Smart $aver Prescriptive in Ohio in early 2012. The Carolina System program manager reports that in anticipation of this change, the Carolina System Custom program has been aligning its requirements for LED projects so that they would be the same requirements supported by the Prescriptive program. Prior to this, LEDs were eligible for incentives through the Custom program. Although the Smart $aver Custom and Prescriptive programs do not have separate kWh or kW objectives, the Carolina System program manager acknowledged that the Custom program may have a smaller energy savings impact in the future due to this change. However the Duke Energy program manager says Duke Energy is pleased to be able to add LEDs to the prescriptive program because of customer demand: “We had a lot of [Custom] applications. Prices are going down and people are happy with the quality”.

There were other recent code changes in new construction and in motors, but the Duke Energy program manager reports that the Custom program historically has not seen many applications in those areas.

Participant Interviews

As part of the process evaluation, we were able to interview a larger sample of participants than was feasible in the previous study. The Smart $aver Custom program tracks projects as they progress through the stages of the application process. Projects are classified into six stages:

1. Prospecting: No application has been received, but the customer has indicated interest through a discussion with an account manager or through a pre-screening form.
2. Qualification: An application has been received and is in WECC’s hands for administrative and technical review.
3. Develop Proposal: Duke Energy is calculating the incentive and putting together the offer letter.
4. Proposal to Customer: The customer has received the incentive offer.
5. Contract Approval: The customer has accepted the offer, and plans to implement the project.
6. Closed (Won or Lost): Incentive has been paid, or project has been rejected.

Sample Design and Methods. The evaluation team interviewed 41 customers from four different project stages, randomly selected from a sample frame of projects that were active from September 1, 2009 to March 31, 2012. We interviewed Carolina System customers from stages after which they had received the incentive offer, with the sample sizes shown below. We contacted the person listed as the main contact for each project. Of our 41 interviews, nine were with vendors (5 in South Carolina, 4 in North Carolina) and the rest were with customers. These interviews were conducted in November and December of 2012, and January of 2013. See “Appendix C: Process Evaluation Sample Disposition” for the sample disposition.

The survey instrument was designed to gather feedback on the interviewee’s information gathering process, motivations for taking on the project, and satisfaction ratings of their experience of key stages in their participation in the Smart $aver Custom program. The interview guide allowed for open-ended responses for most discussion issues, except for the satisfaction ratings. Interviewees were also asked to make suggestions for improving the Custom program. See Appendix B: Participant Interview Guide for the Participant Interview Instrument. We included the same six satisfaction rating questions from the evaluation of the 2011 Smart $aver Custom program so that we could assess changes in satisfaction. These satisfaction ratings are shown in Figure 2, and each of the average ratings will be discussed throughout the remainder of the report.

Table 11 shows the number of completed interviews in each project stage in the sample, for North and South Carolina. There were no significant differences found between North Carolina and South Carolina participants in the satisfaction ratings (P>.05).

Table 11. Number of completed interviews

State	Closed Lost	Closed Won	Proposal to Customer	Contract Approval
NC	5	5	5	4
SC	5	6	5	6

Results

Outreach Effectiveness. In the customer/vendor interviews, respondents first learned about the Custom program from several different sources (see Figure 1): Half first learned about the Custom program from their Duke Energy Representative, as might be expected given the prominent role that the account representatives play in promoting this program to the assigned customers. In this sample, six first learned from a vendor. Four learned from a business associate outside their company, four learned from a colleague within their company, and the remaining five learned from other sources. Only one in this last category reported they first learned of the Custom program from Duke Energy's website. The others reported that were either already aware, or they were vendors who reported that it was their company's business model to know about rebate programs. While the sample size is too small to support generalizations to the larger population, this breakdown suggests that there may be a sizeable proportion of the population that is learning about the Custom program through word of mouth from business associates.

> RECOMMENDATION: If not already doing so, Duke Energy should consider analyzing the sources from which applicants first learned of the Custom program. If a sizeable proportion in the population also learns about the program through word of mouth or through referrals from colleagues, this knowledge may allow Duke Energy to reallocate marketing resources to other targets.

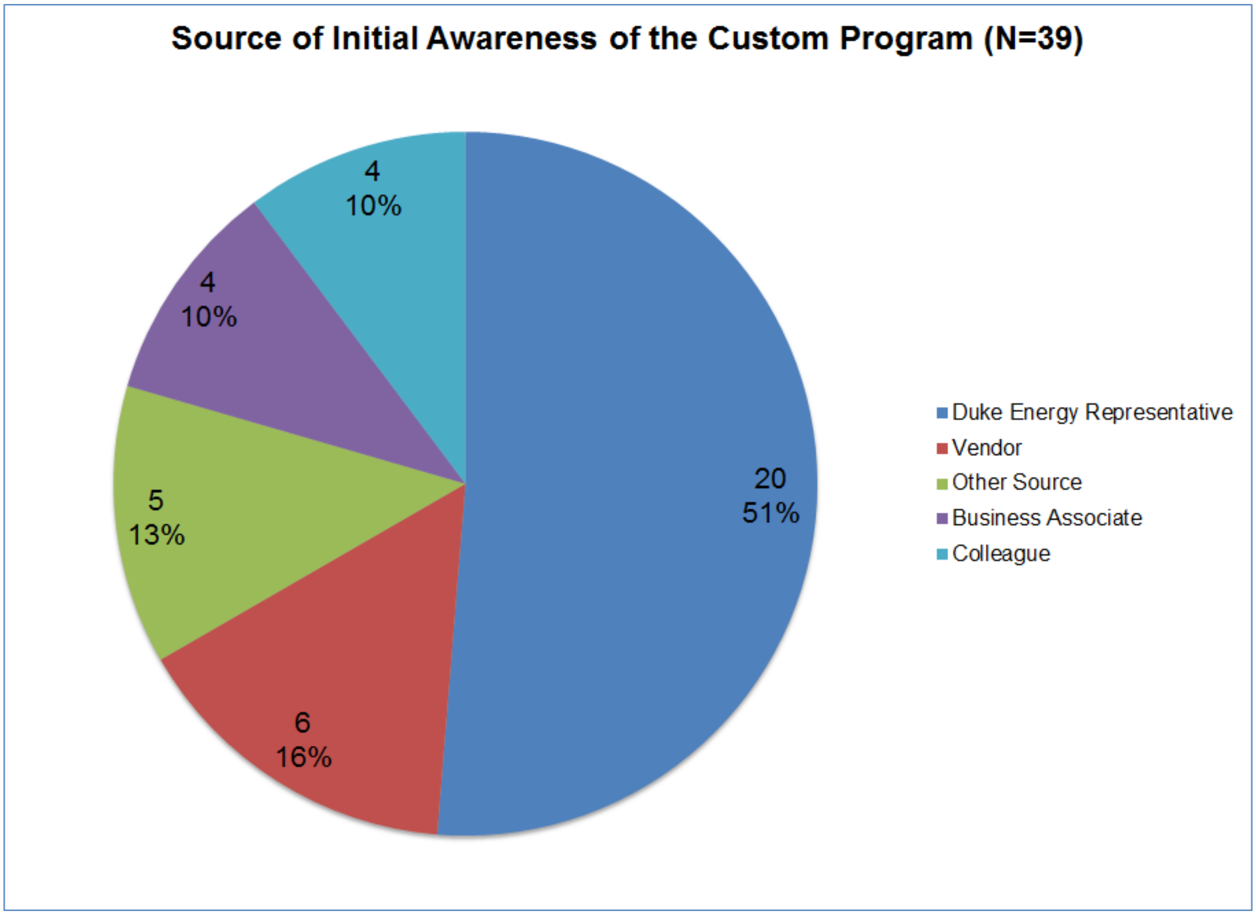

Figure 1. The Source of the Participants' Initial Awareness of the Custom Program

During the application process, over half of the respondents (13 of 23, or 57%) reported that they did consult the Duke Energy website for more information. Across all their sources, most of the respondents in this sample, 92% (or 23 of 25) reported that they were able to find the information they needed to apply for the program. Of the two who did not get the information they needed, one said he wasn't able to find out until after he had applied that projects with a payback period of less than one year payback were not eligible. The other said he made some phone calls but that didn't help. "I really would have liked someone to come out and help." When asked specifically whether they needed to contact a Duke Energy representative during the application process, 23 of 31 respondents (74% of the sample) said they did, and that their questions were successful answered by the representative. A few volunteered that they had called Duke Energy in order to check on the status of the application, and not for technical questions.

Account Representatives. Most of the assigned customers in our sample sang the praises of their Duke Energy account representative. The role of the account representative as the main communicator of the Smart $aver Custom program fits naturally within the expectations that the assigned customers had for them. In most reports, the Duke Energy account representative is their main point of contact for all issues relating to Duke Energy.

- *"Once again, I keep bragging on my customer representative."*

- *"I can say this, our rep was always there and extremely helpful in resolving any questions that we may have had. Either 'was something qualified' or something we weren't sure of in the application. All those questions I've had from time to time, [and they were] answered quickly and completely by the DE rep…For our company, what's really helped us is the DE rep actually being proactive and coming and meeting with us, telling us what programs are out there, familiarizing himself by visiting our plant, knowing some of our needs…helping us identify needs. My number 1 answer is get your DE rep involved."*

- *"She is absolutely wonderful, we stay in touch and once she found out we were interested in pursuing energy savings, she's given us a lot of info on rate changes and various options...that really gave us an indication [of what] you guys offer and that sort of thing. We've explored a lot with her; had she not been an outstanding rep, we probably wouldn't know about some of these things.*

A textile manufacturer reports that his account representative is helping them to screen projects before needing to invest resources in an application. *"If something that comes up that might even qualify, we contact our Duke Energy rep to see if it qualifies. If it doesn't, we won't make the application. As a result of knowing beforehand, we haven't been turned down for any of our applications."*

The improvements in the Duke Energy website and the ongoing work of the account representatives seem to have paid off. Participants were asked to rate their satisfaction with two aspects of the information-gathering process. They were asked about the quality of the information they were provided about the program's requirements and benefits. On a scale of 1 to 10, where 1 means very dissatisfied and 10 means very satisfied, participants gave a satisfaction rating of 8.61 (see Figure 2). Participants were also asked about their satisfaction with the technical expertise of Duke Energy representatives, who were in some cases the Duke Energy business account manager, but not always. Not all participants had reason to contact Duke Energy about technical issues, but the 23 who did reported high satisfaction of 8.63 out of a possible 10 (see Figure 2).

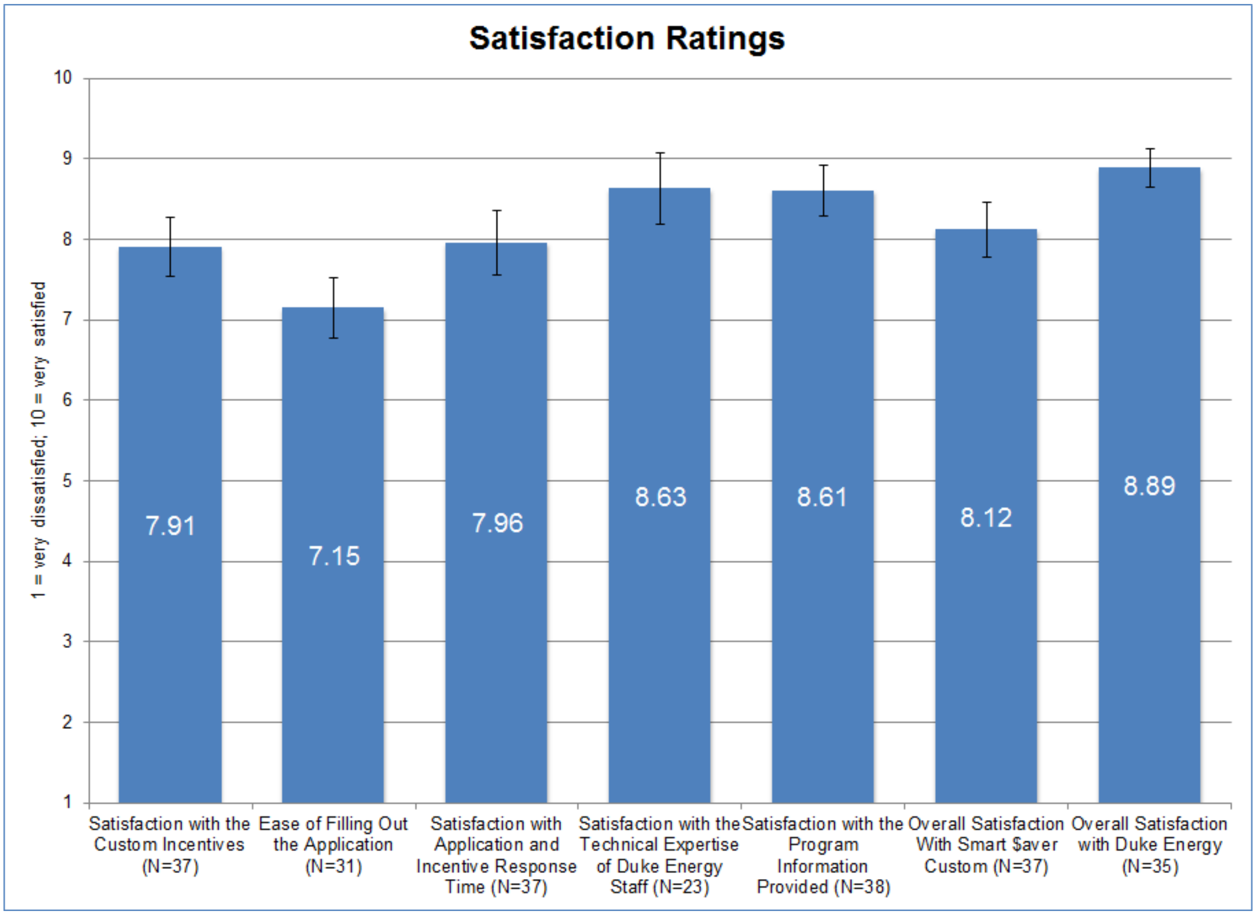

Figure 2. Satisfaction Ratings. Error bars plot ± one standard error of the mean. Mean ratings are shown in white text on each bar.

Application Process

Over half of the participants we interviewed (24 of 41, or 58%) also filled out the application themselves. All participants, whether or not they filled out their own application, were asked to rate how easy it was to understand the application, and on average they gave a rating of 7.15 on a scale of 1 to 10, with 1 meaning extremely difficult and 10 meaning extremely easy (see Figure 2). The other participants said the application was filled out by others, usually a vendor or an engineering consultant they had hired to help with the project.

Two respondents said they had problems during the application approval process in that they did not receive any updates about the status of their application and they had to initiate calls to find out. Three other respondents mentioned that it took a long time to hear about the application approval or denial, but otherwise reported no problems.
Two respondents also volunteered some suggestions for improving the application form. One thought the application requires redundant information across files. He would like to fill in the front sheet and have the rest of the application automatically populated. Another thought the format is difficult to use in the PDF form because it does not leave enough space for responses. The participant not only had to include exhibits, but had to include 7 of them to provide the required information. A post hoc analysis found that the average satisfaction rating for the ease

of filling the application was significantly lower (p<.001) than the other ratings shown in Figure 2.

Project Decision-Making

Motivations. When respondents were given a list of 12 possible motivations for undertaking projects, the most common motivation was "energy or energy cost savings", cited by 86% (32 of 37) of these respondents (see Figure 3). The second most common motivation was "Cost of repair or maintenance of old units", cited by 20 of 37 respondents. Respondents cited an average of 4.3 motivations for undertaking a project (although it should be noted that many of the motivation options are related). The pattern of results here is not particularly surprising, but from the anecdotes gathered in the interviews, several customers cited motivations that were not energy related, such as labor cost reductions. Future evaluations should investigate non-energy motivations for undertaking Custom projects. This will help Duke Energy understand the hierarchy of customer needs in the decision making process.

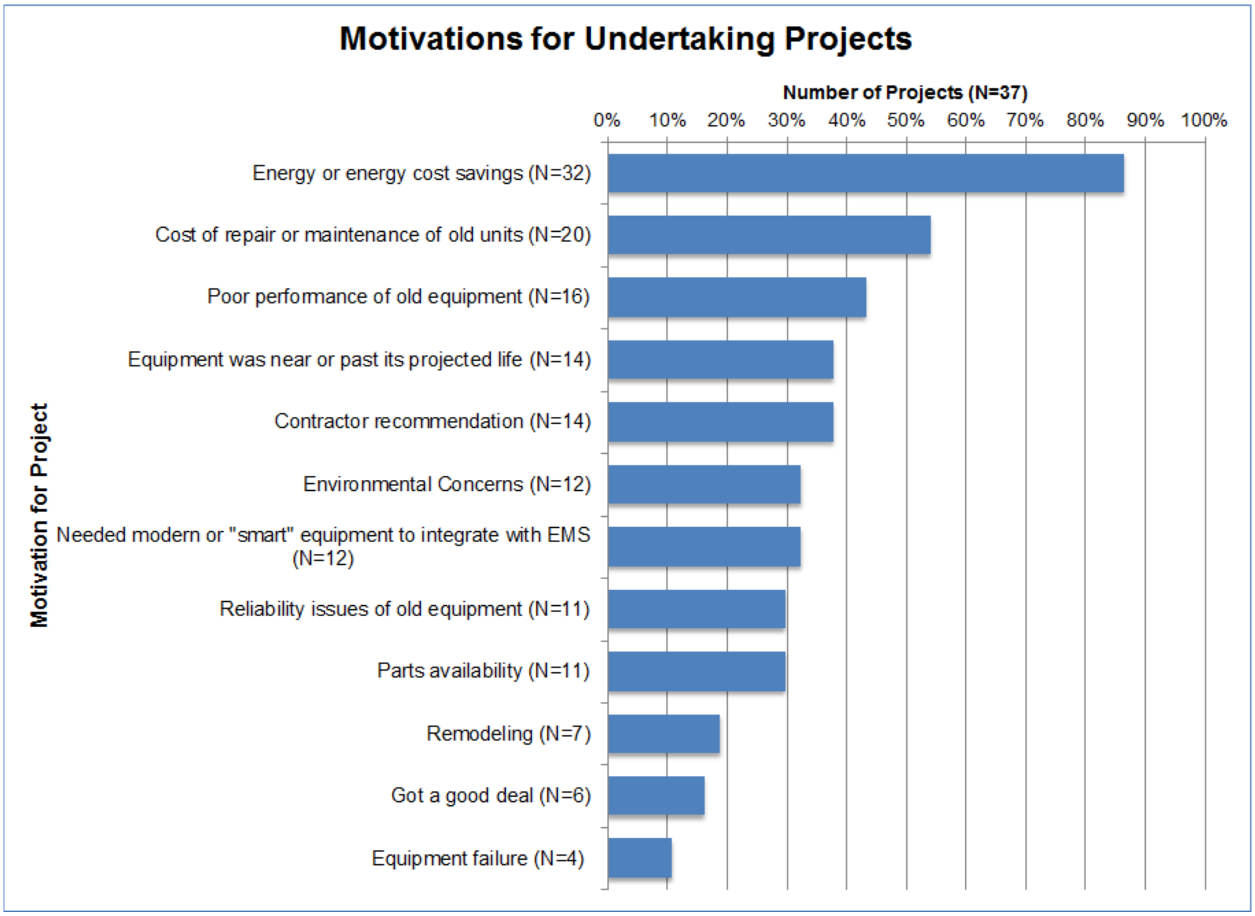

Figure 3. Frequency with which participants selected different motivations for undertaking projects. Multiple selections were accepted.

Where are they now? During the interview, participants also reported on the current status of their project. We interviewed 10 participants in each of four project status categories defined earlier; here are the status updates from those who had not completed their projects according to Duke Energy's records.

"Closed Lost": Of the projects that did not qualify for an incentive, three proceeded to complete the project as planned in the application, with the same equipment. Three others were not able to bring the payback down within company requirements. Their explanations included:

- Did it after getting another model at a lower price.
- Started project before applied. Now replacing upon burnout.
- Didn't go ahead, didn't have money. Payback wasn't there.
- Lost for this application because had installed prior to application (but had other similar projects approved)
- "DE was out of rebate money", we proceeded and installed the same equipment.
- Completed, labor savings greater than energy savings
- Didn't do project because payback was still too long (but did the others).
- Didn't qualify because that particular facility didn't opt into the program. Went ahead with the same equipment.
- Not eligible, still trying to get payback down to 2 years, it's a 50/50 chance of moving forward.
- Completed, installed the same.

"Proposal to Customer": Of these projects, where an incentive had been offered to a customer but the customer did not respond, we found that most had completed the project or were in the process of implementing the project.

- On hold
- In the midst of implementing, putting the package together.
- Completed Q2 2011
- On hold; ownership dilemma
- Completed late 2012
- Completed, awaiting incentive
- Competed, received rebate
- Completed last year, received incentive
- Completed
- Installed, testing (establishing baseline for usage)

"Contract Approval": Of these projects, where the customer indicated they were planning to proceed with the project, they were all either completed or in progress.

- Completed (only did part)
- Completed, received rebate
- Completed late 2012
- Completed same equipment, received the incentive.
- Completed, same equipment
- In progress
- Installed, received rebate

- Installed, testing system prior to applying for rebate
- In progress

The Custom program seems to continue to fulfill its function of motivating energy savings projects for those customers who cannot otherwise implement them. As one South Carolina “closed lost” customer said, “*If the project is justifiable, I don’t mess with Duke. I just get the money approved…We need [Duke’s] help justifying paying for things that are borderline, that we can’t justify on our own*.” The same customer also jokes, "*Most of us are basically lazy, we’ll do the work if there’s a reason for it. The incentives have not been adequate for me at this facility*."

One North Carolina “contract approval” customer in the midst of the installation said “*Ordinarily it would have only been done in dribs and drabs, and would have not gained the high margin of savings otherwise. Very much the stimulus [needed].*”

Suggestions for Increasing Custom Participation. When asked what Duke Energy could to increase participation for companies similar to theirs, almost a third of the customers (13/41) had no suggestions. Another 29% of the sample (12 of 41) suggested that Duke Energy needs to increase awareness of the Smart $aver Custom program through more marketing, without specifying what kind of marketing. The remaining 41% of the sample (17/41) made various other suggestions. These are listed below, not as recommendations from the evaluation team, but merely to show the range of suggestions, some of which reflect a misunderstanding of the program’s scope.

Suggestions in the “other” category include:

- Make info easier to find on the website (her assistant wasn’t able to find the Custom application).
- Create an intermediate program where projects can be started but customers could then apply for incentives on the incremental cost to use higher efficiency measures.
- Allow retroactive applications for the difference between standard and premium efficiency equipment.
- Provide engineering resources to help customers.
- (Directed to other applicants) Get your Duke Energy rep involved.
- Send more reminders about the program, including updates on what is eligible.
- Have a quick and dirty rule of thumb to estimate potential rebate.
- Help with financing (suggested twice by a lighting vendor and by a commercial real estate company).
- Allow a project covering multiple sites to be on the same application, rather than multiple applications.
- Send out emails with success stories and updates, rather than asking customers to go to the website.
- Assistance understanding what project options are.
- Provide a list of recommended vendors.
- Make LED prescriptive (from two customers).
- Higher incentives (from two customers).

RECOMMENDATION: Duke Energy should compare the participant suggestions for improvement with other suggestions they have heard in the past. For any recurring suggestions that reflect a misunderstanding of the current program, Duke Energy should consider addressing those issues in the Frequently Asked Questions section of the Smart $aver website. If that information is made widely available, it may help decrease the recurrence of these suggestions in the future.

The evaluation team notes that many of the issues that have arisen in the course of the interviews do seem to be addressed by the FAQs. For example, earlier in the report we mentioned that one participant did not feel he was able to get the information he had needed, specifically, that projects with less than 1 year payback were not eligible. This is on the website, but not available unless the reader accesses the correct FAQ (out of the three FAQs available). It may be worthwhile to specifically ask participants about the frequency of use and the usefulness of the FAQs in future process evaluations.

Interestingly, only two respondents said that incentives should be increased, which may suggest that Custom incentives may be at the appropriate levels. This is supported by the average satisfaction rating of 7.91 (see Table 2) for the incentive levels, which is a relatively high rating.

Channeling To and From Other Duke Energy Programs

Channeling to Other Programs. Duke Energy offers information about all their programs on their website, and explicitly tries to channel participants of one program to other programs whenever it is appropriate. Channeling to other programs may succeed because of many reasons. For example, customers may have learned about the existence of other Duke Energy programs through their participation in Smart $aver. Or customers may have had a positive experience with Smart $aver that helped them to understand the overall benefits of participating. In some cases, a customer may have used a Duke Energy Smart $aver incentive to help fund participating in other energy efficiency programs or vice versa.

Thirty-nine percent (16 of 41) of the participants we interviewed had submitted other applications to the Smart $aver Custom and Prescriptive programs in the past, and almost half (19 of 41) reported they had participated in other Duke Energy programs (including Prescriptive) as a result of their current participation in the Smart $aver Custom program. These responses likely underreport the actual occurrence of channeling from the Custom program because several of the respondents were vendors or otherwise reported they did not have knowledge of participation in other programs.

Repeat participants form a sizeable proportion of our sample, and likely of the entire population as well. It seemed that this segment may have incorporated the application for Smart $aver incentives into their capital projects process. This impression came from anecdotal information volunteered by the respondents, but was not directly queried in this evaluation. It may be worthwhile to investigate whether or not applying for rebates has become part of customers' business practices directly in future evaluations, as another measure of the Smart $aver's value.

Not surprisingly, vendors, particularly those who had clients across different states, also tended to have been involved in other Smart $aver applications. One large corporate real estate company participant reports that they are "globally aware of rebate programs" and that their application was "*Part of a global effort to apply to all incentive programs*."

Channeling from Smart $aver to and from other programs was difficult to gauge due to poor recall of the names of the other programs. In many cases, respondents would describe another program's activities in lieu of a name. The Energy Assessment program was described by one participant from a water utility, who said that he learned about an audit program that started with a telephone audit. However, he reports that the telephone audit was not useful because no one at his facility was able to answer the audit's technical questions.

Spillover within the Custom Project

The participant survey also included a question about spillover to gauge whether this is an area worth investigating in greater detail in future Smart $aver evaluations. Spillover refers to energy savings that are causally linked to program participation. In this case, we investigated spillover as defined by the inclusion of un-rebated energy efficient measures within the Custom project.

Many participants reported spillover within their Custom project. Fourteen of 32 respondents (44%) said their project included electric energy efficiency improvements that did not qualify for any incentive or rebate, whether from Duke Energy, the state, or the federal government. Of these 15, five customers mentioned that they simply didn't bother to apply for an incentive, citing lack of time or difficulty in "proving" the savings. The measures reported as spillover measures included HVAC equipment that was high efficiency but not eligible for a Custom incentive, LED lights in an elevator cab, a new air compressor, a VFD on a pool pump, a scheduling program for their HVAC system, an efficient chiller that didn't have a high enough SEER to qualify for an incentive, submeters, and an evaporative subcooler with floating head suction (that the customer said was too difficult to prove out). One customer reported they started taking behavioral action, namely turning off the lights, as a result of participating in the Custom program. Another customer reported they switched to a gas water heater, something they considered to fall under electric efficiency. One customer who said their project had spillover to other measures said that "every time we put in something new it's more efficient."

While these participants indicate that spillover did occur within their projects, their feedback also suggests that quantifying these energy savings may be an expensive effort for anyone to undertake, including Duke Energy. However, the fact that the Custom program accounts for free ridership during the application process means that any estimate of overall energy savings errs on the side of conservatism, and Duke Energy is likely achieving more net energy savings than is being calculated.

> RECOMMENDATION: In the incentive application that is submitted with the project invoices, Duke Energy should consider asking customer to answer an optional question about measures that were also included in the project. This data may help Duke Energy determine whether the spillover that participants are reporting may be easily quantified. Even if savings are not easily quantified, qualitative data on spillover measures may help Duke Energy show the full benefits of the Custom program.

Customer Voice: What's working well, and what's not

Respondents were asked if anything about the Smart $aver Custom program was working particularly well, as well as whether anything was not working well. Some of the comments made about aspects that were working well included statements that the entire program was working well:

- That Duke Energy offers the Custom program at all; excellent program.
- *"All of it"*
- *"Everything went pretty smoothly…Answer came back within 30 days. I was surprised and impressed by the process from beginning to end."*
- One customer who may have participated in Duke Energy's Smart Building Advantage program says he is *"Very comfortable with Duke Energy and their consultant"*.

Other respondents were pleased with the speed with which the application and incentives were processed.

- Received the incentive faster than expected
- *"Money appeared quicker than I thought."*
- *"Pleasantly surprised by how quickly they respond."*
- One customer reported the *"ease with which the application was completed and processed. We got feedback when the application was received, info on when we should hear back, and the check. It all happened quickly*."
- The application went well and approval was fast.
- *"This was a pleasant experience for us. I was pleased with the outcome."*
- *"Instead of one of the things you dread going through, it's actually pretty nice. They get the incentive out pretty quickly." Also, this customer says "at Duke there was one point person, pointing you in the right direction, which was extremely helpful for us."*
- *"They do a pretty good job of educating us. Their response time has always been good."*

Two of the respondents were vendors who offered differing views of Duke Energy's Custom program relative to the other utilities they have experienced.

- One vendor said "*From a national perspective, to be honest, Duke Energy was one of my easier ones. They were very easy to work with."*
- Another vendor in a separate interview disagrees and says. "*No; I have the perspective of working with other utilities. They're all fairly consistent. The process is varied but I don't think Duke has anything ahead of the other utilities that are doing this."*

Other respondents reported that the Smart $aver Custom program motivated them to achieve results they would not have been able to see.

- *"It's allowed us to do several projects that we wouldn't otherwise have been able to do. It's accomplishing what it was set out to do."*
- The Custom program is increasing awareness about energy efficiency and "*making people think, should I include this, should I include that?"*

- One customer reported that they calculated the payback on the rider, and his plant had a payback of 2000%.

When asked if anything about the Custom program was not working well, customers enumerated a number of issues, most of which are already known to the Duke Energy program manager.

- Lack of awareness about the program's existence.
- Lack of familiarity with the program's requirements and processes, "the vendor had to be the subject matter expert".
- Small companies need to hire engineers to help with the applications.
- "*Too much work.*"
- Another customer was disappointed in the size of the rebate, given the number of hours that went into the application.
- One university customer whose management already had an objective of looking for energy efficiency projects said that the administrative costs of participating in the Custom program are high. He didn't feel that the Custom program's incentives increased their motivation for energy efficiency, and would have preferred to be able to opt out.

Several customers mentioned they experienced a delay in hearing about the application. Another customer said that after the project was completed, there was a several-week delay in order for Duke Energy to make a site visit to confirm the installation, before they could receive the incentive.

While the delays may have been undesirable, there are indications that they did not dominate the customer's overall experience. For example, one customer said what was not working well was "*duration that it took to get approved. I submitted the original paperwork…didn't get approved until [five months later]. Some things fell into holes and I had to call up*." Yet this was the same customer mentioned earlier who described his Custom participation as a "pleasant experience". Duke Energy already has internal objectives to shorten the time for processing applications, and those should not be relaxed, but overall the participants in our sample were satisfied with the application processing time, as shown in Figure 2 by their average rating of 7.96.

Duke Energy is also aware of the difficulties in aligning program cycles with the customers' business decision-making cycles. One customer reported that including the incentive in the payback calculation within the budget cycle was a challenge, as his department gets a lot of energy project funding at the end of the year, and they have difficulty getting the approval and the rebate in the same year. In another case, a national retail chain-store customer said it was difficult for his company to submit invoices within the 90 day period. They would prefer to submit invoices for all projects at one time, and implement those projects at different times throughout the year.

Participants also offered other comments on what was not working well:

- One billboard company mentioned that Duke Energy's customer databases listed incorrect addresses for their billboards.
- One customer said his only suggestion is to allow customers to see usage aggregated across accounts.

- One customer said he received a worksheet (from the third party vendor) that had protected cells that should not have been protected.
- Another customer mentioned the biggest challenge was working through the third party vendor, "*we go back and forth 3, 4, 5 times to get the information right. I've had to call a Duke Energy rep to find out, because I haven't heard anything. It was bogged down by that third party*."

Overall, the interviewees in our sample relate very different experiences. This may be due in part to the fact that our sample frame covered a period during which Duke Energy has made significant improvements to program operations, as well as the period in which WECC, the main vendor assisting Duke Energy with program implementation, has also undergone large staffing changes.

Satisfaction over Time

We compared current responses to the six main satisfaction questions with the ratings obtained in the spring of 2011 for the evaluation of the 2011 Smart $aver program[11]. Figure 4 shows that while there was a trend toward a general increase in participant satisfaction over all areas, this increase was not statistically significant ($p>.05$). Despite this, the evaluation team sees this as a very promising trend that there was an overall improvement in the Smart $aver Custom program.)[12]. The evaluation team has noted a number of improvements throughout the Smart $aver Custom program in 2012, and believes that the increased ratings reflect those improvements. For future evaluation studies, we suggest that Duke Energy consider planning for approximately the same sample size used in this evaluation in order to be able to detect significant increases or decreases in satisfaction.

[11] *Evaluation of the Non-Residential Smart $aver Custom Program in North and South Carolina: Results of a Process Evaluation* (TecMarket Works, Aug 12 2011)

[12] The evaluation team believes that the lack of significance was likely due to the smaller sample size in the 2011 study, which yields a less precise estimate of the average ratings (this can be seen in the larger error bars for the 2011 ratings in Figure 4). In the last study there were only 21 interviews completed compared with the 41 interviews in this study. That smaller sample size was used due to budget limitations. Larger sample sizes generally lead to greater precision in estimating means.

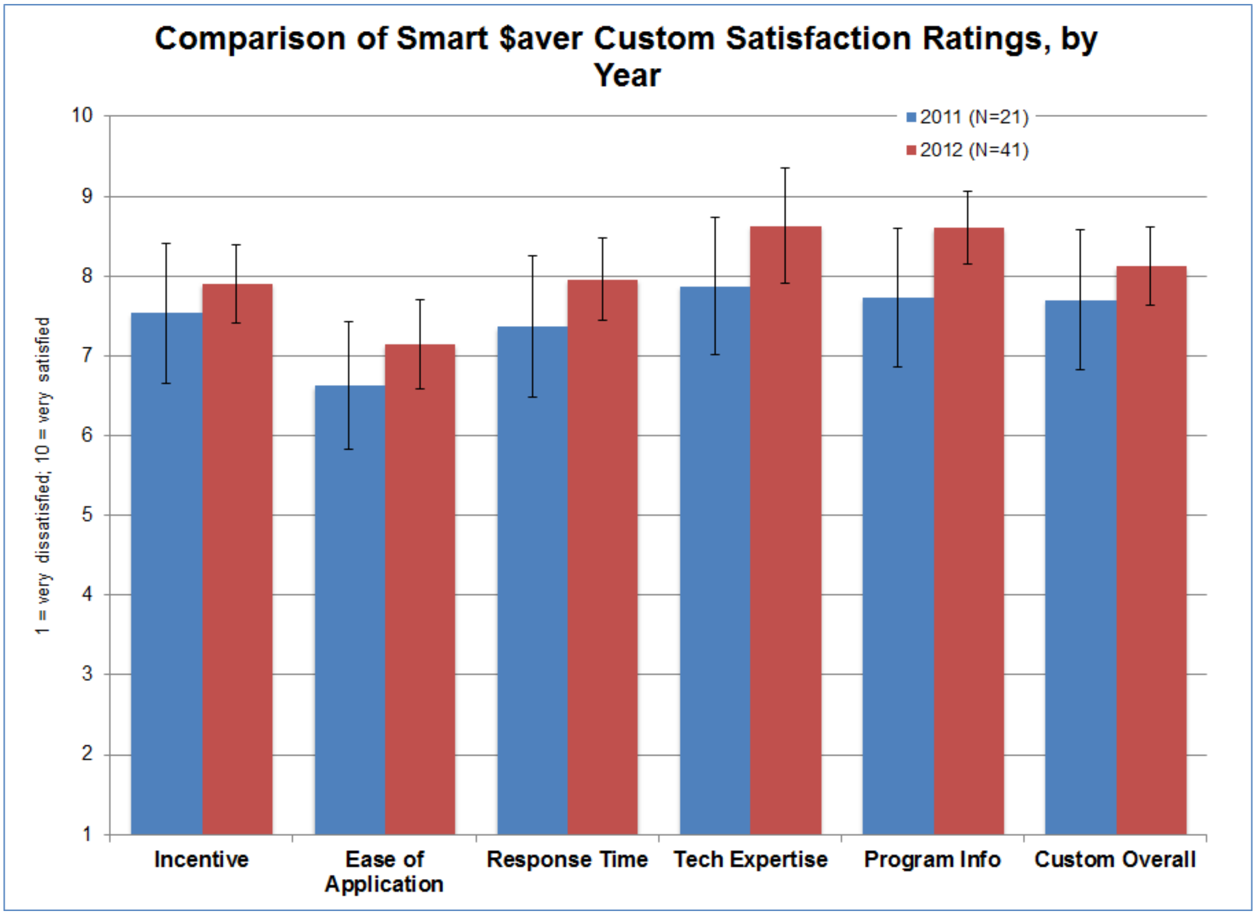

Figure 4. Satisfaction ratings from the 2011 Smart $aver Custom interviews compared with ratings from the current study.

Satisfaction by Application Status. It would be surprising to find that participant satisfaction was not dependent upon the outcome of their incentive application. Indeed, we did find some relationship between a project status and certain areas of satisfaction[13]. Post hoc analyses shows that the satisfaction of "closed lost" participants, whose incentive applications were declined, had lower satisfaction in the response time to the application. Their responses can be seen the second set of clustered bars in Figure 5, where the "closed lost" participants gave an average rating of 5.5. A marginal effect can be seen in the "closed lost" ratings of overall satisfaction with Smart $aver, with an average rating of 6.25 (second set from the right). Although this does not reach significance, this tendency toward a lower rating would not be unexpected. Interestingly, the "closed lost" participants still had a very high rating of Duke Energy overall.

[13] Statistics available upon request.

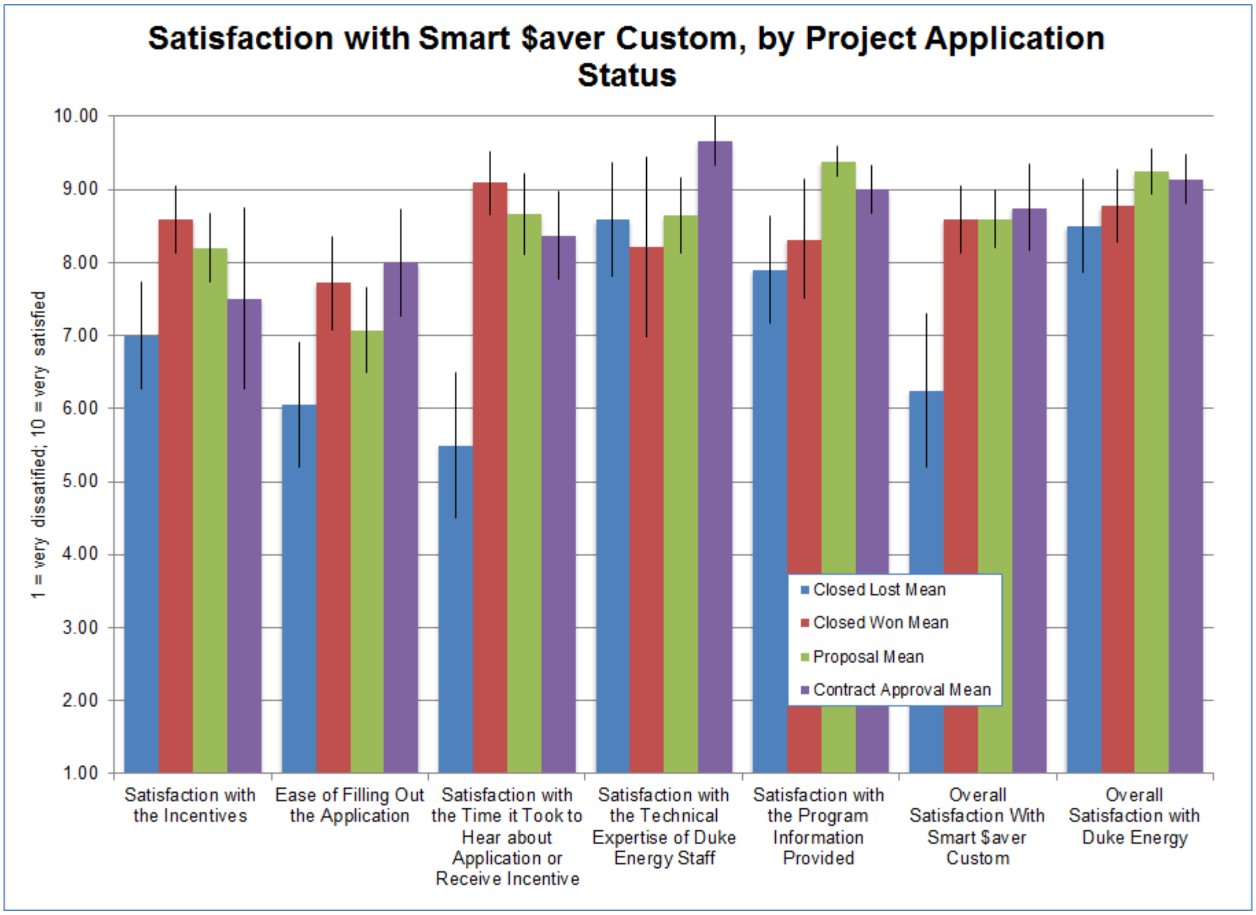

Figure 5. Satisfaction Ratings by Project Application Status

Conclusions

There is overall agreement that the biggest barrier to participation in the Custom program is the uncertainty of the incentives. As the Duke Energy program manager describes, *"Applicants want to know a rough estimate of the incentive before they apply, so that they can make a judgment on whether or not it's worth their time."* As mentioned earlier, WECC also reported that this uncertainty carries over to potential trade ally network participants.

As described throughout this report, the Smart $aver Custom program has been making changes to the program design to lower the uncertainty that is experienced by the participants. However, it is important to keep two things in mind: First, the very flexibility of the Custom program also means it cannot be predictable. Predictability is not the purpose of the Custom program within Duke Energy's non-residential program portfolio. Second, the level of program resources needed to review a small or mid-sized project may not be significantly less than for a large project. As pointed out in the previous evaluation study, the more detailed application requirements of the Custom program may also provide some "gate-keeping", such that customers who can justify the costs of the program without a Duke Energy incentive may choose to avoid the application entirely.

Overall, the evaluation team has seen major improvements in program operations. While there were some implementation issues associated with staffing changes, we believe the core program design and planned implementation are sound. The Non-residential Smart $aver Custom program is a program that is well-liked and well-appreciated by customers, and positioned to fill a key need in Duke Energy's portfolio of energy programs.

Impact Evaluation Findings

Engineering-Based Impact Analysis

The impact evaluation employed a tracking system review, sample design and selection, an engineering review of the custom program applications, field measurement and verification (M&V) of selected projects, data analysis, and reporting. Tracking data obtained from Duke Energy from June 2009 through March 2012 shows that following breakdown of ex-ante energy savings by measure:

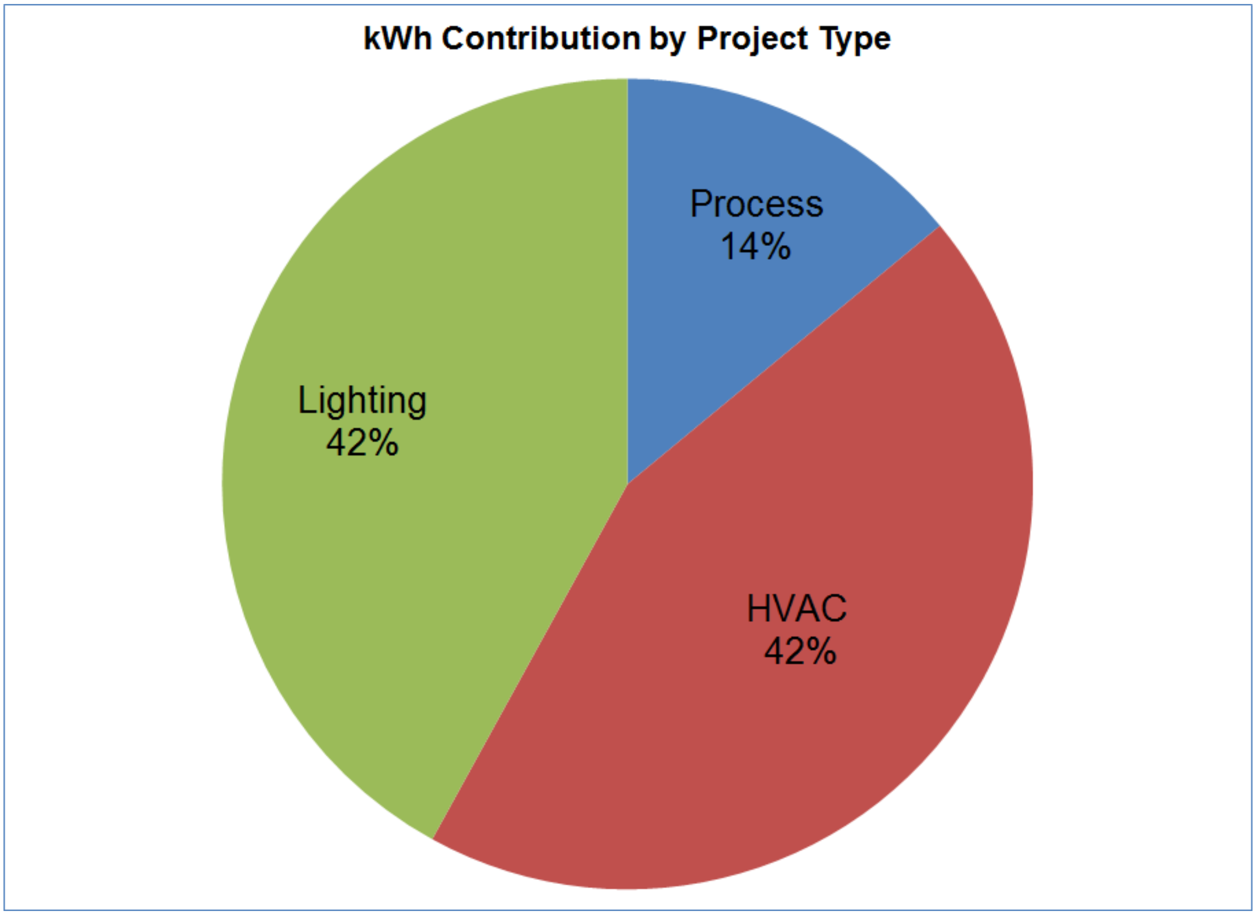

Figure 6. Energy Savings by Project Type

Sample Design

The program evaluation started in June of 2009. Program participation was light in the early stages of the program, but program managers were interested in getting early feedback. Thus, the initial projects were evaluated as they were approved. As program participation increased, projects were studied on a sample basis. The projects were assigned as the program developed to one of three categories: Lighting, HVAC, and Process. The projects were grouped into similar technology categories to minimize the variation in the realization rates across projects and provide better precision in the overall program results. The realization rates across the technology categories also provided an idea of which types of projects are performing closer to original expectations.

The program tracking system is based on the Sales Force customer relationship management tool. Project leads are entered into the Sales Force system, and tracked as they progress in the system. In general, the process is as follows:

1. ***Initial Application***. Customer submits an application for the project, including a project description and energy savings calculations.
2. ***Application Review***. Applications are reviewed by a Duke Energy contractor for program eligibility and reasonableness. Modifications are made to the savings estimates as necessary. Project cost effectiveness is calculated and the incentive offer is determined.
3. ***Proposal to Customer***. A rebate proposal based on the reviewed and adjusted (as necessary) savings estimate and incentive offer is presented to the customer.
4. ***Contract Approval***. The customer has accepted the incentive and plans to move forward with the project.
5. ***Project Completion***. The customer has completed the project, and requested and received their incentive.

Projects that are at the Proposal to Customer stage are put in a list of potential candidates. Once the project proceeds to Contract Approval, it is eligible for sampling. The intention is to capture as many projects in the contract approval phase before construction begins in order to obtain pre-installation data.

The sampling plan incorporates a stratified random sample approach, where the projects are stratified according to technology type (lighting, HVAC or process), and sampled randomly within each stratum. Early projects were evaluated systematically to satisfy the needs for early feedback. As program participation increased, a random sample approach was introduced.

The total sample size is calculated from the following equation[14]:

$$n = \frac{\left(\sum_k \left(kWh_k \times cv_k\right)\right)^2}{\left(\frac{P \times kWh}{Z}\right)^2 + \sum_k \frac{\left(kWh_k \times cv_k\right)^2}{N_k}}$$

where:

n = total sample size required
kWh_k = estimated savings from group k
cv_k = assumed coefficient of variation for group k

[14] Bonneville Power Administration, *Sampling Reference Guide. Research Supporting an Update of BPA's Measurement and Verification Protocols,* August, 2010.

P = desired precision
KWh = total kWh savings
Z = z statistic (1.645 at 90% confidence)
N_k = population size of group k

Samples are allocated to each group based on the following equation:

$$n_k = n \times \frac{kWh_k \times cv_k}{\sum_k (kWh_k \times cv_k)}$$

The Carolina System participation at the time of sample selection is summarized in Table 12. This projection assumed all projects in the Contract Approval stage would complete construction and would be paid in this evaluation cycle.

Table 12. Sample Selection for Custom Component of Carolina Custom Program

Group	kWh	cv	Total Projects	Sample Size
Lighting	80,585,880	0.3	211	12
HVAC	83,000,706	0.5	81	21
Process	27,321,539	0.5	37	7
Total			329	40

Since lighting projects are generally more predictable, an initial assumption of 0.3 was used for the coefficient of variation. Otherwise, a coefficient of variation of 0.5 was used, consistent with sampling criteria in the IPMVP for projects where previous variability data are not available. A sample of 40 projects was initially selected, split across lighting, HVAC and Process projects.

Sample Status

At the conclusion of the evaluation, the sample sizes exceeded the original sample design across all three project categories. The achieved sample is shown in the table below.

Table 13. Status of 2009-2012 Sample

Group	Sample Size	Completed	Notes
Lighting	12	13	One additional site completed
HVAC	21	23	Two additional sites completed
Process	7	8	One additional site completed
	40	44	

The completed projects are summarized in Table 14 below.

Table 14. Summary of Completed Projects

Site Number	Customer	Facility Type	Project Type	Claimed kWh Savings	Claimed kW NCP[15] Savings
1	[redacted]	Multiple Bank Branch Office	HVAC	1,161,979	319
2	[redacted]	Manufacturing	HVAC	507,450	107
3	[redacted]	Manufacturing	HVAC	214,596	35
4	[redacted]	Office	HVAC	38,108	15
5	[redacted]	Manufacturing	Process	782,308	134
6	[redacted]	Manufacturing	Process	1,630,774	343
7	[redacted]	Wastewater	Process	637,882	73
8	[redacted]	Warehouse	Lighting	944,175	108
9	[redacted]	Parking Structure	Lighting	634,479	72
10	[redacted]	TV studio	Lighting	298,686	54
11	[redacted]	Parking Structure	Lighting	89,241	25
12	[redacted]	Office	Lighting	53,538	15
13	[redacted]	Service Station	Lighting	27,505	0
14	[redacted]	Office	HVAC	217,763	54
15	[redacted]	Data Center	HVAC	11,460,000	1,840
16	[redacted]	Data Center	HVAC	10,300,000	900
17	[redacted]	Office	HVAC	1,326,557	121
18	[redacted]	Data Center	Process	2,325,225	265
19	[redacted]	Office	HVAC	32,237	7
20	[redacted]	Warehouse	Lighting	1,530,886	175
21	[redacted]	Office	HVAC	318,009	117
22	[redacted]	Office	HVAC	307,821	15
23	[redacted]	Office	HVAC	188,251	35
24	[redacted]	Office	HVAC	3,895,980	841
25	[redacted]	Office	HVAC	368,392	105
26	[redacted]	Hotel	HVAC	231,779	1
27	[redacted]	Parking Structure	Lighting	56,659	6
28	[redacted]	Water treatment plant	Process	929,177	106
29	[redacted]	Industrial	Process	408,652	55
30	[redacted]	Office	Lighting	44,110	0
31	[redacted]	Retail	Lighting	59,876	11
32	[redacted]	Office and Industrial	HVAC	600,449	144
33	[redacted]	Grocery	HVAC	320,792	101
34	[redacted]	Technical College	HVAC	257,170	70
35	[redacted]	Big Box Retail	HVAC	944,175	108
36	[redacted]	Industrial	Process	804,345	92
37	[redacted]	Courthouse	HVAC	542,970	101
38	[redacted]	Police Station	HVAC	72,311	40
39	[redacted]	Assembly	Lighting	108,439	7
40	[redacted]	Poultry Production	Lighting	165,885	32
41	[redacted]	Warehouse	Lighting	182,003	21

[15] NCP = Non-Coincident Peak

42	[redacted]	Retail	HVAC	61,269	20
43	[redacted]	Industrial	Process	153,809	23
44	[redacted]	Office	HVAC	375,015	110

Application Review

The customer application for each site was obtained from Duke Energy, along with any supporting documentation. Each application was reviewed to gain an understanding of the measures included and the expected savings. The Duke Energy Business Relations Manager (BRM) associated with each sampled site was contacted to secure customer participation in the evaluation. Once contact was established with the customer, follow-on phone calls and emails were exchanged to better understand the facility, the measures, and the construction schedule.

M&V Plan Development

An M&V plan was developed by Architectural Energy Corporation for each sampled site. The M&V plan covered the following topic areas:

Introduction. The project and the measures installed were described in sufficient detail to understand the M&V project scope and methodology. Savings by measure were shown and the M&V priorities for measures within the project were listed. The project baseline assumptions were also described.

Goals and Objectives. The overall goals and objectives of M&V activity were listed.

Building Characteristics. An overview of the building, with a summary table of relevant building characteristics, such as building size (square footage), number of stories, building envelope, lighting system, HVAC system type and so on was provided.

Data Products and Project Output. Specific end products – kWh savings, coincident and noncoincident kW savings, and therm savings were listed. Raw and processed data to be supplied at the conclusion of the study were identified.

M&V Option. The M&V Option according to the International Performance Measurement and Verification Protocol (IPMVP) was described. The options are summarized below:

- ***Option A - Partially Measured Retrofit Isolation***. Savings under Option A are determined by partial field measurement of the energy use of the system(s) to which an energy conservation measure (ECM) was applied separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous. Partial measurement means that some parameter(s) affecting the building's energy use may be stipulated, if the total impact of possible stipulation error(s) is not significant to the resultant savings. Savings are estimated from engineering calculations based on stipulated values and spot, short-term and/or continuous post-retrofit measurements.

- ***Option B - Retrofit Isolation.*** Savings under Option B are determined by field measurement of the energy use of the systems to which the ECM was applied separate from the energy use of the rest of the facility. Savings are estimated directly from measurements. Stipulated values are not allowed.
- ***Option C - Whole Facility.*** Savings under Option C are determined by measuring energy use at the whole-facility level. Short-term or continuous measurements are taken throughout the post-retrofit period and compared to 12 to 24 months of pre-retrofit data. Savings are estimated from analysis of whole-facility utility meter or sub-meter data using techniques ranging from simple comparison of utility bills to regression analysis.
- ***Option D - Calibrated Simulation.*** Savings under Option D are determined through building energy simulation[16] of the energy use of components or the whole facility, calibrated with hourly or monthly utility billing data, and/or end-use metering.

Data Analysis. The engineering methods and/or equations used to generate the data products identified above were listed. The data sources, either measurements or stipulated values from secondary data sources, were identified.

Field Data Points. Specific field data points collected through the M&V plan were listed. The field data were a combination of survey data, one-time measurements, and time series data collected from data loggers installed for the project or trend data collected from the site energy management system (EMS).

Data Accuracy. Meter and sensor accuracy for each field measurement point was listed.

Verification and Quality Control. The steps taken to validate the accuracy and completeness of the raw field data were listed.

Recording and Data Exchange Format. The format of the raw and processed data files used in the analysis and supplied as data products were listed.

The M&V plans, along with the processed data summary and project results are shown in Appendix B. A summary of the M&V plan for each site is shown in Table 15.

Table 15. M&V Plan Summary

Site Number	Customer	Facility Type	Project Type	IPMVP Option	Plan Summary
1	[redacted]	Multiple Bank Branch Office	HVAC	A	Pre/post light logger and HVAC unit current combined with spot kW
2	[redacted]	Manufacturing	HVAC	B	Pre/post kW measurements
3	[redacted]	Manufacturing	HVAC	A	Post only fan current measurement combined with spot kW
4	[redacted]	Office	HVAC	D	Calibrated DOE-2 model

[16] DOE-2 is a commonly used building energy simulation program.

5	[redacted]	Manufacturing	Process	N/A	N/A – Project ineligible for program; no M&V done.
6	[redacted]	Manufacturing	Process	A	Post only chiller, AHU, pump and cooling tower measurements
7	[redacted]	Wastewater	Process	A	Pre/post true electric power using portable meter. Flowrate from process controller
8	[redacted]	Warehouse	Lighting	A	Post only lighting circuit current
9	[redacted]	Parking Structure	Lighting	A	Pre/post fixture counts and verified 8760 operation
10	[redacted]	TV studio	Lighting	A	Post only fixture inspection and verification of lighting hours
11	[redacted]	Parking Structure	Lighting	N/A	Post only fixture inspection and verification of lighting hours
12	[redacted]	Office	Lighting	A	Post only fixture inspection and lighting operating hour logging
13	[redacted]	Service Station	Lighting	A	Post only fixture inspection and lighting circuit current monitoring
14	[redacted]	Office	HVAC	A	Post only EMS trending of CHW temps, CHW pump and tower fan current.
15	[redacted]	Data Center	HVAC	D	Calibrated DOE-2 model
16	[redacted]	Data Center	HVAC	D	Calibrated DOE-2 model
17	[redacted]	Office	HVAC	D	Calibrated DOE-2 model
18	[redacted]	Data Center	Process	A	Pre/post IT equipment and HVAC kW
19	[redacted]	Office	HVAC	D	Calibrated DOE-2 model
20	[redacted]	Warehouse	Lighting	A	Post only fixture inspection and lighting operating hour logging
21	[redacted]	Office	HVAC	D	Calibrated DOE-2 model
22	[redacted]	Office	HVAC	D	Calibrated DOE-2 model
23	[redacted]	Office	HVAC	D	Calibrated DOE-2 model
24	[redacted]	Office	HVAC	A	Pre/post AHU and chiller kW
25	[redacted]	Office	HVAC	A	Pre/post monitoring of a sample of affected equipment
26	[redacted]	Hotel	HVAC	A	Pre/post monitoring of a sample of rooms
27	[redacted]	Parking Structure	Lighting	A	Post only monitoring of lighting circuits
28	[redacted]	Water treatment plant	Process	C	Whole building billing analysis of pump station
29	[redacted]	Industrial	Process	A	Pre/post monitoring of compressor system
30	[redacted]	Office	Lighting	A	Post only monitoring of

					lighting circuits
31	[redacted]	Retail	Lighting	A	Post only monitoring of lighting circuits
32	[redacted]	Office and Industrial	HVAC	D	Calibrated Simulation
33	[redacted]	Grocery	HVAC	D	Calibrated Simulation
34	[redacted]	Technical College	HVAC	A	Regression analysis of monitored data
35	[redacted]	Big Box Retail	HVAC	A	Regression analysis of monitored data
36	[redacted]	Industrial	Process	A	Post only monitoring of compressor plant kW
37	[redacted]	Courthouse	HVAC	D	Calibrated DOE-2 model
38	[redacted]	Police Station	HVAC	D	Calibrated DOE-2 model
39	[redacted]	Assembly	Lighting	A	Post only monitoring of lighting circuits
40	[redacted]	Poultry Production	Lighting	A	Post only monitoring of lighting circuits
41	[redacted]	Warehouse	Lighting	A	Post only monitoring of lighting circuits
42	[redacted]	Retail	HVAC	D	Calibrated DOE-2 model
43	[redacted]	Industrial	Process	A	Post only monitoring of compressor plant kW
44	[redacted]	Office	HVAC	D	Calibrated DOE-2 model

Measurement and Verification

Field data were collected by Duke Energy contractors according to the M&V plan. The Duke Energy contractors were trained by personnel from Architectural Energy Corporation and BuildingMetrics Incorporated. Metering equipment consisted of a combination of light loggers, portable data acquisition equipment (capable of measuring temperature, relative humidity, electric current, etc.), as well as true electric power meters. The specific instrumentation used at each site is described in "Appendix F: Site M&V Reports" and summarized below. Survey data and spot measurements were obtained during meter installation. The metering equipment was installed for a period ranging from 2 weeks to 6 weeks, depending on the nature and variability of the energy consumption of the metered equipment. The metering duration used in each site is also described in Appendix B and summarized in Table 16 below.

Table 16. M&V Approach Summary

Site Number	Customer	Facility Type	Project Type	Measurements Taken	Monitoring Duration
1	[redacted]	Multiple Bank Branch Office	HVAC	Light logger on/off status, HVAC unit current and temperature, spot kW	3 weeks pre and 3 weeks post
2	[redacted]	Manufacturing	HVAC	Chiller and pump kW	3 weeks pre and 3 weeks

					post
3	[redacted]	Manufacturing	HVAC	Fan amps and spot kW	Post only 2+ weeks
4	[redacted]	Office	HVAC	Billing data	12 months
5	[redacted]	Manufacturing	Process	N/A	N/A – Project Project ineligible for program. No M&V done.
6	[redacted]	Manufacturing	Process	Current and spot kW; temperatures and RH	3 weeks post only
7	[redacted]	Wastewater	Process	True electric power, flowrate	10 days pre and 10 days post
8	[redacted]	Warehouse	Lighting	Lighting circuit current	1 month post
9	[redacted]	Parking Structure	Lighting	None required (8760 operation)	N/A
10	[redacted]	TV studio	Lighting	Lighting circuit current	3 weeks post only
11	[redacted]	Parking Structure	Lighting	None required (verified schedule at time clock)	N/A
12	[redacted]	Office	Lighting	Light logger monitoring	3 weeks post only
13	[redacted]	Service Station	Lighting	Lighting circuit current	3 weeks post only
14	[redacted]	Office	HVAC	Trend of CHW and CW temp, CHW and tower current	3 weeks post only
15	[redacted]	Data Center	HVAC	Server kW, chiller kW, CHW pump kW and speed, AHU fan speed, return temp and mixed air temp; space temperature, ambient temp	4 weeks post only
16	[redacted]	Data Center	HVAC	Server kW, chiller kW, CHW pump kW and speed, AHU fan speed, return temp and mixed air temp; space temperature, ambient temp	4 weeks post only
17	[redacted]	Office	HVAC	AHU fan kW and supply, mixed and return air temps. Outdoor temp and RH, lighting panel current.	3 weeks post only
18	[redacted]	Data Center	Process	Server power	3 wk pre/post

	[redacted]			distribution unit and computer room AC kW	
19	[redacted]	Office	HVAC	Billing data	12 mo. pre
20	[redacted]	Warehouse	Lighting	Lighting circuit current	4 weeks
21	[redacted]	Office	HVAC	Billing data	12 months
22	[redacted]	Office	HVAC	Billing data plus short term monitoring of project affected equipment	12 months billing data plus 3 week monitoring
23	[redacted]	Office	HVAC	Billing data plus short term monitoring of project affected equipment	12 months billing data plus 3 week monitoring
24	[redacted]	Office	HVAC	Trend log kW data of affected HVAC components	7 months pre / 6.5 months post
25	[redacted]	Office	HVAC	Time series kW measurements on a sample of pumps and AHUs	3 weeks pre / 3 weeks post
26	[redacted]	Hotel	HVAC	Room HVAC unit current; and entering and leaving temperatures. Trend data of room rental status.	3 weeks pre/post. Pre simulated by disabling controls in a sample of rooms.
27	[redacted]	Parking Structure	Lighting	Current logging of a sample of lighting circuits	5 weeks post only.
28	[redacted]	Water treatment plant	Process	Pump station billing data analysis	2 years pre / 6 months post
29	[redacted]	Industrial	Process	kW logging of compressor plant	5 days pre / 3 wk post
30	[redacted]	Office	Lighting	Current logging of a sample of lighting circuits	5 weeks post only.
31	[redacted]	Retail	Lighting	Current logging of a sample of lighting circuits	3 weeks post only.
32	[redacted]	Office and Industrial	HVAC	Current logging on a sample of HVAC units, plus billing analysis	3 weeks post only on HVAC units, 2 yr pre , 1 yr post for billing data
33	[redacted]	Grocery	HVAC	kW plus temperature/RH measurements of RTU; current logging of evaporator fans	7 wk post only plus 12 mo billing data

34	[redacted]	Technical College	HVAC	kW logging of chiller plus EMS trend logging of flow and temperature	3 wk post-only
35	[redacted]	Big Box Retail	HVAC	Outdoor temp and RH; CO2 concentration and temperature/current logging of a sample of RTUs	3 wk post-only
36	[redacted]	Industrial	Process	kW logging of compressors and dryer	6 wk post only
37	[redacted]	Courthouse	HVAC	Current logging of AHU plus billing calibration	3 wk post only AHU data plus 12 mo billing data.
38	[redacted]	Police Station	HVAC	Billing data calibration of DOE-2 model	12 mo billing data.
39	[redacted]	Assembly	Lighting	Current logging of a sample of lighting circuits	3.5 wk post only
40	[redacted]	Poultry Production	Lighting	Current logging of a sample of lighting circuits	47 days (corresponding to chicken production cycle)
41	[redacted]	Warehouse	Lighting	Current logging of a sample of lighting circuits	3 week post only
42	[redacted]	Retail	HVAC	Billing data calibration of DOE-2 model	12 mo billing data.
43	[redacted]	Industrial	Process	kW logging of compressor plant	3 week post only
44	[redacted]	Office	HVAC	Billing data calibration of DOE-2 model	12 mo billing data.

Calculations and Reporting

Pre and post installation data were collected by Duke Energy contractors and forwarded to Architectural Energy Corporation for analysis. The data were analyzed according to the M&V plan developed for each project. Data analysis consisted of pre / post comparisons of monitored data extrapolated to annual consumption and demand using simple engineering models or linear regression techniques as described in the M&V plan. A site report was developed for each completed project. The reports are attached in “Appendix F: Site M&V Reports”. The calculations and analysis techniques are summarized in Table 17.

Table 17. Calculation Approach Summary

Site Number		Facility Type	Project Type	Calculations
1	[redacted]	Multiple Bank Branch Office	HVAC	Engineering equations and regression model expanded using bin data.
2	[redacted]	Manufacturing	HVAC	Regression model expanded using bin data.
3	[redacted]	Manufacturing	HVAC	Regression model expanded using bin data.
4	[redacted]	Office	HVAC	DOE-2 building energy simulation
5	[redacted]	Manufacturing	Process	Project ineligible for program; no M&V done.
6	[redacted]	Manufacturing	Process	Regression model expanded using bin data.
7	[redacted]	Wastewater	Process	Engineering equations
8	[redacted]	Warehouse	Lighting	Engineering equations
9	[redacted]	Parking Structure	Lighting	Engineering equations
10	[redacted]	TV studio	Lighting	Engineering equations
11	[redacted]	Parking Structure	Lighting	Engineering equations
12	[redacted]	Office	Lighting	Engineering equations
13	[redacted]	Service Station	Lighting	Engineering equations
14	[redacted]	Office	HVAC	Engineering equations and regression model expanded using bin data.
15	[redacted]	Data Center	HVAC	DOE-2 building energy simulation
16	[redacted]	Data Center	HVAC	DOE-2 building energy simulation
17	[redacted]	Office	HVAC	DOE-2 building energy simulation
18	[redacted]	Data Center	Process	Engineering equations
19	[redacted]	Office	HVAC	DOE-2 building energy simulation
20	[redacted]	Warehouse	Lighting	Engineering equations
21	[redacted]	Office	HVAC	DOE-2 building energy simulation
22	[redacted]	Office	HVAC	DOE-2 building energy simulation

23	[redacted]	Office	HVAC	DOE-2 building energy simulation
24	[redacted]	Office	HVAC	Regression analysis of trend data
25	[redacted]	Office	HVAC	Regression analysis of logger data
26	[redacted]	Hotel	HVAC	Regression analysis of logger data
27	[redacted]	Parking Structure	Lighting	Engineering equations
28	[redacted]	Water treatment plant	Process	Pre / post kWh comparison
29	[redacted]	Industrial	Process	Pre / post kWh comparison
30	[redacted]	Office	Lighting	Engineering equations
31	[redacted]	Retail	Lighting	Engineering equations
32	[redacted]	Office and Industrial	HVAC	DOE-2 building energy simulation
33	[redacted]	Grocery	HVAC	DOE-2 building energy simulation
34	[redacted]	Technical College	HVAC	Regression analysis of monitored data
35	[redacted]	Big Box Retail	HVAC	Regression analysis of monitored data
36	[redacted]	Industrial	Process	Engineering equations
37	[redacted]	Courthouse	HVAC	DOE-2 building energy simulation
38	[redacted]	Police Station	HVAC	DOE-2 building energy simulation
39	[redacted]	Assembly	Lighting	Engineering equations
40	[redacted]	Poultry Production	Lighting	Engineering equations
41	[redacted]	Warehouse	Lighting	Engineering equations
42	[redacted]	Retail	HVAC	DOE-2 building energy simulation
43	[redacted]	Industrial	Process	Engineering equations
44	[redacted]	Office	HVAC	DOE-2 building energy simulation

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[17] Other than previous Duke Custom programs that had evaluated NTG values of 1.0.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

[redacted]

Results

The results of the evaluation are reported in this section. Annual savings for kWh and kW are reported along with their realization rates for each project. These data are summarized by project type. An independent assessment of the project life is also reported.

Annual Savings

The estimated sampling precision in the realization rates is shown in Table 18. Note, 276 of the 329 anticipated projects in the sample frame were completed and paid. A summary of the annual savings from each project is shown in Table 19. The average annual realization rate by project type is shown in Table 20.

Table 18. Realization Rate Achieved Sampling Precision

Project Type	Population Size	Sample Size	Actual Sample cv	Relative Precision
Lighting	178	13	0.26	11%
HVAC	62	23	1.23	34%
Process	36	8	0.78	40%
Total	276	44		13.9%

Table 19. Annual Results Summary

Site	Customer	Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
			Evaluated	Expected	RR	Evaluated	Expected	RR	Evaluated	Expected	RR
1	[redacted]	HVAC	248,891	1,161,979	0.21	54.0	319	0.17	8.7	104	0.08
2	[redacted]	HVAC	1,234,631	507,450	2.43	-5.0	107	-0.05	-5.0	95	-0.05
3	[redacted]	HVAC	208,279	214,596	0.97	23.0	35	0.66	23.0	36	0.64
4	[redacted]	HVAC	16,253	38,108	0.43	29.5	15	1.97	29.5	13	2.27
5	[redacted]	Process	0	782,308	0.00	0.0	134	0.00	0.0	131	0.00
6	[redacted]	Process	118,688	1,630,774	0.07	0.0	343	0.00	0.0	306	0.00
7	[redacted]	Process	156,666	637,882	0.25	31.0	73	0.42	77.0	119	0.65
8	[redacted]	Lighting	1,645,455	944,175	1.74	62.0	108	0.57	87.4	108	0.81
9	[redacted]	Lighting	699,285	634,479	1.10	80.0	72	1.11	80.0	72	1.11
10	[redacted]	Lighting	241,512	298,686	0.81	43.0	54	0.80	45.0	47	0.96
11	[redacted]	Lighting	91,980	89,241	1.03	25.0	25	1.00	25.0	25	1.00
12	[redacted]	Lighting	51,642	53,538	0.96	16.0	15	1.07	16.0	0	N/A
13	[redacted]	Lighting	36,695	27,505	1.33	6.8	0	N/A	0.0	0	N/A
14	[redacted]	HVAC	416,346	217,763	1.91	47.0	54	0.87	47.0	34	1.38
15	[redacted]	HVAC	5,293,436	11,460,000	0.46	276.0	1,840	0.15	284.0	949	0.30
16	[redacted]	HVAC	3,065,196	10,300,000	0.30	580.0	900	0.64	543.0	293	1.85
17	[redacted]	HVAC	791,017	1,326,557	0.60	-125.0	121	-1.03	-45.9	121	-0.38
18	[redacted]	Process	1,895,128	2,325,225	0.82	216.3	265	0.82	216.3	266	0.81
19	[redacted]	HVAC	6,347	32,237	0.20	23.3	7	3.33	-1.8	6	-0.30
20	[redacted]	Lighting	1,759,560	1,530,886	1.15	170.0	175	0.97	103.5	175	0.59
21	[redacted]	HVAC	35,606	318,009	0.11	0.9	117	0.01	0.0	0	N/A
22	[redacted]	HVAC	151,374	307,821	0.49	7.9	15	0.53	-48.8	10	-4.88
23	[redacted]	HVAC	119,013	188,251	0.63	-2.0	35	-0.06	-0.7	29	-0.02
24	[redacted]	HVAC	4,072,566	3,895,980	1.05	719.0	841	0.85	684.0	555	1.23
25	[redacted]	HVAC	3,229,589	368,392	8.77	1,001.0	105	9.53	548.0	57	9.61
26	[redacted]	HVAC	42,591	231,779	0.18	15.4	1	15.40	7.4	1	7.35
27	[redacted]	Lighting	56,965	56,659	1.01	6.6	6	1.11	6.5	6	1.08
28	[redacted]	Process	949,380	929,177	1.02	202.0	106	1.91	202.0	106	1.91
29	[redacted]	Process	87,808	408,652	0.21	-42.5	55	-0.77	-24.6	51	-0.48
30	[redacted]	Lighting	43,960	44,110	1.00	11.3	0	N/A	0.0	0	0.00
31	[redacted]	Lighting	54,103	59,876	0.90	12.8	11	1.16	12.7	11	1.15
32	[redacted]	HVAC	2,747,160	600,449	4.58	30.2	144	0.21	30.2	40	0.76

Site	Customer	Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
			Evaluated	Expected	RR	Evaluated	Expected	RR	Evaluated	Expected	RR
33	[redacted]	HVAC	33,039	320,792	0.10	9.4	101	0.09	9.0	49	0.18
34	[redacted]	HVAC	18,148	257,170	0.07	217.0	70	3.10	189.0	52	3.63
35	[redacted]	HVAC	854,373	944,175	0.90	933.0	108	8.64	933.0	108	8.64
36	[redacted]	Process	375,910	804,345	0.47	-10.7	92	-0.12	2.3	36	0.06
37	[redacted]	HVAC	1,414,900	542,970	2.61	79.0	101	0.78	74.0	0	N/A
38	[redacted]	HVAC	102,530	72,311	1.42	32	40	0.80	21.0	11	1.91
39	[redacted]	Lighting	70,907	108,439	0.65	14.0	7	2.00	6.3	7	0.90
40	[redacted]	Lighting	147,130	165,885	0.89	18.2	32	0.57	8.7	32	0.27
41	[redacted]	Lighting	182,561	182,003	1.00	24.9	21	1.18	24.6	21	1.17
42	[redacted]	HVAC	148,845	61,269	2.43	5.6	20	0.28	-4.4	10	-0.44
43	[redacted]	Process	143,781	153,809	0.93	14.4	23	0.63	16.6	23	0.72
44	[redacted]	HVAC	660,451	375,015	1.76	156.9	110	1.43	151.9	53	2.87

Table 20. Average Sample Realization Rate by Project Type

Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
	Evaluated	Expected	RR	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	5,081,755	4,195,482	1.21	491	526	0.93	416	504	0.82
HVAC	24,910,581	33,743,073	0.74	4,108	5,206	0.79	3,476	2,626	1.32
Process	3,727,361	7,672,172	0.49	411	1,091	0.38	490	1,038	0.47

The realization rates by project type for the sampled projects were expanded to the participant population. The results are shown in Table 21 through Table 23.

Table 21. Program kWh Savings by Project Type

Project Type	Sample kWh Savings			Population kWh Savings		
	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	5,081,755	4,195,482	1.21	137,546,332	113,557,847	1.21
HVAC	24,910,581	33,743,073	0.74	50,009,419	67,741,153	0.74
Process	3,727,361	7,672,172	0.49	19,380,064	39,890,738	0.49
				206,935,814	221,189,738	0.94

Table 22. Program NCP kW Savings by Project Type

Project Type	Sample NCP kW Savings			Population NCP kW Savings		
	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	491	526	0.93	17,339	18,590	0.93
HVAC	4,108	5,206	0.79	10,868	13,773	0.79
Process	411	1,091	0.38	1,904	5,061	0.38
				30,111	37,424	0.80

Table 23. Program CP kW Savings by Project Type

Project Type	Sample CP kW Savings			Population CP kW Savings		
	Evaluated	Expected	RR	Evaluated	Expected	RR
Lighting	416	504	0.82	14,302	17,340	0.82
HVAC	3,476	2,626	1.32	7,720	5,832	1.32
Process	490	1,038	0.47	2,039	4,323	0.47
				24,062	27,495	0.88

A summary of the specific findings from each project are shown in Table 24. See "Appendix F: Site M&V Reports" for more information on each sampled project.

Table 24. Findings Summary

Site Number	Customer	Facility Type	Project Type	Findings and observations
1	[redacted]	Multiple Bank Branch Office	HVAC	Little evidence of HVAC control. Outdoor air dampers shut and non-operable.
2	[redacted]	Manufacturing	HVAC	No demand savings realized
3	[redacted]	Manufacturing	HVAC	Project performed very close to expectations
4	[redacted]	Office	HVAC	Cool roof project – manufacturer's sales tool overestimated savings
5	[redacted]	Manufacturing	Process	Project ineligible – like for like replacement of existing compressor
6	[redacted]	Manufacturing	Process	Controls operating as intended; ex-ante calculations overestimated savings
7	[redacted]	Wastewater	Process	Higher flowrates and less turndown limited savings
8	[redacted]	Warehouse	Lighting	Slight discrepancies between application verified fixture counts
9	[redacted]	Parking Structure	Lighting	Slight discrepancies between application verified fixture counts and wattage
10	[redacted]	TV studio	Lighting	Project performed very close to expectations
11	[redacted]	Parking Structure	Lighting	Project performed very close to expectations
12	[redacted]	Office	Lighting	Lighting operating hours overestimated slightly
13	[redacted]	Service Station	Lighting	Discrepancy in lighting fixture count between application and verified fixture count. Compensated by underestimate of operating hours.
14	[redacted]	Office	HVAC	Verified savings exceed application. VFDs observed to run at low speeds, maximizing savings.
15	[redacted]	Data Center	HVAC	Savings overestimated due to equipment loading and modeling errors
16	[redacted]	Data Center	HVAC	Savings overestimated due to equipment loading and modeling errors
17	[redacted]	Office	HVAC	Project performed very close to expectations
18	[redacted]	Data Center	Process	Pre/post monitoring showed about 50% of expected savings.
19	[redacted]	Office	HVAC	Insulation R-values reduced due to poor installation quality
20	[redacted]	Warehouse	Lighting	Customer also installed occupancy sensors
21	[redacted]	Office	HVAC	Savings overestimated due to partial conditioning of space
22	[redacted]	Office	HVAC	EMS upgrade – not all control actions implemented
23	[redacted]	Office	HVAC	Measures performing as expected. Difference due to calculation technique.
24	[redacted]	Office	HVAC	Operational problems with chilled water plant limited savings.
25	[redacted]	Office	HVAC	Measures working well; monitored data show

				savings in excess of program expectations
26	[redacted]	Hotel	HVAC	Controls appear to be working, but high occupancy rate limits savings.
27	[redacted]	Parking Structure	Lighting	System performs very close to project expectations
28	[redacted]	Water treatment plant	Process	Higher than expected flow rates limit VFD savings
29	[redacted]	Industrial	Process	Baseline kW overestimated; measure kW underestimated. Reduced operating hours and total flow.
30	[redacted]	Office	Lighting	System performs very close to project expectations
31	[redacted]	Retail	Lighting	Verified fixture count less than application
32	[redacted]	Office and Industrial	HVAC	Savings exceeded expectations
33	[redacted]	Grocery	HVAC	Manufacturer overestimated humidification/dehumidification loads
34	[redacted]	Technical College	HVAC	Lower loading observed. Condenser water temperature low limit reduces savings from VFD chiller.
35	[redacted]	Big Box Retail	HVAC	Manufacturer's analysis underestimated HVAC and outdoor air loads.
36	[redacted]	Industrial	Process	Compressed air volume less than application assumption
37	[redacted]	Courthouse	HVAC	Whole building analysis provides greater savings than assumed in application.
38	[redacted]	Police Station	HVAC	Whole building analysis provides greater savings than assumed in application.
39	[redacted]	Assembly	Lighting	Occupancy sensor and photocell controls not operating correctly.
40	[redacted]	Poultry Production	Lighting	Pre fixture watts overestimated; dimmers not included.
41	[redacted]	Warehouse	Lighting	System performs very close to project expectations
42	[redacted]	Retail	HVAC	Application savings based on fixed percent of annual billing kWh; simulations predict additional savings.
43	[redacted]	Industrial	Process	Loading less than application assumption
44	[redacted]	Office	HVAC	Savings exceeded expectations due to increased operating hours and equipment (plug load) usage.

Project Life

An independent assessment of the project life was conducted and compared to the project life estimates prepared by Wisconsin Energy Conservation Corporation[18] (WECC), in consultation with Duke Energy program managers. The WECC project life estimates were used to set incentive levels, and calculate the lifecycle savings and benefits of each project. The project life estimates for each project are shown in Table 25.

[18] WECC is a contractor hired by Duke Energy to assist in program implementation and application review.

Table 25. WECC Project Life Estimates

Site Number	Customer	Facility Type	Project Type	WECC Project Life
1	[redacted]	Multiple Bank Branch Office	HVAC	7.0
2	[redacted]	Manufacturing	HVAC	10.0
3	[redacted]	Manufacturing	HVAC	5.0
4	[redacted]	Office	HVAC	20.0
5	[redacted]	Manufacturing	Process	7.0
6	[redacted]	Manufacturing	Process	7.0
7	[redacted]	Wastewater	Process	10.0
8	[redacted]	Warehouse	Lighting	10.0
9	[redacted]	Parking Structure	Lighting	10.0
10	[redacted]	TV studio	Lighting	7.0
11	[redacted]	Parking Structure	Lighting	7.0
12	[redacted]	Office	Lighting	10.0
13	[redacted]	Service Station	Lighting	12.0
14	[redacted]	Office	HVAC	10.0
15	[redacted]	Data Center	HVAC	15.0
16	[redacted]	Data Center	HVAC	20.0
17	[redacted]	Office	HVAC	10.0
18	[redacted]	Data Center	Process	5.0
19	[redacted]	Office	HVAC	15.0
20	[redacted]	Warehouse	Lighting	10.0
21	[redacted]	Office	HVAC	20.0
22	[redacted]	Office	HVAC	10.0
23	[redacted]	Office	HVAC	7.0
24	[redacted]	Office	HVAC	10.0
25	[redacted]	Office	HVAC	7.0
26	[redacted]	Hotel	HVAC	10.0
27	[redacted]	Parking Structure	Lighting	10.0
28	[redacted]	Water treatment plant	Process	15.0
29	[redacted]	Industrial	Process	20.0
30	[redacted]	Office	Lighting	10.0
31	[redacted]	Retail	Lighting	10.0
32	[redacted]	Office and Industrial	HVAC	7.0
33	[redacted]	Grocery	HVAC	15.0
34	[redacted]	Technical College	HVAC	15.0
35	[redacted]	Big Box Retail	HVAC	10.0

Site Number	Customer	Facility Type	Project Type	WECC Project Life
36	[redacted]	Industrial	Process	20.0
37	[redacted]	Courthouse	HVAC	7.0
38	[redacted]	Police Station	HVAC	20.0
39	[redacted]	Assembly	Lighting	10.0
40	[redacted]	Poultry Production	Lighting	5.0
41	[redacted]	Warehouse	Lighting	10.0
42	[redacted]	Retail	HVAC	7.0
43	[redacted]	Industrial	Process	15.0
44	[redacted]	Office	HVAC	20.0

An independent assessment of the project life was conducted by examining the measures making up each project and assigning an effective useful life (EUL) to each measure. EUL estimates were obtained from the California Database for Energy Efficiency Resources (DEER) EUL table, the Ohio Technical Reference Manual (TRM) or California IOU workpapers. A project level EUL was calculated as the kWh savings weighted average of the measure EULs. The results of this assessment are shown in Table 26.

Table 26. Evaluated Project Life Estimates

Site Number	Customer	Facility Type	Project Type	Measures	EUL	Wt	Wt EUL	Source
1	[redacted]	Multiple Bank Branch Office	HVAC	HVAC - Miscellaneous - Energy Management System	15	60.1%	12.2	DEER, Energy Management System
				Indoor Lighting - Timeclocks	8	39.9%		DEER, Time Clock
2	[redacted]	Manufacturing	HVAC	HVAC - Miscellaneous - VSD Supply Fan Motors	15	100.0%	15.0	Ohio TRM
3	[redacted]	Manufacturing	HVAC	HVAC - Miscellaneous - VSD Supply Fan Motors	15	100.0%	15.0	DEER, VFD Supply Fan Motor
4	[redacted]	Office	HVAC	Building Envelope - Cool Roof	15	100.0%	15.0	DEER, Cool Roof
5	[redacted]	Manufacturing	Process	Air compressors	15	100.0%	15.0	Ohio TRM
6	[redacted]	Manufacturing	Process	HVAC - Miscellaneous - Energy Management System	15	100.0%	15.0	DEER, Energy Management System
7	[redacted]	Wastewater	Process	HVAC - Other Central Plant - Variable Flow Water Loop, VSD Pump	15	100.0%	15.0	DEER, VSD Pump
8	[redacted]	Warehouse	Lighting	Indoor Lighting - Linear Fluorescents	15	100.0%	15.0	Ohio TRM
9	[redacted]	Parking Structure	Lighting	Indoor Lighting - LED	16	100.0%	16.0	2006 PG&E Workpaper
10	[redacted]	TV studio	Lighting	Indoor Lighting - Linear Fluorescents	15	100.0%	15.0	Ohio TRM
11	[redacted]	Parking Structure	Lighting	Indoor Lighting - Linear Fluorescents	15	100.0%	15.0	Ohio TRM
12	[redacted]	Office	Lighting	Indoor Lighting - Linear Fluorescents	15	100.0%	15.0	Ohio TRM
13	[redacted]	Service Station	Lighting	Outdoor Lighting - LED	16	100.0%	16.0	2006 PG&E Workpaper
14	[redacted]	Office	HVAC	High-Efficiency Chillers	20	100.0%	20.0	DEER, Chiller

Site Number	Customer	Facility Type	Project Type	Measures	EUL	Wt	Wt EUL	Source
	[redacted]							
15	[redacted]	Data Center	HVAC	Whole Building	10	100.0%	20.0	DEER, Chiller and Building Envelope
16	[redacted]	Data Center	HVAC	Whole Building	10	100.0%	20.0	DEER, Chiller and Building Envelope
17	[redacted]	Office	HVAC	HVAC - Miscellaneous - Duct Sealing - Single Zone Package System	18	3.6%	9.1	DEER, Duct Sealing
				HVAC - Miscellaneous - Energy Management System	15	10.4%		DEER, Energy Management System
				Indoor Lighting - Timeclocks	8	86.0%		DEER, Time Clock
18	[redacted]	Data Center	Process	HVAC - Miscellaneous - Energy Management System	4	100.0%	4.0	Server life 2-5 yr
19	[redacted]	Office	HVAC	Building Envelope - Roof/Ceiling Insulation	20	90.0%	19.8	DEER, Roof Insulation
				HVAC - Miscellaneous - Duct Sealing - Single Zone Package System	18	10.0%		DEER, Duct Sealing
20	[redacted]	Warehouse	Lighting	Indoor Lighting - Linear Fluorescents	15	100.0%	15.0	Ohio TRM
21	[redacted]	Office	HVAC	Building Envelope - Roof/Ceiling Insulation	20	100.0%	20.0	DEER, Roof Insulation
22	[redacted]	Office	HVAC	HVAC - Miscellaneous - VSD Supply Fan Motors	15	15.0%	15.0	DEER, VFD Supply Fan Motor
			HVAC	HVAC - Other Central Plant - Variable Flow Water Loop, VSD Pump	15	35.0%		DEER, VSD Pump
			HVAC	HVAC - Miscellaneous - Energy Management System	15	50.0%		DEER, Energy Management System
23	[redacted]	Office	HVAC	HVAC - Miscellaneous - Energy Management System	15	100.0%	15.0	DEER, Energy Management System
24	[redacted]	Office	HVAC	HVAC - Other Central	15	100.0%	15.0	DEER, VSD Pump

Site Number	Customer	Facility Type	Project Type	Measures	EUL	Wt	Wt EUL	Source
	[redacted]			Plant - Variable Flow Water Loop, VSD Pump				
25	[redacted]	Office	HVAC	HVAC - Other Central Plant - Variable Flow Water Loop, VSD Pump	15	21.6%	15.0	DEER, VSD Pump
				HVAC - Miscellaneous - VSD Supply Fan Motors	15	78.4%		DEER, VFD Supply Fan Motor
26	[redacted]	Hotel	HVAC	HVAC - Miscellaneous - Energy Management System	15	100.0%	15.0	DEER, Energy Management System
27	[redacted]	Parking Structure	Lighting	Indoor Lighting - Induction	16	100.0%	16.0	PG&E 2006 Workpaper
28	[redacted]	Water treatment plant	Process	HVAC - Other Central Plant - Variable Flow Water Loop, VSD Pump	15	100.0%	15.0	DEER, VSD Pump
29	[redacted]	Industrial	Process	Air compressors	15	100.0%	15.0	Ohio TRM
30	[redacted]	Office	Lighting	Indoor Lighting - Linear Fluorescents	15	80.8%	14.4	Ohio TRM
				Indoor Lighting - CFL Lighting	12	19.2%		DEER, CFL Fixture
31	[redacted]	Retail	Lighting	Indoor Lighting - Linear Fluorescents	15	100.0%	15.0	Ohio TRM
32	[redacted]	Office and Industrial	HVAC	HVAC - Miscellaneous - Energy Management System	15	100.0%	15.0	DEER, Energy Management System
33	[redacted]	Grocery	HVAC	HVAC - Split/Package - Air Conditioners/Heat Pumps (split and unitary)	15	74.4%	15.0	DEER, AC and Heat Pump
				Refrigeration - High Efficiency Evaporator Fan Motors	15	25.6%		DEER, Evaporator Fan Motor
34	[redacted]	Technical College	HVAC	HVAC - Miscellaneous - VSD Supply Fan Motors	15	100.0%	15.0	DEER, VFD Supply Fan Motor
35	[redacted]	Big Box Retail	HVAC	HVAC - Miscellaneous - Reducing Overventilation	10	100.0%	10.0	DEER, Reduce ventilation
36	[redacted]	Industrial	Process	Air compressors	15	100.0%	15.0	Ohio TRM

Site Number	Customer	Facility Type	Project Type	Measures	EUL	Wt	Wt EUL	Source
37	[redacted]	Courthouse	HVAC	HVAC - Miscellaneous - Energy Management System	15	100.0%	15.0	DEER, Energy Management System
38	[redacted]	Police Station	HVAC	Building Envelope - Roof/Ceiling Insulation	20	10.0%	15.5	DEER, Roof Insulation
				HVAC - Split/Package - Air Conditioners/Heat Pumps (split and unitary)	15	30.0%		DEER, AC and Heat Pump
				Indoor Lighting - Linear Fluorescents	15	60.0%		Ohio TRM
39	[redacted]	Assembly	Lighting	Indoor Lighting - Induction	16	4.4%	15.3	PG&E 2006 Workpaper
				Indoor Lighting - LED	16	22.3%		PG&E 2006 Workpaper
				Indoor Lighting - Linear Fluorescents	*15*	73.3%		*Ohio TRM*
40	[redacted]	Poultry Production	Lighting	Indoor Lighting - LED	16	100.0%	16.0	PG&E 2006 Workpaper
41	[redacted]	Warehouse	Lighting	Indoor Lighting - Linear Fluorescents	15	100.0%	15.0	Ohio TRM
42	[redacted]	Retail	HVAC	HVAC - Miscellaneous - Energy Management System	15	100.0%	15.0	DEER, Energy Management System
43	[redacted]	Industrial	Process	Air compressors	15	100.0%	15.0	Ohio TRM
44	[redacted]	Office	HVAC	Whole Building	20	100.0%	20.0	DEER, Chiller and Building Envelope

The WECC estimated project life and the independent project life estimates were weighted by the expected kWh savings and the evaluated kWh savings respectively, and a weighted average project life was calculated for each project type. The realization rate on project life was calculated as the ratio of the evaluated EUL to the WECC project life estimate. These results are shown in Table 27.

Table 27. Summary of Project Life Estimates by Project Type

Project Type	WECC Project Life	Evaluated EUL	Realization Rate
Lighting	9.5	15.2	1.60
HVAC	16.0	16.5	1.03
Process	9.6	9.6	1.00

Note, the evaluated project life estimates for Lighting projects were 60%, higher than the WECC estimates, indicating WECC and Duke Energy used a conservative approach to establishing project lifetimes for lighting projects. EUL estimates for HVAC and process projects were very close.

Appendix A: Program Manager Interview Protocol

Name: ____

Title: ____

Position description and general responsibilities:

____

____

____

We are conducting this interview to obtain your opinions about and experiences with the Non Residential Smart $aver® Custom program. We'll talk about the Smart $aver® Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The purpose of this study is to capture the program's current operations as well as help identify areas where the program might be improved. Your responses will feed into a report that will be shared with Duke Energy and the state regulatory agency. I want to assure you that the information you share with me will be kept confidential; we will not identify you by name. However, you may provide some information or opinions that could be attributed to you by virtue of your position and role in this program. If there is sensitive information you wish to share, please warn me and we can discuss how best to include that information in the report.

The interview will take about an hour to complete. Do you have any questions for me before we begin?

Program Background and Objectives

1. Please describe your role and scope of responsibility in detail.

2. How long have you been involved with the Smart $aver program?

3. (PM only) Describe the evolution of the Smart $aver® Program. Why was the program created, and has the program changed since it was it first started?

4. Have there been any recent changes been made to your duties since you started?

    a. If YES, please tell us what changes were made and why they were made. What are the results of the change?

5. In your own words, please describe the Smart $aver® Program's objectives. (e.g. enrollment, energy savings, non-energy benefits)

6. (PM only) Can you please walk me through the program's implementation, starting with how the program is marketed and how you target your customers, through how the customer participates and finishing with how savings are verified?

    a. Marketing/Targeting: How & Who

    b. Enrollment/Participation

    c. Rebate processing

    d. Savings verification: How & Who

7. Of the program objectives you mentioned earlier, do you feel any of them will be particularly easy to meet, and why?

8. Which program objectives, if any, do you feel will be relatively difficult to meet, and why?

9. Are there any objectives you feel should be revised prior to the end of this program cycle? If yes, why?

Vendors

10. (PM only) Do you use any vendors or contractors to help implement the program?

    a. What responsibilities do they have?

    b. Are there any areas in which think they can improve their services?

11. *(If not captured earlier)* Please explain how activities of the program's vendors, customers and Duke Energy are coordinated.

    a. Do you think methods for coordination should be changed in any way? If so, how and why?

Rebates

12. (PM only) How do you determine which pieces of equipment are included in the program? For example, how do you determine what level of efficiency the rebated equipment should have?

    a. Do you use any outside vendors or experts to help with this process?

    b. What should be changed about this selection process?

13. Describe your quality control and process for tracking participants, rebates, and other program data.

14. Do you believe that the program currently offers rebates on enough energy efficient products to meet your customers' needs?

    a. If not, what products would you like to add? Are these currently being considered?

15. Is the program offering enough of a rebate to motivate your customers to participate?

    a. If not, which rebates do you think should be changed, and why?

Contractor Training

16. Describe Smart $aver®'s contractor program orientation training and development approach.

    a. (PM and WECC only) How do you ensure that contractors are getting adequate program training and updated program information?

    b. Can we obtain training materials that are being used?

    c. Are there any new areas where you think contractors could be trained?

17. Do you have any suggestions for improving contractor effectiveness?

Improvements

18. Are you currently considering any changes to the program's design or implementation?

    a. What are the changes?

    b. What is the process for deciding whether or not to make these changes?

19. Do you have suggestions for improvements to the program that would increase participation rates, or is Duke Energy happy with the current level of participation?

20. Do you have suggestions for increasing energy impacts *per participant*, given the same participation rates, or is Duke Energy happy with the current per participant impact?

21. Overall, what would you say about the Smart $aver® program is working really well?

    a. Is there anything in this program you could highlight as a best practice that other utilities might like to adopt?

22. What area needs the most improvement, if any?

    a. (If not mentioned before) What would you suggest can be done to improve this?

23. Are there any other issues or topics we haven't discussed that you feel should be included in this report?

24. Do you have any further questions for me about this study or anything else?

Appendix B: Participant Interview Guide

Name ____

Company____

Title____

1. What does your company do, and what is your role within your company?

2. Our records indicate that you participated in the Smart Saver Custom Program. Do you recall participating in this program?

3. Please tell me what you remember about this project: How long did it take? Why did you decide to take on the project at that time, rather than sooner or later? If not complete, what is its status now?

4. How did you first hear about the Smart $aver Residential Program?

5. At the time you were learning about the program did you have to do any additional investigation about the program's requirements and benefits before you could make a decision to participate? What did you do?

6. Have you submitted other applications in the past, to either the Smart $aver Custom or Prescriptive programs?

7. If yes, what information did you need, and where did you obtain that information?

8. I would like to know what reasons factored into your decision to purchase or upgrade your equipment? I will read a list of reasons to you, and please tell me whether or not it factored into your decision-making process.

    a. Remodeling
    b. Cost of repair or maintenance of old unit(s)
    c. Parts availability
    d. Reliability issues of old equipment
    e. Equipment was near or past its projected life• Equipment failure
    f. Poor performance of old equipment
    g. Contractor recommendation
    h. Energy or energy cost Savings
    i. Environmental concerns
    j. Got a good deal
    k. Needed more modern, smarter equipment (energy manager systems integration or SmartGrid compatible)"

9. (If Closed Lost and went ahead with the project) Did you install the same equipment that was listed in your Smart $aver application? If not, what did you use?

   a. Why did you choose that piece of equipment?

10. Who filled out the program application forms for your company?

11. Did you have any problems receiving the incentive or having the application approved?

    a. How was the problem resolved?

12. When firms have experience with energy efficiency programs or products they sometimes make similar decisions to continue the energy savings in other parts of their business. Has your firm taken advantage of any other Duke Energy's energy efficiency programs as a result of your participation in the Smart Saver Custom program?

    a. Which programs?

13. As a result of your participation in Duke energy's Smart $aver Custom program, have you made any other electric energy efficiency improvements that do not qualify for any kind of any incentive or rebate, whether from Duke or state or federal sources?

    a. What did you do?

14. One of the objectives that the program would like to see over the next year is increased participation of businesses like yours. Can you think of things that the program can do to help increase participation or help increase interest from companies like yours?

15. At any time during your application process, did you need to contact Duke Energy to obtain information, or ask about the progress on the application, or obtain any other help, assistance or information? If yes, what was the issue and how was it resolved?

16. Overall, what about the Smart $aver Program is working well, if anything? And, why?

17. What would you say is NOT working well about the Smart $aver program? What could be done to improve this?

Please rate on a scale of 1 to 10, where 1 indicates "very dissatisfied" and 10 indicates "very satisfied":

18. The incentive levels provided by the program

    1 2 3 4 5 6 7 8 9 10
    If score is 8 or less ask: What could have been done to make this better?
    ____

19. The ease of filling out the participation and incentive forms

    1 2 3 4 5 6 7 8 9 10
    If score is 8 or less ask: What could have been done to make this better?
    ____

20. The time it took for you to receive your incentive

    1 2 3 4 5 6 7 8 9 10
    If score is 8 or less ask: What could have been done to make this better?

    ____

21. The technical expertise of Duke Energy staff

    1 2 3 4 5 6 7 8 9 10
    If score is 8 or less ask: What could have been done to make this better?

    ____

22. The information you were provided explaining the program

    1 2 3 4 5 6 7 8 9 10
    If score is 8 or less ask: What could have been done to make this better?

    ____

23. Considering all aspects of the program, how would you rate your overall satisfaction with the Smart Saver Custom Program?

    1 2 3 4 5 6 7 8 9 10

    If score is 8 or less ask: What could have been done to make your experience better, or have we already covered it?

24. Considering all aspects of the program, how would you rate your overall satisfaction with Duke Energy?

    1 2 3 4 5 6 7 8 9 10
    If score is 8 or less ask: What could have been done to make your application experience better, or have we already covered it?

    ____

Appendix C: Process Evaluation Sample Disposition

Completed Survey	41
No Answer	28
Duplicate Contact	14
Scheduled Interview, Did Not Complete Survey	14
Appropriate Contact Could Not Be Identified	11
Not Contacted, No Number Available	10
Overscheduled, Canceled	6
Refusal, Lack Of Time	6
Wrong Number Provided	3
Contacted, Failed To Schedule Survey	2
Not Reached Due To Quota Being Met	1
Refusal, Company Policy Against Surveys	1
Unsuccessful Referral	1
Voice Mail Full	1
Total	139

Appendix D: Required Savings Tables

	Project	Facility Type	Ex Ante kWh Savings	Ex Ante NCP kW Savings	Ex Ante CP kW Savings
1	[redacted]	Multiple Bank Branch Office	1,161,979	319	104
2	[redacted]	Manufacturing	507,450	107	95
3	[redacted]	Manufacturing	214,596	35	36
4	[redacted]	Office	38,108	15	13
5	[redacted]	Manufacturing	782,308	134	131
6	[redacted]	Manufacturing	1,630,774	343	306
7	[redacted]	Wastewater	637,882	73	119
8	[redacted]	Warehouse	944,175	108	108
9	[redacted]	Parking Structure	634,479	72	72
10	[redacted]	TV studio	298,686	54	47
11	[redacted]	Parking Structure	89,241	25	25
12	[redacted]	Office	53,538	15	0
13	[redacted]	Service Station	27,505	0	0
14	[redacted]	Office	217,763	54	34
15	[redacted]	Data Center	11,460,000	1,840	949
16	[redacted]	Data Center	10,300,000	900	293
17	[redacted]	Office	1,326,557	121	121
18	[redacted]	Data Center	2,325,225	265	266
19	[redacted]	Office	32,237	7	6
20	[redacted]	Warehouse	1,530,886	175	175
21	[redacted]	Office	318,009	117	0
22	[redacted]	Office	307,821	15	10
23	[redacted]	Office	188,251	35	29
24	[redacted]	Office	3,895,980	841	555
25	[redacted]	Office	368,392	105	57
26	[redacted]	Hotel	231,779	1	1
27	[redacted]	Parking Structure	56,659	6	6
28	[redacted]	Water treatment plant	929,177	106	106
29	[redacted]	Industrial	408,652	55	51
30	[redacted]	Office	44,110	0	0
31	[redacted]	Retail	59,876	11	11
32	[redacted]	Office and Industrial	600,449	144	40
33	[redacted]	Grocery	320,792	101	49
34	[redacted]	Technical College	257,170	70	52
35	[redacted]	Big Box Retail	944,175	108	108
36	[redacted]	Industrial	804,345	92	36
37	[redacted]	Courthouse	542,970	101	0
38	[redacted]	Police Station	72,311	40	11
39	[redacted]	Assembly	108,439	7	7
40	[redacted]	Poultry Production	165,885	32	32
41	[redacted]	Warehouse	182,003	21	21
42	[redacted]	Retail	61,269	20	10

	Project	Facility Type	Ex Ante kWh Savings	Ex Ante NCP kW Savings	Ex Ante CP kW Savings
43	[redacted]	Industrial	153,809	23	23
44	[redacted]	Office	375,015	110	53

Table 28. Evaluated Savings Estimate Breakdown by Customer

	Customer	Facility Type	kWh	NCP kW[19]	CP kW[20]	MMBtu[21]
1	[redacted]	Multiple Bank Branch Office	248,891	54.0	8.7	N/A
2	[redacted]	Manufacturing	1,234,631	-5.0	-5.0	N/A
3	[redacted]	Manufacturing	208,279	23.0	23.0	N/A
4	[redacted]	Office	16,253	29.5	29.5	N/A
5	[redacted]	Manufacturing	0	0.0	0.0	N/A
6	[redacted]	Manufacturing	118,688	0.0	0.0	N/A
7	[redacted]	Wastewater	156,666	31.0	77.0	N/A
8	[redacted]	Warehouse	1,645,455	62.0	87.4	N/A
9	[redacted]	Parking Structure	699,285	80.0	80.0	N/A
10	[redacted]	TV studio	241,512	43.0	45.0	N/A
11	[redacted]	Parking Structure	91,980	25.0	25.0	N/A
12	[redacted]	Office	51,642	16.0	16.0	N/A
13	[redacted]	Service Station	36,695	6.8	0.0	N/A
14	[redacted]	Office	416,346	47.0	47.0	N/A
15	[redacted]	Data Center	5,293,436	276.0	284.0	N/A
16	[redacted]	Data Center	3,065,196	580.0	543.0	N/A
17	[redacted]	Office	791,017	-125.0	-45.9	N/A
18	[redacted]	Data Center	1,895,128	216.3	216.3	N/A
19	[redacted]	Office	6,347	23.3	-1.8	N/A
20	[redacted]	Warehouse	1,759,560	170.0	103.5	N/A
21	[redacted]	Office	35,606	0.9	0.0	N/A
22	[redacted]	Office	151,374	7.9	-48.8	N/A
23	[redacted]	Office	119,013	-2.0	-0.7	N/A
24	[redacted]	Office	4,072,566	719.0	684.0	N/A
25	[redacted]	Office	3,229,589	1001.0	548.0	N/A
26	[redacted]	Hotel	42,591	15.4	7.4	N/A
27	[redacted]	Parking Structure	56,965	6.6	6.5	N/A
28	[redacted]	Water treatment plant	949,380	202.0	202.0	N/A
29	[redacted]	Industrial	87,808	-42.5	-24.6	N/A
30	[redacted]	Office	43,960	11.3	0.0	N/A
31	[redacted]	Retail	54,103	12.8	12.7	N/A
32	[redacted]	Office and Industrial	2,747,160	30.2	30.2	N/A

[19] NCP kW is an abbreviation for non-coincident peak kW
[20] CP kW is an abbreviation for coincident peak kW
[21] The study evaluated electricity savings only.

	Customer	Facility Type	kWh	NCP kW[19]	CP kW[20]	MMBtu [21]
33	[redacted]	Grocery	33,039	9.4	9.0	N/A
34	[redacted]	Technical College	18,148	217.0	189.0	N/A
35	[redacted]	Big Box Retail	854,373	933.0	933.0	N/A
36	[redacted]	Industrial	375,910	-10.7	2.3	N/A
37	[redacted]	Courthouse	1,414,900	79.0	74.0	N/A
38	[redacted]	Police Station	102,530	-6.4	21.0	N/A
39	[redacted]	Assembly	70,907	14.0	6.3	N/A
40	[redacted]	Poultry Production	147,130	18.2	8.7	N/A
41	[redacted]	Warehouse	182,561	24.9	24.6	N/A
42	[redacted]	Retail	148,845	5.6	-4.4	N/A
43	[redacted]	Industrial	143,781	14.4	16.6	N/A
44	[redacted]	Office	660,451	156.9	151.9	N/A

Appendix E: Duke Energy Response to Docket No. E-7, Sub 1031, Order Item #6

In its recent Order in Docket No. E-7, Sub 1031, the North Carolina Utilities Commission directed Duke Energy Carolinas ("DEC") to explain the significant reduction in measure savings in the Non-Residential Smart $aver Custom Rebate Program ("Program") in this report. This directive is in response to the apparent erosion in the calculated per participant kWh impact filed in Docket No. E-7, Sub 979 and Docket No. E-7, Sub 1031. The projected number of program participants in docket E-7 sub 979, showed 1,518 participants with an average of 11,571.5 kWh/participant, which reflected larger projects per program participant. The projection was based on historical data for the Program. The true-up results filed in Docket No. E-7 ,Sub 1031 reflect 67,339 participants in the Program with an average of 1,683.7 kWh/participant reflecting a larger number of program participants with smaller projects and therefore lower impacts per participant. The 665 GWh reflects what the program would have lost due to the kWh/participant reduction if the projected number of participants in the true-up was the same as in docket E-7 sub 979.

The impacts and program participation filed in Docket No. E-7, Sub 979 were based on historical program data at the time of filing. Over time, the Program has seen a large increase in the number of applications and a change in the type of applicants. While larger customers continue to participate in the program, small and medium customers have also submitted applications more frequently over time. Some program changes that were implemented after being identified in past EM&V process evaluations have made it easier for customers to apply for smaller projects. Additionally, the types of measures installed by those participants has changed over time. In some cases, one participant may be one whole building or one entire system. In other cases, one participant may be one fixture or one piece of equipment. In years when there are more projects installed that involve the latter, there will be a larger number of participants and a lower kWh/participant reflected overall.

The variance due to changes in impacts, measure mix, and participation may be useful metrics for programs that do not have a variation in kWh/participant, but may not be appropriate for the custom program where the size and types of projects vary from year to year. The important metric for the custom program is the overall kWh savings increase.

Appendix F: Site M&V Reports

To reduce the overall file size, the individual site M&V reports are not included in this version of the report.