GUNSTER
FLORIDA'S LAW FIRM FOR BUSINESS

Writer's Direct Dial Number: (850) 521-1706
Writer's E-Mail Address:
bkeating@gunster.com

April 2, 2024

BY E-PORTAL

Mr. Adam Teitzman
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

Re: **Docket No. 20240015-EG: Commission review of numeric conservation goals (Florida Public Utilities Company).**

Dear Mr. Teitzman:

Attached for filing, please find Florida Public Utilities Company's Petition for Approval of Numeric Conservation Goals, along with the supporting testimonies and exhibits of the following on behalf of the Company:

Testimony	Exhibits
Derrick M. Craig – Florida Public Utilities Company	DMC-1, DMC-2, DMC-3 and DMC-4
Michael Ty Clark- Christensen Associates Energy Consulting, LLC for *FPUC*	MTC-1 and MTC-2
Jim Herndon, Resource Innovations, Inc. for *FPUC* (Joint Witness)	JH-1 through JH-16

Thank you for your assistance with this filing. As always, please don't hesitate to let me know if you have any questions whatsoever.

Sincerely,

Beth Keating

Beth Keating
Gunster, Yoakley & Stewart, P.A.
215 South Monroe St., Suite 601
Tallahassee, FL 32301
(850) 521-1706

MEK
cc:/(Service List)

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Commission review of numeric conservation goals (Florida Public Utilities Company).	) Docket No. 20240015-EG)) Filed: April 2, 2024)

PETITION FOR APPROVAL OF
NUMERIC CONSERVATION GOALS
BY FLORIDA PUBLIC UTILITIES COMPANY

Pursuant to Sections 366.82, Florida Statutes, and Rules 25-17.001, 25-17.0021, Florida Administrative Code, Florida Public Utilities Company ("FPUC" or "the Company"), by and through its undersigned attorneys, files this petition addressing the Company's proposed numeric conservation goals and asks that the Florida Public Service Commission ("Commission") accept and approve FPUC's proposal for the period 2025 through 2034. In further support of this Petition, FPUC states:

1. The Company is a public utility, subject to jurisdiction of the Florida Public Service Commission ("Commission") in accordance with Chapter 366, Florida Statutes. The Company's principal offices are located at:

Florida Public Utilities Company
208 Wildlight Ave
Yulee, Florida 32097

2. The name and mailing address of the persons authorized to receive notices and pleadings are:

Beth Keating Gunster Law Firm 215 S. Monroe Street, Suite 601 Tallahassee, FL 32301-1804 (850) 521-1706 bkeating@gunster.com	Mike Cassel, Vice President/Governmental and Regulatory Affairs Florida Public Utilities Company/Chesapeake 208 Wildlight Ave Yulee, Florida 32097 mcassel@fpuc.com

3. The Commission is vested with jurisdiction in this matter in accordance with Section 366.82, Florida Statutes, part of the Florida Energy Efficiency and Conservation Act ("FEECA"), Section 366.80 *et seq.*, Florida Statutes, pursuant to which the Commission is required to adopt appropriate goals designed to increase the efficiency of energy consumption and the development of demand-side renewable energy systems and resources, increase the conservation of expensive resources, such as petroleum fuels, reduce and control the growth rates of electric consumption, and reduce the growth rates of weather-sensitive peak demand.[1]

4. The Company is unaware of any material facts in dispute at this time, but the proceeding may involve disputed issues of material fact. The Company's request does not involve reversal or modification of a Commission decision or proposed agency action. This is instead a Petition representing an initial request to the Commission, which is the affected agency located at 2540 Shumard Oak Boulevard, Tallahassee, Florida 32399.

5. The instant docket is one of six dockets opened by the Commission to establish numeric conservation goals for the electric utilities subject to FEECA. These dockets have been consolidated for purposes of hearing as set forth in the Order Consolidating Dockets and Establishing Procedure, Order No. PSC-2024-0012-PHO-EG, ("OEP") issued January 24, 2024, in each of the respective utility dockets.[2] This Petition, as well as the accompanying testimonies and exhibits of Michael T. Clark, Derrick M. Craig, and Jim Herndon on behalf of FPUC, are submitted in compliance with that OEP.

6. As result of FPUC's analysis and the studies performed by Witness Herndon and Resource Innovations, Inc., the Company respectfully proposes that approval of the following conservation goals for FPUC would be consistent with Section 366.82, Florida Statutes:

---

[1] s. 366.82(2), F.S.

[2] Dockets Nos. 20240012-EG (FPL);20240013-EG (Duke); 20240017-EG (Orlando Utilities); 20240016 –EG JEA);

Year	Residential			Commercial/Industrial		
	Summer MW	Winter MW	Annual MWh	Summer MW	Winter MW	Annual MWh
2025	.05	.15	365	02	02	100
2026	.05	.15	377	.02	.02	129
2027	.06	.16	390	.03	.02	163
2028	.06	.16	401	.03	.03	198
2029	.07	.16	407	.04	.03	233
2030	.07	.15	406	.04	.04	264
2031	.07	.15	396	.04	.04	287
2032	.06	.15	380	.04	.04	300
2033	.05	.14	361	.05	.04	301
2034	.04	.14	345	.04	.04	294

7. As noted, FPUC is filing, contemporaneously with this Petition, the Direct Testimony and Exhibits of Michael T. Clark, who describes the development of the avoided cost inputs utilized in the studies of technical, economic, and achievable potential for cost-effective energy efficiency measures conducted for FPUC. FPUC is also co-sponsoring the testimony and exhibits of Resource Innovations, Inc. ("RI") witness Jim Herndon, which is also incorporated in this filing. Witness Herndon introduces and summarizes the methodology and findings of the Market Potential Studies that RI conducted for each of the six FEECA utilities. FPUC is also

---

and 20240014-EG (TECO).

submitting the Testimony of Derrick M. Craig, who provides a historical perspective on FPUC's approach to conservation and demand-side management (DSM) programs, describes FPUC's evaluation process and the rationale behind FPUC's proposed DSM goals for the next 10-year cycle, along with an overview of the Company's existing conservation programs and changes the Company is contemplating in concert with the proposed new goals.

8. As reflected in the testimony and exhibits of Witnesses Clark, Herndon, and Craig, FPUC's proposed goals for the 10-year period 2025 through the end of 2034 are reasonable and consistent with the requirements of Section 366.82, Florida Statutes, and Rule 25-17.0021, Florida Administrative Code.

WHEREFORE, FPUC respectfully requests that the Commission enter an Order approving the Company's proposed numeric conservation goals as set forth herein for the period 2025 through 2034 and direct the Company to submit its demand-side management plan consistent with such goals.

RESPECTFULLY SUBMITTED this 2nd day of April, 2024.

Beth Keating
Gunster, Yoakley & Stewart, P.A.
215 S. Monroe Street, Suite 601
Tallahassee, FL 32301-1804
(850) 521-1706
bkeating@gunster.com
Attorneys for Florida Public Utilities Company

CERTIFICATE OF SERVICE

I hereby certify that true and correct copies of the foregoing Petition for Approval of Numeric Conservation Goals for Florida Public Utilities Company, filed in the referenced docket, have been served by Electronic Mail this 2nd day of April, 2024, upon the following:

Jacob Imig Jonathan Rubottom Florida Public Service Commission 2540 Shumard Oak Boulevard Tallahassee, FL 32399-0850 jimig@psc.state.fl.us jrubotto@psc.state.fl.us	Walter Trierweiler/ Patricia Christensen Office of Public Counsel c/o The Florida Legislature 111 W. Madison Street, Room 812 Tallahassee, FL 32399-1400 Trierweiler.walt@leg.state.fl.us Christensen.patty@leg.state.fl.us
Erik L. Sayler Florida Department of Agriculture and Consumer Services The Mayo Building 407 S. Calhoun Street, Suite 520 Tallahassee FL 32399 erik.sayler@FDACS.gov	Stephanie U. Eaton Spilman Thomas & Battle, PLLC 110 Oakwood Drive, Suite 500 Winston-Salem NC 27103 (336) 631-1062 (336) 725-4476 seaton@spilmanlaw.com

By: Beth Keating

Beth Keating
Gunster, Yoakley & Stewart, P.A.
215 South Monroe St., Suite 601
Tallahassee, FL 32301
(850) 521-1706

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 20240015-EG - In re: Commission review of numeric conservation goals (Florida Public Utilities Company).

DIRECT TESTIMONY OF DERRICK M. CRAIG

On behalf of Florida Public Utilities Company

I. Introduction

Q. Please state your name, occupation and business address.

A. My name is Derrick M. Craig. I am the Manager of Energy Conservation for Florida Public Utilities Company (FPUC). My business address is 208 Wildlight Avenue, Yulee, FL 32097.

Q. Describe briefly your educational background and professional experience?

A. I graduated from the Georgia Institute of Technology in 1991 with a Bachelor's degree of Electrical Engineering, and I obtained a Masters of Business Administration in 1997 from the Darden Graduate School of Business (the University of Virginia). I have worked in various engineering and financial analysis roles for several utilities, including Baltimore Gas and Electric, Oglethorpe Power Company and Southern Company. I have been employed with FPUC since 2019, where I started my career as a Regulatory Analyst before being promoted to Energy Conservation Manager in 2021.

Q. What is the purpose of your testimony in this docket?

A. The purpose of my testimony is to (1) discuss FPUC's commitment to energy conservation and demand-side management (DSM), both historically and presently; (2) describe the comprehensive methodology used in assessing

FPUC's forthcoming DSM objectives for the upcoming 10-year period; and (3) elucidate FPUC's proposed DSM goals along with its strategy for conservation programs.

Q. Are there any exhibits that you wish to sponsor in this proceeding?

A. Yes. I am sponsoring the following exhibits: Exhibit No. __[DMC-1] is a copy of my curriculum vitae; Exhibit No. _____ [DMC-1] is a listing of FPUC's current DSM and Conservation Programs; Exhibit No. ____ [DMC-3] is a summary of the historical participation rates in FPUC's current, approved DSM programs, and Exhibit No.___[DMC-4] is a table reflecting the FPUC's current goals as established in Docket No. 20190017-EG.

Q. Please describe FPUC's service territories and the customers it serves.

A. In this context, FPUC operates as an electric utility subject to the Commission's jurisdiction under Chapter 366, Florida Statutes. With an electric customer base of just over 33,000, FPUC provides electric distribution services in two distinct, non-contiguous service territories known as the Northeast Division and the Northwest Division. The Northeast Division serves approximately 18,000 customers on Amelia Island, including the City of Fernandina Beach, while the Northwest Division serves approximately 15,000 customers in the City of Marianna and adjacent areas, encompassing portions of Calhoun, Jackson, and Liberty counties in Florida's panhandle region. FPUC primarily serves residential customers across the two divisions, although it does serve some commercial and industrial customers.

II. Historical Context for FPUC's Goals and Plan

Q. What are FPUC's current Conservation Goals based upon?

A. FPUC's current goals, consistent with Order No. PSC-2019-0509-FOF-EG, are based upon the continuation of the goals set for FPUC in Docket No. 20130205-EI using a proxy methodology.

Q. Is there an impact to FPUC's DSM programs associated with building code changes and appliance efficiency improvements?

A. Yes. As noted later in my testimony and in the testimony of Witness Herndon, there is a notable impact. As building codes apply heightened standards and appliances become more and more efficient, it becomes more difficult to design programs that effectively achieve improved efficiency levels while still demonstrating savings in the required timeframe.

Q. Please describe the evolution of FPUC's DSM Plan and its current DSM programs.

A. The Commission initially established conservation goals for FPUC in 1996, concentrating on cost-effective conservation programs evaluated under the Ratepayer Impact Measure (RIM) and Participant Tests.

In 2008, FPUC joined forces with other Florida utilities subject to the requirements of the Florida Energy Efficiency and Conservation Act (FEECA), Sections 366.80 et seq., Florida Statutes, collectively referred to as FEECA utilities. They collaborated to hire a single contractor, Itron, tasked with identifying DSM measures and assessing the technical, economic, and achievable potential for DSM across each utility's service areas.

By 2015, FPUC proposed modifications to its DSM Plan based on revised conservation goals established through a proxy methodology approved by the Commission in Order PSC-2013-0645-PAA-EU. The adjusted DSM Plan gained Commission approval, as evidenced in Order No. PSC-2015-0326-PAA-EU and Consummating Order No. PSC-2015-0360-CO-EU.

In 2018, FPUC once again collaborated with other FEECA utilities to collectively engage an experienced external engineering consultant (Nexant). This consultant was assigned the task of evaluating the technical, economic, and achievable potential for DSM measures tailored to the service areas of each utility. None of the DSM measures examined were deemed cost-effective under the RIM scenario, prompting FPUC to suggest that it would be appropriate for the Commission to establish no goals for the Company, but to nonetheless allow FPUC to maintain its existing conservation programs. In that proceeding, the Commission ultimately determined that it would be appropriate for the Company to adhere to its previously established goals for the remainder of the 10-year period, as reflected in Order No. PSC-2019-0509-FOF-EG, issued November 26, 2019.

In anticipation of the ongoing FEECA DSM goals docket, FPUC collaborated with other FEECA utilities to collectively finance the retention of Resource Innovations, an engineering consulting firm. This firm was responsible for assessing the technical potential for energy efficiency in the state of Florida. FPUC's proposed goals are informed by the measures and programs evaluated as a result of this initiative.

Q. What is FPUC's approach to designing and implementing DSM programs?

A. Given that FPUC is the smallest FEECA utility and the only non-generating electric utility, the Company utilizes its constrained resources to maximum effect. With that perspective, FPUC has found that educating customers about the advantages of energy efficiency and conservation is a critical and cost-effective component of its DSM Plan. The Company places significant emphasis on advocating for zero-cost or low-cost energy efficiency and conservation measures through its customer education initiatives.

Q. Since FPUC is the only non-generating utility to which FEECA applies, please outline how the Company acquires the electricity to supply its customers?

A. Florida Public Utilities Company utilizes power purchase agreements to obtain the wholesale electricity needed for its customers. Two of these wholesale contracts, both of which are with Florida Power and Light, have been extended through December 31, 2026, and obligate the counterparty to provide FPUC with the electricity needed to meet its customers' demand. The Company also has two negotiated agreements with Qualifying Facilities (QFs), and purchases as-available power from a third under its Standard Offer (As-Available) rate schedule:

QF	Contracted Amount	Expiration Date
Eight Flags	21 MW	2036
Rayonier	Up to 3 MW	2036
WestRock	As Available	Not applicable

Q. Does FPUC have a Demand Response (DR) program?

A. No, FPUC currently does not have an established Demand Response program, even though it has implemented time-of-use rates in its Northwest Division for experimental purposes. The integration of Demand Response (DR) has not been included in FPUC's goals, and the assessment indicates that DR Programs have not proven to be cost-effective.

Q. Please provide additional detail regarding FPUC's current demand-side management programs.

A. As mentioned earlier, FPUC's Demand-Side Management Plan for 2015 received approval in August of the same year. As part of its ongoing DSM strategy, FPUC has executed the following programs: Residential Energy Survey, Residential Heating and Cooling Upgrade, Commercial Heating and Cooling Upgrade, Commercial Chiller, and Commercial Reflective Roof.

Since 2015, the Residential Energy Survey program recorded a total of 1,504 participants, and the Residential Heating and Cooling Upgrade saw the engagement of 1,474 participants over the same period. The Commercial Heating and Cooling Upgrade had a total of 9 participants since 2015. As for the Commercial Chiller program it had one participant, while the Commercial Reflective Roof program garnered 87 participants.

In 2023, FPUC notably surpassed the residential winter peak demand and energy reduction goals but, for the first time, did not meet its summer demand goal. The primary factor behind the goal exceedance was the remarkably high participation rate in the Residential Heating and Cooling Upgrade Program. However, with no commercial participants in 2023, FPUC fell short of the commercial/industrial winter peak and energy reduction goals, resulting in an overall shortfall in meeting the Total Energy Savings Goals for all programs and classes. Only 65% of the GWh Energy goals were achieved, along with

93% of the Winter Demand goals and 54% of the Summer Demand Goals.

III. Evaluation of New Goals

Q. What cost-effectiveness test or tests should the Commission use to set new DSM goals for FPUC, pursuant to Section 366.82, F.S.?

A. FPUC recommends that the commission use the approach that was previously approved in the rule development proceeding prior to the current DSM goals docket. This approach involves providing multiple scenarios, including a portfolio of RIM and Participants Test-based programs, as well as a portfolio of TRC and Participants Test-based programs, to the commission for goal setting. Given that no measures passed the RIM portfolio, FPUC is now proposing goals derived from a portfolio based on TRC results.

Q. How were potential new DSM measures identified and evaluated for FPUC for purposes of this proceeding?

A. The DSM measures assessed for FPUC resulted from collaboration with other FEECA utilities to evaluate the technical potential for energy efficiency, demand response, and demand-side renewable energy. This assessment was carried out through a contract with the firm Resource Innovations. The specific process of identifying and evaluating these DSM measures is described in the testimony of Jim Herndon.

Q. How was FPUC's achievable potential for the 2025 through 2034 period determined?

A. The achievable potential for FPUC was developed by Resource Innovations and is detailed in the testimony of Jim Herndon and exhibit JH-5.

Q. What are FPUC's estimated residential and commercial/industrial energy

efficiency achievable potentials based on the RIM or TRC test?

A. No measures passed the RIM screening; therefore, the proposed DSM goals are based on the TRC scenario with a 2-year minimum payback screen applied. These figures represent a 10-year goal time frame. The total achievable residential potential is 5.1 GWh, commercial potential is4.3GWh, and industrial potential is 2.5 GWh, resulting in a total 10-year goal of 11.8 GWh. The achievable summer peak MW savings are 1.0 MW for residential, 0.7 MW for commercial, and 0.3 MW for industrial, totaling 2.0 MW for the system. FPUC's achievable winter potential for residential savings is 1.2 MW, 0.7 MW for commercial, 0.3 MW for industrial, and a total of 2.2 MW for the system.

Q. Is the demand response achievable potential included in FPUC's proposed DSM goals?

A. As a result of the lack of cost-effective demand response measures, none have been incorporated into the proposed DSM programs, even after excluding the startup costs associated with demand response capability from the cost-benefit analysis.

Q. Have any residential and commercial/industrial demand-side renewable energy technologies been identified as meeting the achievable potential standard under the RIM test?

A. The study conducted by Resource Innovations concluded that there was no achievable potential for residential and commercial demand-side renewable technologies based on either TRC or RIM scenarios.

Q. Do applicable building codes and requirements for appliance efficiencies

impact the assessment of DSM technologies for FPUC under the RIM test and TRC test Scenarios?

A. Indeed, the analysis considers the impacts of energy codes and standards, specifically the Florida Building Code, Energy Conservation (8th edition), as highlighted in Jim Herndon's testimony.

Q. Does the analysis conducted by Resource Innovations provide an adequate assessment of the full technical potential of demand-side and supply-side conservation and efficiency measures available to FPUC, including demand-side renewable energy systems?

A. Yes. Resource Innovations leveraged its extensive experience of conducting over 50 similar technical potential studies to comprehensively evaluate the full potential for DSM across the state of Florida. Utilizing a combination of its diverse internal expertise, advanced software, and analytical tools, Resource Innovations thoroughly assessed the complete technical potential for achievable DSM.

Q. Does the analysis conducted by Resource Innovations provide an adequate assessment of the achievable potential of demand-side and supply-side conservation and efficiency measures available to FPUC, including demand-side renewable energy systems?

A. As a non-generating utility, supply-side conservation and efficiency measures are not applicable to FPUC, nor does it benefit from avoided units. FPUC experiences the entirety of its DSM benefits through the avoided cost of purchased electricity, and in accordance with the forecast supported by Mike Clark's testimony However, the achievable potential assessment conducted by

Resource Innovations does offer a reasonable evaluation of the potential for available demand-side conservation and efficiency measures, including demand-side renewable systems.

Q. Please provide an estimate of how the proposed goals might the conversation cost recovery factor charges paid by a residential customer using 1,000 kWh of electricity per month.

A. The proposed goals by FPUC are expected to result in an estimated cost of $1.44 per month for a residential customer using 1,000 kWh of electricity.

Q. Please provide a description of the efforts made to address customers who rent.

A. FPUC focused on prioritizing renters in conservation programs by improving and expanding energy-saving kit offerings. These kits include non-permanent, portable energy-saving devices such as LED lights, weather stripping, and pipe insulation, allowing renters to implement energy-saving measures without the need for major appliance purchases typically required by homeowners. Renters also gain access to online resources and energy survey tools for better energy management. FPUC will implement a program similar to its renter program for low-income customers.

Q. Under its proposed goals, will FPUC be able to develop programs that would be specifically beneficial to low-income customers?

A. FPUC is focused on finding ways to facilitate conservation for our lower income customers. As stated earlier in this testimony, FPUC has found that educating customers about the advantages of energy efficiency and conservation is a critical and cost-effective component of its DSM Plan, which is particularly beneficial for both lower income customers and our customers that reside in rental properties. Through proactive information programs and our energy-saving kits, we are able to provide some meaningful conservation opportunities to our lower income customers, as well as those who rent.

Q. Provide a comparison of the programs used to determine FPUC's goals to its current demand-side management program offerings.

A. FPUC's main focus was to enhance its existing programs and to develop new programs where needed. The expanded residential programs include the residential energy survey and heating and cooling upgrade initiatives. The residential energy survey program energy survey kit was enhanced to include additional items beyond LEDs, such as weather stripping, a low-flow showerhead, hot water pipe insulation, and a tube of caulking. The heating and cooling program now covers multiple tiers of air source heat pumps with increased incentives was expanded to include Energy Star-rated ground source heat pumps, Energy Star room air conditioners, smart thermostats, and Variable Refrigerant Flow (VRF) HVAC Systems. Additionally, new residential equipment rebates have been introduced in FPUC's DSM proposed goals, offering incentives for advanced-tier clothes washers and Energy Star clothes washers.

The commercial heating and cooling upgrade initiative now includes high-efficiency direct expansion units, high-efficiency package terminal heat pumps, smart thermostats, and packaged terminal air conditioners.

Additionally, FPUC will maintain its chiller upgrade program and terminate its Reflective Roof Program. Lastly, FPUC is set to introduce a new commercial lighting program, including incentives for interior lighting equipment, lighting controls, and exterior lighting.

IV. Conclusions

Q. Should the Commission establish separate goals for demand-side renewable energy systems for the period 2025 through 2034?

A. No, the Commission ought not to set distinct targets for FPUC regarding demand-side renewable energy systems. All conservation objectives for FPUC should aim to encourage cost-efficient DSM without favoring any specific technology or initiative. Additionally, if demand-side renewable energy systems prove to be cost-effective, FPUC should have the freedom to integrate such systems into their renewable portfolio or DSM objectives

Q. Should the Commission establish separate goals for FPUC for residential and Commercial/industrial customer participation in utility energy audit programs for the period 2025 through 2034?

A. No, the Commission should refrain from setting distinct objectives for residential and commercial/industrial customer engagement in utility energy audit initiatives. These audits, conducted by FPUC, are initiated upon customer request without any mandatory participation requirement. FPUC should retain the flexibility to incorporate energy audits into its conservation programs as deemed suitable.

Q. Please identify the 2025 through 2034 projected technical potential for

FPUC.

A. The projected technical potential for FPUC is presented in section 5.2 EE Technical Potential, page 32, and 5.3 DR Technical Potential, page 38, of the Resource Innovations report titled Technical Potential Study of Demand-Side Management - Florida Public Utilities Company, which is Exhibit JH-5 to Witness Herndon's testimony.

Q. What overall DSM goals (peak demand and energy reductions) are appropriate and reasonably achievable for FPUC for the 2025 through 2034 period?

A. FPUC's reasonably achievable goals for the period covering 2025 to 2034 are outlined as follows:

The 10-year total goal for residential energy efficiency is targeted at 3.8 GWh, with non-residential aiming at 2.3 GWh and an overarching energy efficiency goal of 6.1 GWh.

For summer MW goals, residential targets are set at 2.58 MW, and non-residential targets at 0.35 MW, with a cumulative total goal of 0.93 MW. Achievable winter MW goals would be 1.15 MW for residential and 0.33 MW for non-residential, culminating in a combined total winter megawatt goal of 1.83 MW.

Q. Should DSM goals nonetheless be set for FPUC to reflect the costs imposed by state and federal regulations on the emission of greenhouse

gases, pursuant to Section 366.82(3)(d), F.S.?

A. No, currently, neither the State nor Federal level regulates greenhouse gases, and there are no existing costs associated with their emissions. Therefore, it is not suitable to establish DSM goals based on speculation about future regulations on greenhouse gas emissions.

Q. Does this conclude your testimony?

A. Yes.

DERRICK M. CRAIG, CFA

SENIOR FINANCIAL ANALYST

Accomplished, results-driven financial analyst/manager who utilizes all aspects of his engineering and MBA backgrounds and his 25+ years of progressive experience in the energy utility, commercial banking, and manufacturing industries.

AREAS OF EXPERTISE

Financial Analysis & Modeling • Data Mining • Trend Analysis• Performance Measurement • Credit Analysis • • Price/Cost/Margin Analysis • Forecasting • Cost of Capital Calculation

PROFESSIONAL EXPERIENCE

FLORIDA PUBLIC UTILITIES, Yulee, FL
Energy Conservation Manager, 2021-Current

- Management of a team of Energy Conservation Professionals
- Completion of the daily Cash Batch Process For the Back Office
- Production of ad hoc financial analysis

FLORIDA PUBLIC UTILITIES, Fernandina Beach, FL
Regulatory Analyst III, 2019-2021

- Margin variance analysis (Actual to Budget, Actual to Previous Year)
- Submission of Written Testimony to Public Service Commission
- Production of ad hoc financial analysis

OGLETHORPE POWER CORPORATION, Tucker GA
Senior Financial Analyst, 2016-2019

- Assist with the creation of the Twenty-Year Financial Forecast
- Pre-calculation of credit metrics for the three rating agencies (Fitch, Moodys, and S&P)
- Production of ad hoc financial analysis

Key Accomplishments:

- Detailed analysis of cash flow statement variances
- Increased the department's understanding of some balance sheet accounts

LANDIS + GYR CORPORATION, Alpharetta, GA
Senior Financial Specialist, 2014-2016

- Recommended pricing for much of the company's product line.
- Assists with the development of project budgets

Key Accomplishments:

- Created financial models allowing for the cost/benefit analysis of potential corporate transactions

ELECTRIC CITIES OF GEORGIA, Atlanta, GA
Principal Analyst/National Accounts Representative, 2011-2013
Key Accomplishments:
- Extensive data-mining of customer power bills to create a customer rate pricing schedule
- Performed an accounting audit of financial statements for a Georgia municipality.

SOUTHERN POWER, Atlanta, GA & Birmingham, AL
Staff Financial Analyst, 2005-2011
- Prepared and analyzed Southern Power Company's $1.2 billion, 21-year financial plan.
- The pre-calculation of rating agency credit metrics used for SPC's credit rating.

Key Accomplishments:
- Created pro-formas showing discounted cash flows used for the valuation of several Southern Power acquisition targets.

BALTIMORE GAS AND ELECTRIC, Baltimore, MD
Senior Engineer (functioning as a Regulatory Analyst)/Black Belt Candidate, 2002-2005
- Responsible for the analysis of governmental regulatory changes and their effects on the company's transmission assets.

MIRANT CORPORATION, Atlanta, GA
Middle Office Financial Analyst, 1999-2002
- Verified trading positions and confirmed spot prices for natural gas traders.
- Provided financial performance (natural gas trading) updates to upper level management on daily basis.

Key Accomplishments:
- Created financial model that estimated the profit made from plant ancillary services.
- Spearheaded establishment of middle office job function written procedures.

WACHOVIA BANK, N.A., Atlanta, GA
Corporate Associate, 1997-1999
- Prepared and analyzed corporate customer financial statements, wrote credit memoranda and industry reviews, and marketed bank products to current and prospective corporate customers.

Key Accomplishments:
- Created a financial model used to create a estimated valuation for one of bank's customers, which was used by the customer's CFO to help formulate strategy.

Other Previous positions include a Marketing Intern for Danaher Corporation (a manufacturer of industrial instruments), an Engineering Intern for Honeywell (a defense contractor), and an Instruments and Controls Engineer for Southern Company Services.

EDUCATION & CERTIFICATIONS

- **Darden Graduate School of Business**, Charlottesville, VA, MBA, 1997
- **Georgia Institute of Technology**, Atlanta, GA, BS, Electrical Engineering, 1991
- **Certifications:**
    - **Chartered Financial Analyst (CFA) Designation (2011),**
    - **Engineer In Training (EIT) Designation (1993)**

Florida Public Utilities Company 2020
Demand-Side Management Plan
Program Standards

Residential Energy Survey

Program Description

The Residential Energy Survey program is provided in-home or on-line at no cost to the customer and provides participating customers with information they need to determine which energy saving measures are best suited to their individual needs and requirements.

During the in-home survey, FPUC will provide the customer with multiple LED bulbs if determined to be appropriate by the FPUC auditor. While the intent of the LEDs is to provide energy and demand savings, the main purpose of the kit is to empower customers to actively practice and replicate energy conservation behavioral habits.

The FPUC auditor will inspect accessible duct work and use forward looking infrared detectors. If leaks are obvious, the FPUC auditor will recommend repair. If a duct-blaster test is needed to identify and quantify duct leakage, the auditor will provide the customer with a list of contractors that can perform the test. The customer is responsible for the cost of the testing.

The audit is conducted using an Energy Calculator from a third-party vendor. The results of the energy audit are summarized for the customer in an easy-to-read format to illustrate the potential energy efficiency and cost savings in the home.

During the online survey, customers also utilize an Energy Calculator from a third party vendor to identify similar types of energy efficiency measures that FPUC's auditors would identify in an in-home survey. The on-line survey collects information about customers' homes, appliances, and other information to determine the most appropriate measures that customers can implement themselves or have implemented in their homes by a contractor. Customers are responsible for any costs associated with repair or recommendations that are beyond the scope of the audit. On-line survey customers that complete the survey will be sent two LED bulbs.

The procedures used to make the installation cost and energy savings estimates produced in the audit report are consistent with Commission rules and good engineering practices. However, the actual installation costs incurred and energy savings realized from installing the measures may be different from the estimates contained in this audit report. The estimates are based on measurements of the customer's house and on assumptions which may not be entirely correct for the customer's household due to differing energy use patterns

Customer Eligibility Requirements

The program is available to all of FPUC's residential customers and is provided at no cost to the customer. However, the customer is responsible for the cost of any duct-blaster testing. A customer may request an in-home energy audit once per calendar year. FPUC may authorize in-home audits more frequently than once per year due to high bill complaints by the customer. Customers can conduct on-line surveys as often as they like, but are limited to receiving two LED bulbs per calendar year.

Program Procedures

Interested customers must request the energy audit either by filling out the Residential Energy Audit Request form on-line, by contacting FPUC by phone or at FPUC conservation events, or by accessing the on-line audit through FPUC's website. In addition, FPUC encourages all customers otherwise meeting the audit qualification requirements that contact FPUC with high bill complaints to request an audit. FPUC will contact customers to schedule appointments after the requests have been formally received. Customers can request an in-home energy audit once per calendar year or can conduct an on-line audit at any time, but can only receive the two LED bulbs once per year. FPUC will follow-up with the customer to answer questions or provide a list of contractors to perform recommended services if necessary.

Savings Verification

FPUC conducts follow-up surveys after customers have implemented the specific recommendations. Data concerning these changes are accumulated so the impact of the energy surveys can be more accurately measured. The reporting requirements for this program will follow Rule 25-17.0021 (5), Florida Administrative Code. Additionally, program expenses will be identified in the ECCR True-up and Projection filings.

Residential Heating and Cooling Efficiency Upgrade Program

Program Description

The Residential Heating and Cooling Efficiency Upgrade Program is directed at reducing the rate of growth in peak demand and energy throughout FPUC's electric service territories. The program will do this by increasing the saturation of high-efficiency heat pumps and central air conditioning systems. The program requires that customer install a high-efficiency central air conditioning system or heat pump with a minimum 16 SEER (15.3 SEER2).

The Residential Heating & Cooling Efficiency Upgrade Program focuses in two areas. The first is to incent customers with operating inefficient heat pumps and air conditioners to replace them with more efficient units. The program also incents customers with resistance heating to install a new heat pump. The second area of focus for the program is to incent customers that are replacing a heat pump or air conditioner that has reached the end of its life with a more efficient heat pump or air condition than is required by codes and standards. The incentive to install a more efficient heat pump or air conditioner also applies to heat pumps and air conditioners being installed in new construction. The Residential Heating & Cooling Efficiency Upgrade Program was approved as an update to a former program, which was done so to reflect current codes and standards as well as market conditions.

Residential Heating & Cooling Efficiency Upgrade Rebates		
	Customer Rebate	**Dealer Incentive**
Type 1	$100.00	$75.00
Type 2	$100.00	$25.00
Type 3	$100.00	$25.00
Type 4	$100.00	$25.00

Customer Eligibility Requirements

Single family, multifamily, and mobile home residential customers that meet the following requirements are eligible for the program.

- Replace existing equipment with, or install new, straight air conditioners or heat pump
- Install a heat pump (AHRI rating only) or central air conditioning system with a minimum rating of 16.0 SEER (15.3 SEER2)
- Must be the owner of the residence which must be located in FPUC's electric service area
- Mobile homes must be permanent or stationary. Mobile homes must have their wheels removed and set on a lot. (FPUC reserves the right to remotely verify the permanence of a dwelling via Google Maps to confirm eligibility.)

Concerning the installation of heat pumps:

When installing/replacing with a new heat pump, the maximum supplemental strip heating physically contained in the system shall not exceed 2 kW per nominal ton. On a system of less than 2.5 tons, a 5 kW heat strip will be allowed. For a heat pump using supplemental strip heating, a two-stage indoor thermostat is required.

Customer and/or contractor must attest that the heat pump or air conditioner installation meets all required codes and standards. FPUC does not warrant that installation meets all required codes and standards and accepts no liability whatsoever for the installation.

Concerning the installation of straight cooling systems:

The residence cannot have oil or electric resistance as the primary heat source.

Program Procedures

HVAC contractors or the customer will submit rebate request forms either by mail or through the FPUC online portal within 30 days after the work is completed. The purchase receipt and invoice verifying installation is required and can be uploaded or mailed with the application. No payments will be made until FPUC verifies and approves the rebate request conforms to program standards. Once FPUC approves the rebate request, FPUC's contractor for issuing rebates will issue an FPUC Visa gift card (or check when appropriate) via First-Class mail to the customer or contractor within 30-45 business days. The contractor will be paid by check within 30-45 business days for the dealer rebate when the rebate request is approved.

Savings Verification

FPUC will randomly perform verifications on 10 percent of the program installations. Verification will be conducted for all installations not conducted by an FPUC partner contractor. FPUC will conduct the verifications within 30 business days of receiving the complete rebate request. FPUC will calculate demand and energy savings based on the values presented in FPUC's 2015 DSM Plan. FPUC will maintain a data base of the size and SEER of air conditioners and heat pumps installed for use in updating the demand and energy savings during the next goals cycle.

Commercial Heating & Cooling Efficiency Upgrade Program

Program Description

The Commercial Heating & Cooling Efficiency Upgrade Program is directed at reducing the rate of growth in peak demand as well as reducing energy consumption throughout FPUC's commercial sector. The program will do this by increasing the saturation of high-efficiency heat pumps and central air conditioning systems. There are four Rebate Types available for this program. A description of the types and associated incentives/rebates are:

- Type 1 - Heat pump replacing resistance heat
- Type 2 - Heat pump replacing a heat pump
- Type 3 - Air conditioner replacement
- Type 4 - New heat pump or air conditioner installation

Commercial Heating & Cooling Efficiency Rebates		
	Customer Rebate	**Dealer Incentive**
Type 1	$100.00	$75.00
Type 2	$100.00	$25.00
Type 3	$100.00	$25.00
Type 4	$100.00	$25.00

Customer Eligibility Requirements

Eligible commercial customers must:

- Replace existing equipment with, or install new, straight air conditioners or heat pumps
- Install a heat pump (AHRI rating only) or central air conditioning system with a minimum rating of 16.0 SEER (15.3 SEER2)
- Must be the owner of the facility which must be located in FPUC's electric service area

Concerning the installation of heat pumps:

- When installing/replacing with a new heat pump, the maximum supplemental strip heating physically contained in the system shall not exceed 2 kW per nominal ton. On a system of less than 2.5 tons, a 5 kW heat strip will be allowed.
- For a heat pump using supplemental strip heating, a two-stage indoor thermostat is required.
- Customer and/or contractor must attest that the heat pump or air conditioner installation meets all required codes and standards. FPUC does not warrant that installation meets all required codes and standards and accepts no liability whatsoever for the installation.

Concerning the installation of straight cooling systems:

The business cannot have oil or electric resistance as the primary heat source.

Program Procedures

HVAC contractors or the customer will submit rebate request forms either by mail or through the FPUC online portal within 30 days after the work is completed. The purchase receipt and invoice verifying installation is required and can be uploaded or mailed with the application. No payments will be made until FPUC verifies and approves the rebate request conforms to program standards. Once FPUC approves the rebate request, FPUC's contractor for issuing rebates will issue an FPUC Visa gift card (or check when appropriate) via First-Class mail to the customer or contractor within 30-45 business days. The contractor will be paid by check within 30-45 business days for the dealer rebate when the rebate request is approved.

Savings Verification

FPUC will randomly perform verifications on 10 percent of the program installations. Verification will be conducted for all installations not conducted by an FPUC partner contractor. FPUC will conduct the verifications within 10 business days of receiving the complete rebate request. FPUC will calculate demand and energy savings based on the values presented in FPUC's 2015 DSM Plan. FPUC will maintain a data base of the size and SEER of air conditioners and heat pumps installed for use in updating the demand and energy savings during the next goals cycle.

Commercial Chiller Upgrade Program

Program Description

The Commercial Chiller Upgrade Program is directed at reducing the rate of growth in peak demand and energy throughout FPUC's commercial sector. To serve this purpose, this program requires that commercial customers replace existing chillers with a more efficient system. By doing so, they will qualify for an incentive of up to $175 per kW of additional savings above the minimum efficiency levels.

Customer Eligibility Requirements

All of FPUC's non-residential customers are eligible for this program. The program covers only three types of new chillers: water-cooled centrifugal, water-cooled scroll or screw, and air-cooled. Each type has minimum qualifications of efficiency listed below:

- Water-Cooled Centrifugal Chillers:
    1. Under 150 tons = 0.65 kW/ton with a 5.4 COP
    2. 150 - 300 tons 0.60 kW/ton with a 5.9 COP
    3. Over 300 tons = 0.56 kW/ton with a 6.3 COP
- Water-Cooled Scroll or Screw Chillers:
    1. Under 150 tons = 0.72 kW/ton with a 4.9 COP
    2. 150 - 300 tons = 0.66 kW/ton with a 5.3 COP
    3. Over 300 tons = 0.59 kW/ton with a 5.9 COP

  Air-Cooled Electric Chillers (any size):
    1. Any size = 1.17 kW/ton with a 3.0 COP

Program Procedures

Interested customers must send project proposals to FPUC and a representative will schedule an on-site visit for inspection prior to installation. After the project is completed, an FPUC representative will conduct an on-site inspection. The on-site inspection will be completed within 30 business days of the customer providing notification that the project is complete. The customer will sign the rebate form verifying that the equipment was installed and that the incentive recipient's name and mailing address are correct and submit the receipt for the installation. No payments will be made until FPUC verifies and approves the rebate request. Once FPUC approves the rebate request, FPUC's contractor for issuing rebates will issue an FPUC Visa gift card (or check when appropriate) via First-Class mail to the customer or contractor within 30 business days.

Savings Verification

The demand and energy savings will be based on the values presented FPUC's 2020 DSM Plan. The FPUC inspector will note the efficiency ratings and size of the existing and replacement equipment.

Commercial Reflective Roof Program

Program Description

The Commercial Reflective Roof Program is directed at reducing demand and energy throughout FPUC's commercial sector through the installation of cool roofs. The program allows non-residential customers installing cool roofs to obtain rebates of $0.15 per sq. ft. for new roofs on new or existing facilities and $0.65 per sq. ft. for roofs converting to a cool roof. To be eligible for the rebates, the roofing material must be Energy Star certified.

Customer Eligibility Requirements

All of FPUC's non-residential customers are eligible to participate in the Commercial Reflective Roof Program. Eligible installations must:

- Have roofs covering air conditioned space.
- Roofing material must be ENERGYSTAR certified.

Program Procedures

Interested customers or their roofing contractor must contact FPUC to schedule a pre-installation inspection. FPUC will respond to the customer's request and will attempt to conduct the pre-installation inspection within 10 business days subject to the customer's availability. The pre-installation inspection will review the customer's roofing plans and the FPUC representative will determine which rebate applies and assure that the materials proposed to be used qualify. After the roof is completed, the customer or their roofing contractor will contact FPUC and request a post installation inspection. FPUC will respond to the customer's request and will attempt to conduct the post installation inspection within 10 business days subject to the customer's availability. The customer will sign the rebate form verifying that the equipment was installed and that the incentive recipient's name and mailing address are correct and submit the receipt for the installation. No payments will be made until FPUC verifies and approves the rebate request. Once FPUC approves the rebate request, FPUC's contractor for issuing rebates will issue an FPUC Visa gift card (or check when appropriate) via First-Class mail to the customer or contractor within 30 business days.

Savings Verification

FPUC will track the size and type of the installations. Savings will be calculated based on the demand and energy savings presented in FPUC's 2020 DSM plan.

Conservation Demonstration and Development (CDD) Program

Program Description

The primary purpose of the Conservation Demonstration and Development (CDD) program is to pursue research, development, and demonstration projects that are designed to promote energy efficiency and conservation. This program will supplement and complement the other demand-side management programs offered by FPUC.

The CDD program is meant to be an umbrella program for the identification, development, demonstration, and evaluation of promising new end-use technologies. The CDD program does not focus on any specific end-use technology but, instead, will address a wide variety of energy applications that will lead to the Next Generation of FPUC's DSM Programs.

Program Requirements

The projects that may be studied within this program will vary greatly and, therefore, need careful screening. The screening criteria will include the potential for peak demand and energy reductions, the technology's state-of-development, and an evaluation of the degree of potential customer acceptance and marketability. The activities that may take place under the auspices of this program include:

- Literature searches and reviews
- Engineering appraisals & feasibility analysis (Assessment of Commercial DR Options)
- Financial analyses of promising programs, projects or technologies
- Baseline data collection (Residential Energy Monitoring and DSM Savings Verification)

- Benchmark analysis(Distributed Generation/Communicty Solar DSM Programs)
- Field-testing with customers
- Technology demonstrations (Battery Storage)
- Pilot programs.

Field-testing will be limited to the demonstration of emerging end-use technologies that meet the guidelines described in the Program Description section above. Funding for the field-testing will be constrained by this program's expenditure limitations. If any field-testing or pilot projects require funding beyond these limitations and if FPUC believes them necessary, the FPUC will seek approval for continued Energy Conservation Cost Recovery.

Program Limitations

FPUC will limit the total CDD expenditures to a maximum of $75,000 per year. FPUC will also notify the Florida Public Service Commission of any CDD project that exceeds $15,000. Costs for CDD projects that meet the program's criteria for acceptance will be charged to the Energy Conservation Cost Recovery account.

The projects undertaken by this program are research and development projects. The levels of costs and benefits and the potential peak demand and energy reductions are not known with sufficient certainty. The major thrust of the activities performed under the CDD program will be to develop better estimates of these economic drivers.

Savings Verification

Any technology investigated as a CDD project will be investigated using well-accepted methods of measurement and evaluation. Before any project is approved for study, the project's justification will be clearly documented. The justification will include:

- Detailed project description (a-priori).
- Research design plan.
- Project potential.

- Project alignment with CDD program goals
- Project costs.

All expenditures allocated to this program will be properly accounted for and reported. All approved CDD projects that do not require field-testing will be fully documented. The documentation will include descriptions of the methodology, modeling, and engineering estimation procedures used to justify the study's results and conclusions.

Specific deliverables that will be provided from all CDD projects include:

- Detailed project description (a-posteriori)
- Conservation potential.
  - Achieved.
  - Projected.
- Technical evaluation.
- Cost-benefit considerations
- Customer acceptance
  - Achieved with test subjects
  - Projected

These findings will be reported and filed with the Florida Public Service Commission's staff for their review and consideration.

Standard cost-effectiveness analysis is not applicable for research and development activities. The purpose of these activities is to discover promising energy efficiency options and changes that customers may someday choose to implement. Customers, on average, will choose to implement the most cost-effective options. Programs like this one serves FPUC and its customers by garnering new, reliable information upon which to base future demand-side management programs and services.

Low Income Energy Outreach Program

Program Description

The Low Income Energy Outreach Program is an educational program designed to enhance the effectiveness of the existing weatherization programs for low-income households. These activities include Residential Energy Surveys scheduled by the Low Income Weatherization Program operators, weatherization contract training, distributing energy efficiency educational literature to participants, and hosting energy conservation events customized for low income households. The Low Income Energy Outreach Program consists of the following four major components:

Residential Energy Surveys:

The Low Income Weatherization Program operators will be responsible for scheduling Residential Energy Surveys to be conducted by FPUC with the low-income households. The Low Income Weatherization Program operators are in the best position to identify low-income households that would benefit from the Residential Energy Surveys. For instance households that have already received conservation audits from the Low Income Weatherization Program operators will not need to receive a Residential Energy Survey from FPUC. Each low-income household receiving a FPUC Residential Energy Survey will receive LED bulbs.

Contractor Training:

Training will be provided by FPUC to educate and inform weatherization contractors about thermal envelope improvement best practices, product procurement ideas, and emerging weatherization strategies. Training events will occur on an annual basis throughout each of the counties FPUC serves. These efforts will include coordination with the Weatherization Assistance Program Technical Assistance Center.

Demographic Targeted Energy Materials:

Energy Conservation materials that are specifically geared towards low income households will be compiled by FPUC and provided by the approved weatherization organization performing the energy improvements.

Community Conservation Events:

Annual Community Conservation events will be conducted in each of the territories that FPUC serves. These events will educate and inform low income households about the weatherization programs offered in their county and depending upon the event each participant will receive LED bulbs along with instructional information about reading electric bills and energy conservation tips.

Customer Eligibility Requirements

Eligibility requirements for the Low Income Energy Outreach Program apply to both the weatherization program operators as well as the FPUC residential customers.

Weatherization Organization Partnership Requirements:

Each low income weatherization organization partner must comply with the Florida Department of Economic Opportunity policy of using weatherization organizations that have been approved by the county within which they operate.

Residential Customer Participation Eligibility Requirements:

The low income household must have a residential electric service account with FPUC, must meet the income verification requirements specified by the local low income weatherization organization, the home must be older than three years old, and the customer must receive a FPUC Residential Energy Survey if deemed required by the low

Program Procedures

FPUC will identify the appropriate low income weatherization organization in each county that FPUC has electric service area. FPUC will contact each low income weatherization organization selected and schedule a meeting to introduce the program to the low income weatherization organization. FPUC will provide the low income weatherization organization with blocks of time that FPUC can conduct the Residential Energy Surveys. The low income weatherization organization will identify qualifying households that meet the income requirements and residence age requirements and schedule the Residential Energy Surveys. The low income weatherization organization will provide the schedule to FPUC. FPUC will verify that the household is a FPUC residential electric customer. FPUC will conduct the Residential Energy Survey and provide the results of the Residential Energy Survey to both the customer and the low income weatherization organization. The low income weatherization organization will work with the customer to implement the Residential Energy Survey recommendations through any means available to the low income weatherization organization. If the Residential Energy Survey recommends the installation or replacement of a heat pump or air conditioner under FPUC's Residential Heating & Cooling Efficiency Upgrade Program, the low income weatherization organization will attempt to facilitate the installation and ensure that customer conforms with the Residential Heating & Cooling Efficiency Upgrade Program and receives the associated rebate or that the rebate is applied to the installation costs.

FPUC will meet with the Weatherization Assistance Program Technical Assistance Center to plan and schedule annual training for contractors in each of the counties that FPUC provides electric service. FPUC will work with Weatherization Assistance Program Technical Assistance Center to identify, contact, and schedule the training. FPUC will prepare and present the training program.

FPUC will review existing energy conservation materials and make any modifications which make the materials more appropriate for low income households. FPUC will provide the materials to the low income weatherization organizations participating in the program.

FPUC will participate in annual community conservation events generally in connection with events organized by others such as county fairs. FPUC will provide information specifically targeted to low income customers at these events.

Savings Verification

Since the Low Income Energy Outreach Program is an educational and outreach program, no specific savings are identified. FPUC will track the number of customers participating in the Residential Energy Survey Program and the Residential Heating & Cooling Efficiency Upgrade Program as a result of the Low Income Energy Outreach Program. Energy and demand savings from participation in the Residential Energy Survey Program and the Residential Heating & Cooling Efficiency Upgrade Program will be recorded and verified as part of those specific programs.

Commercial Energy Consultation Program

Program Description

The FPUC Commercial Energy Conservation Program is designed to directly communicate the availability of the commercial DSM programs to commercial customers. This program allows FPUC energy conservation representatives to conduct commercial site visits to educate customers about FPUC's commercial DSM programs, assess the potential for applicable DSM programs, conduct an electric bill review, offer commercial energy savings suggestions, and inform the customer about FPUC's commercial online energy efficiency resources and tools.

Program Requirements

The Commercial Energy Consultation Program is open to all FPUC non-residential customers. Customers wishing to participate can call 800-427-7712 or contact any FPUC representative who will have them contacted by an FPUC energy conservation representative. The availability of the program will announced through bill stuffers in non-residential customers' bills and may be announced through other FPUC media.

Savings Verification

As an educational program, no specific energy or demand savings are identified through the Commercial Energy Consultation Program. FPUC will compile a list of customers who participate in the program. Any participation in FPUC's commercial conservation programs will be recorded and the savings and verification for those specific programs will be part of those specific programs.

2019 ELECTRIC CONSERVATION GOALS	PROGRAM NUMBER	DEC	Y2D TOTALS	2019 GOALS	% TO GOAL
Common	610	0	**0**		
Residential Energy Survey Program	613	7	**123**	180	68.33%
Low Income Program	617	2	**2**	0	
Commercial Heating & Cooling Upgrade	618	0	**0**	10	0.00%
Residential Heating & Cooling Upgrade	619	2	**101**	300	33.67%
Commercial Chiller Upgrade Program	623	0	**0**	1	0.00%
Demonstration and Development	626	0	**0**	N/A	
Commercial Reflective Roof Program	628	0	**1**	10	10.00%
Commercial Energy Consultation	629	0	**19**		

2020 ELECTRIC CONSERVATION	PROGRAM NUMBER	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV	DEC	Y2D TOTALS
Common	610													**0**
Residential Energy Survey Program	613	14	9	1	0	0	0	7	25	15	7	3	2	**83**
Low Income Program	617	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Heating & Cooling Upgrade	618	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Residential Heating & Cooling Upgrade	619	33	6	6	3	6	5	18	3	23	3	18	2	**126**
Commercial Chiller Upgrade Program	623	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Demonstration and Development	626													**0**
Commercial Reflective Roof Program	628	0	0	0	0	0	0	0	0	0	0	0	16	**16**
Commercial Energy Consultation	629	1	0	0	0	0	2	0	4	0	0	2	0	**9**

2021 ELECTRIC CONSERVATION

	PROGRAM NUMBER	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV	DEC	Y2D TOTALS
Common	610	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Residential Energy Survey Program	613	7	5	6	8	0	2	2	5	7	13	10	3	**68**
Low Income Program	617	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Heating & Cooling Upgrade	618	0	0	0	0	0	0	0	0	0	2	0	0	**2**
Residential Heating & Cooling Upgrade	619	3	1	3	13	5	6	4	6	1	20	8	20	**90**
Commercial Chiller Upgrade Program	623	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Demonstration and Development	626	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Reflective Roof Program	628	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Energy Consultation	629	0	1	1	0	0	0	0	0	0	0	0	0	**2**

2022 ELECTRIC CONSERVATION

	PROGRAM NUMBER	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV	DEC	Y2D TOTALS
Common	610	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Residential Energy Survey Program	613	0	1	1	1	0	10	8	28	2	12	0	0	**63**
Low Income Program	617	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Heating & Cooling Upgrade	618	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Residential Heating & Cooling Upgrade	619	10	9	3	2	1	7	6	26	3	14	11	0	**92**
Commercial Chiller Upgrade Program	623	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Demonstration and Development	626	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Reflective Roof Program	628	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Energy Consultation	629	0	0	0	0	0	0	0	1	0	0	0	0	**1**

2023 ELECTRIC CONSERVATION	PROGRAM NUMBER	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV	DEC	Y2D TOTALS
Common	610	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Residential Energy Survey Program	613	3	18	7	15	3	12	6	18	24	30	7	11	**154**
Low Income Program	617	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Heating & Cooling Upgrade	618	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Residential Heating & Cooling Upgrade	619	0	1	6	8	1	0	12	6	1	3	8	4	**50**
Commercial Chiller Upgrade Program	623	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Demonstration and Development	626	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Reflective Roof Program	628	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Commercial Energy Consultation	629	0	0	0	0	3	3	0	1	1	5	31	1	**45**

Exhibit DMC-4

FPUC Current DSM Goals: 2015-2024

Residential Goals:

Year	Summer Demand (MW)	Winter Demand (MW)	Energy (GWh)
2015	0.036	0.012	0.023
2016	0.046	0.015	0.030
2017	0.056	0.018	0.038
2018	0.067	0.022	0.045
2019	0.078	0.025	0.053
2020	0.089	0.028	0.060
2021	0.099	0.031	0.067
2022	0.107	0.034	0.073
2023	0.117	0.036	0.078
2024	0.123	0.039	0.084

Commercial Goals:

Year	Summer Demand (MW)	Winter Demand (MW)	Energy (GWh)
2015	0.021	0.010	0.055
2016	0.027	0.008	0.078
2017	0.031	0.009	0.094
2018	0.039	0.018	0.115
2019	0.045	0.018	0.148
2020	0.052	0.018	0.168
2021	0.058	0.018	0.182
2022	0.058	0.027	0.202
2023	0.065	0.027	0.215
2024	0.071	0.027	0.229

Total Goals:

Year	Summer Demand (MW)	Winter Demand (MW)	Energy (GWh)
2015	0.057	0.022	0.078
2016	0.073	0.023	0.108
2017	0.087	0.027	0.132
2018	0.106	0.040	0.160
2019	0.123	0.043	0.201
2020	0.141	0.046	0.228
2021	0.157	0.049	0.249
2022	0.165	0.061	0.275
2023	0.182	0.063	0.293
2024	0.194	0.066	0.313

BEFORE THE
FLORIDA PUBLIC SERVICE COMISSION

DOCKET NO. 20240015-EG

IN THE MATTER OF: COMMISSION REVIEW OF NUMERIC CONSERVATION GOALS
(Florida Public Utilities Company)

DIRECT TESTIMONY

OF

MICHAEL TY CLARK

ON BEHALF OF

FLORIDA PUBLIC UTILITIES COMPANY

April 2, 2024

TABLE OF CONTENTS

I. Introduction

Q. Please state your full name.

A. My name is Michael Ty Clark.

Q. By whom are you employed and what is your business address?

A. I am a Vice President with Christensen Associates Energy Consulting LLC ("CA Energy Consulting"). My business address is 800 University Bay Drive, Suite 400, Madison, Wisconsin, 53705.

Q. On whose behalf are you submitting testimony?

A. I am submitting this direct testimony on behalf of Florida Public Utilities Company ("FPUC") before the Florida Public Service Commission ("FPSC").

Q. Please summarize your education and professional work experience.

A. I received a Bachelor of Arts degree in Economics from Utah State University in 2011, a Master of Science degree in Economics from Florida State University in 2013, and a Doctor of Philosophy degree in Economics from Florida State University in 2015. I have been employed by CA Energy Consulting since 2015 in positions of increasing responsibility. I have testified on topics relating to marginal costs, load forecasting, and rate design. A copy of my curriculum vitae is attached as Exhibit MTC-1.

Q. Have you previously provided testimony before the Florida Public Service Commission or other state regulatory commissions?

A. While I have not testified before the FPSC, I have testified before other state regulatory commissions and I have contributed to numerous reports, studies and analyses filed with regulatory authorities, with a concentration on customer response to time-of-use tariff options, electric vehicle tariffs, and demand response programs. I have testified on behalf of

Alpena Power Company before the Michigan Public Service Commission regarding load and energy forecasting as well as marginal cost-based rate design. I have also testified on behalf of the New Hampshire Department of Energy before the New Hampshire Public Utilities Commission with respect to a distribution utility's marginal cost of service study. The testimony addressed rate design topics focused on time-of-use, electric vehicles, and revenue decoupling.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony is to discuss FPUC's avoided costs used by Resource Innovations, Inc. to conduct the Technical Potential Study for FPUC, as required by the Florida Energy Efficiency and Conservation Act ("FEECA"). My testimony summarizes FPUC's projections of avoided costs.

Q. Are you sponsoring any exhibits with your testimony?

A. Yes, Exhibit MTC-2 consists of a full report regarding FPUC's avoided costs. The report contains a detailed description of the methodology used to develop FPUC's avoided costs, as well as results, through the intermediate steps to the final application of avoided costs to FPUC's LED lighting program.

Q. How is your testimony organized?

A. Section II provides a description of avoided costs and their application in this proceeding. Section III provides a summary of FPUC's avoided cost estimates.

II. <u>Avoided Costs</u>

Q. Please describe avoided costs.

A. "Avoided cost" refers to the resource cost savings of a service provider associated with a reduction change in the services provided. Sometimes referred to as marginal costs, avoided costs are particularly important to infrastructure industries such as electricity and gas utility services. Avoided costs reflect out-of-pocket cost savings, at the margin: the reduction in the total cost incurred by a service provider with respect to a change (decrease) in the level of services provided. Avoided costs are typically measured as $/MWh for electricity services and are highly specific to the timeframe in which services are provided to consumers as they reflect the underlying resource technologies used in the production and transport of electricity from locations where it is produced to locations where it is consumed. Avoided costs can vary dramatically over the course of hours or from one day to another.

Q. Please describe how avoided cost estimates are used.

A. Calculations of avoided costs are used in the energy industry for a variety of purposes, including rate design, revenue requirement allocation, resource planning, etc. For this immediate proceeding before the FPSC, the relevant application of avoided costs is to evaluate proposed demand side management ("DSM") goals with respect to their economic cost-effectiveness. In brief, avoided costs serve as the cost benchmark by which supply- and demand-side resource options are gauged. The selection of demand-side options often involves long-term commitments, much like supply options. Accordingly, the process of resource assessment employs estimates of avoided costs over extended future years. FPUC's hourly avoided costs were estimated for years 2023-2050 and provided to Resource Innovations, Inc. for use within the process of evaluating impacts of DSM technologies.

Q. What is the structure of avoided costs and how are they estimated?

A. Avoided costs are specific to functional activity including generation, transmission, distribution and, possibly, customer and interconnection services. The estimates of avoided costs provided here are organized in a similar fashion. The generation component includes avoided cost estimates for energy, operating reserves, and capacity (estimated via scarcity pricing after 2026). Avoided costs of power delivery include transmission-related capacity costs as well as transmission- and distribution-related energy costs (as reflected by line and transformer losses). Hourly avoided costs were estimated for each of these components for the years 2023-2050. The avoided costs for years 2023-2026 were based on commercial terms of FPUC's contract with Florida Power and Light ("FPL") for generation and transmission services while the projected avoided costs for years 2027-2050 were based on electricity market simulations. Details of the methodology used to estimate avoided costs for each cost category are provided in Exhibit MTC-2.

III. Summary of Results

Q. Please discuss Florida Public Utility Company's projections of avoided costs for use in the FEECA evaluation studies.

A. Table 1 presents FPUC's estimates of avoided costs, in nominal terms, for selected years between 2024 and 2050. The average hourly avoided costs are provided for each cost component, season, and off-peak/peak timeframes. The seasonal definitions consist of May through September for summer, April and October for "shoulder" months, and November through March for winter. The "peak" period is defined as 4-9 p.m. for all months. As discussed above, the avoided cost components align with the function of providing electricity services: energy (including transmission and distribution line losses), generation capacity, and transmission capacity. All-in generation and transmission ("G&T") costs are the total of the avoided cost components. The annual average of the all-in G&T avoided costs for FPUC increase over time from \$62.31 in 2024 to \$142.14 in 2050, representing an annual increase of 3.2%.

Table 1: Florida Public Utility Company's Estimates of Avoided Costs, 2024-2050

Year	Cost Element	Annual	Summer		Shoulder		Winter	
			Off-Peak	Peak	Off-Peak	Peak	Off-Peak	Peak
2024	Energy	50.53	47.90	47.90	48.28	48.28	54.10	54.10
	Generation Capacity	7.68	5.09	17.30	4.54	19.50	6.75	11.46
	Transmission Capacity	4.11	2.72	9.26	2.43	10.43	3.61	6.14
	All-in G&T Avoided Cost	**62.31**	**55.71**	**74.46**	**55.24**	**78.21**	**64.46**	**71.70**
2026	Energy	54.85	51.62	51.62	51.93	51.93	59.31	59.31
	Generation Capacity	7.68	4.45	19.71	3.79	22.35	5.96	14.48
	Transmission Capacity	4.35	2.52	11.16	2.15	12.65	3.37	8.20
	All-in G&T Avoided Cost	**66.88**	**58.60**	**82.49**	**57.87**	**86.93**	**68.64**	**81.99**
2027	Energy	47.11	40.08	43.28	37.53	41.97	56.21	60.27
	Generation Capacity	0.50	0.00	5.72	0.00	0.00	0.00	0.00
	Transmission Capacity	5.15	5.85	36.24	0.02	0.74	0.03	0.02
	All-in G&T Avoided Cost	**52.76**	**45.93**	**85.24**	**37.56**	**42.71**	**56.24**	**60.29**
2032	Energy	60.78	56.42	62.61	50.78	59.49	65.90	72.13
	Generation Capacity	23.84	3.36	252.65	0.00	0.00	0.73	4.97
	Transmission Capacity	5.66	6.43	39.87	0.03	0.82	0.03	0.02
	All-in G&T Avoided Cost	**90.29**	**66.21**	**355.13**	**50.80**	**60.30**	**66.66**	**77.12**
2038	Energy	75.25	69.50	78.84	62.93	74.83	81.03	90.92
	Generation Capacity	22.19	0.23	198.06	0.00	0.00	2.95	44.66
	Transmission Capacity	6.35	7.22	44.72	0.03	0.92	0.04	0.02
	All-in G&T Avoided Cost	**103.79**	**76.94**	**321.61**	**62.96**	**75.75**	**84.02**	**135.60**
2044	Energy	91.29	84.27	95.73	76.34	90.72	98.36	110.10
	Generation Capacity	14.43	2.33	99.22	0.00	0.00	2.94	46.75
	Transmission Capacity	7.12	8.09	50.15	0.03	1.03	0.04	0.02
	All-in G&T Avoided Cost	**112.84**	**94.69**	**245.10**	**76.37**	**91.74**	**101.35**	**156.87**
2050	Energy	113.25	104.91	117.63	94.77	111.24	122.47	135.04
	Generation Capacity	20.91	22.76	68.07	0.00	2.88	2.93	73.68
	Transmission Capacity	7.99	9.08	56.24	0.04	1.15	0.05	0.03
	All-in G&T Avoided Cost	**142.14**	**136.74**	**241.94**	**94.81**	**115.27**	**125.46**	**208.75**

Note: Summer is May through September, Shoulder is April and October, and Winter is November through March. Peak hours are hours-ending 17-21.

Q. Please summarize your estimates for the avoided costs of energy.

A. The average annual avoided cost of energy is expected to rise from $50.53/MWh in 2024 to $113.25/MWh in 2050, exhibiting an annual increase of 3.2%. The avoided cost of energy is highest during the winter period and lowest during the summer off-peak period. The higher avoided costs in winter are driven by the monthly pattern of projected natural gas prices as well as comparatively low-cost generators coming offline during this period for scheduled maintenance, resulting in less efficient generator units being dispatched to meet demand. Increased energy costs are also driven by rising demand in the near term. Specifically, as load levels get progressively higher, this results in more hours during which, on average, less efficient generators with associated higher fuel costs will need to be dispatched.

Q. Please summarize estimates for the avoided costs of generation and transmission capacity.

A. The annual average of avoided generation capacity costs remains unchanged for years 2024 through 2026, per the FPU-FPL power supply agreement. The annual average of avoided generation capacity costs, however, in 2027 is $0.50/MWh, which increases to $20.91/MWh in 2050.

The avoided costs for 2027 through 2050 are based on electricity market simulations. Generation capacity cost estimates reveal substantial year-over-year variation, reflecting the true nature of wholesale electricity markets: tight supply-demand balance conditions during some years and capacity-long conditions in others. A tight supply-demand balance results in higher generation capacity prices while capacity-long conditions result in lower, even zero, generation capacity prices because of scarcity pricing, which reflects the value of reliability when available generation supply is low relative to demand (i.e., prices increase as reserve margins decrease). For instance, at the time the analysis was carried out, the FRCC region was projected to be comparatively long in generation capacity in 2027, resulting in a relatively low avoided generation capacity cost average of $0.50/MWh. Similarly, between years 2027 and 2050, seasons and off-peak/peak periods with zero avoided generation capacity costs reflects durations when generation capacity is sufficient to meet demand and a reserve margin in all hours. Avoided generation capacity costs are highest during the summer peak period because these reflect hours when generation supply is low relative to demand. In short, annual, seasonal, and off-peak/peak period differentiation in avoided capacity costs are driven by evolving patterns of supply and demand conditions.

Avoided costs for transmission capacity are estimated on the basis of recent historical experience of FPL with respect to investment and operations and maintenance expenditures in transmission facilities, as reflected in their publicly available FERC Form 1. This historical view suggests that transmission costs will rise by 2.6% annually. Seasonal and off-peak/peak period differentiation in avoided transmission capacity costs is driven by evolving load patterns, as these costs are allocated amongst hours with the highest loads.

Q. Does this conclude your testimony.

A. Yes.

Michael Ty Clark

RESUME

April 2024

Address:

Laurits R. Christensen Associates, Inc.
800 University Bay Drive, Suite 400
Madison, WI 53705-2299
Telephone: 608.231.2266
Fax: 608.231.2108
Email: mtclark@LRCA.com

Academic Background:

PhD – Florida State University, 2015, Economics
MS – Florida State University, 2013, Economics
BA – Utah State University, 2011, Economics

Positions Held:

Vice President, Laurits R. Christensen Associates, Inc., 2022-present
Senior Economist, Laurits R. Christensen Associates, Inc., 2017-2021
Economist, Laurits R. Christensen Associates, Inc., 2015-2017
Instructor, Florida State University, Summer 2013-2014
Teaching Assistant, Florida State University, 2011-2015

Professional Experience:

Specialization in energy, antitrust, applied econometrics, data analysis, and microeconomic theory. My energy experience involves econometric application and data management, such as evaluating residential, commercial, or industrial demand response programs for utilities. I have provided testimony regarding load forecasting, marginal cost of service, and rate design issues including time-of-use and revenue decoupling. My antitrust experience includes class action lawsuits concerning price fixing and price discrimination matters; covering industries such as broilers, animation, electrical components, wholesale & retail gasoline, and airlines. I have implemented an array of quantitative techniques including various econometric models, demand estimation, machine learning, forecasting, and management of large complex datasets.

Major Projects:

Provided report and analysis of a Real-Time Pricing pilot program for an Investor-Owned Utility.

Provided report and analysis of a Real-Time Pricing pilot program developed for agricultural customers of a Community Choice Aggregator.

Provided direct testimony evaluating the marginal cost of service study and rate design issues in a utility rate case. The rate design topic areas covered Time-of-Use, electric vehicle rates, and revenue decoupling.

Prepared load forecast and direct testimony for utility rate case including forecasts of energy, demand, electric vehicles, distributed generation, and energy efficiency. Provided direct testimony and analysis for Time-of-Use rate design.

Prepared revenue requirement forecast for utility including projections of energy, generation capacity, and transmission capacity costs. Provided rate design recommendations for Critical Peak Pricing (CPP) and DC Fast Charging (DCFC) options.

Estimated long-term marginal costs in the Florida Reliability Coordinating Council region as part of an evaluation to determine the cost effectiveness of LED lighting.

Provided long-term forecast of utility loads, including simulations of electric vehicle and solar generation adoptions paths and their effect on system loads.

Provided bill-impact analysis and support for utility as part of their general rate case.

Estimated Real-Time Pricing (RTP) load impacts as well as forecasted RTP impacts over various simulations.

Econometric pass-through analysis in antitrust class action (multi-district) supply fixing case.

Estimated Covid-19 related load impacts of Shelter-in-Place (SIP) orders for residential customers. Provided rate comparisons assuming different SIP durations.

Developed and implemented methodology to estimate load impacts for electric vehicle TOU rates by identifying the date customers begin charging electric vehicle via structural breaks in usage.

Provided econometric support in antitrust price discrimination (*i.e.,* Robinson Patman Act) class action case.

Provided support in antitrust price discrimination case regarding wholesale and retail gasoline sales.

Econometric analysis and report of utility pilot program implementing TOU rate and CPP events with customer-installed Wi-Fi thermostats. Analysis included demand response, energy efficiency, and bill impacts.

Estimated TOU load impacts for residential customers with rooftop solar systems (*i.e.,* net energy metering).

Evaluated load impacts associated with installing rooftop solar for residential customers; simulated photovoltaic distributed generation profiles.

Econometric analysis and report of electricity and gas energy efficiency impacts regarding the installation of Wi-Fi thermostats.

Evaluated residential demand response pilot programs with programmable-controllable thermostats; provided weather specific forecasts. Modeled discrete choice event opt-out behavior.

Provided econometric support and data management in multi-district antitrust price fixing case.

Assisted in the development of wholesale electricity transmission prices.

Assisted developing a report regarding the assumptions of non-hydro renewable generation in the Clean Power Plan Regulatory Impact Analysis.

Professional Papers:

"2023 Statewide Load Impact Evaluation of Non-Residential Critical Peak Pricing (CPP) Rates" with Daniel G. Hansen, Xueting Wang, and Daniel McLeod, 2024.

"2023 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates" with Corey Lott and Andi Romanovs-Malovrh, 2024.

"2023 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report" with Daniel G. Hansen and Michael Vigdor, 2024.

"Mid-Term Evaluation of Valley Clean Energy's Agricultural Pumping Dynamic Rate Pilot" with Daniel G. Hansen, December 22, 2023.

"Mid-Term Evaluation of Southern California Edison's Dynamic Rate Pilot" with Daniel G. Hansen, December 22, 2023.

"2022 Statewide Load Impact Evaluation of Non-Residential Critical Peak Pricing (CPP) Rates" with Daniel G. Hansen, Corey Lott, and Xueting Wang, 2023.

"2022 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates" with Nick Crowley, and Aidan Glaser Schoff, 2023.

"2022 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report" with Daniel G. Hansen and Michael Vigdor, 2023.

"2021 Statewide Load Impact Evaluation of Non-Residential Critical Peak Pricing (CPP) Rates" with Daniel G. Hansen, Corey Lott, Xueting Wang, and Michael Vigdor, 2022.

"2021 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates" with Daniel G. Hansen, Nick Crowley, and Aidan Glaser Schoff, 2022.

"2021 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report" with Daniel G. Hansen and Michael Vigdor, 2022.

"2020 Load Impact Evaluation of San Diego Gas and Electric's Electric Vehicle Rates" with Daniel G. Hansen, 2021.

"2020 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates" with Daniel G. Hansen, Nick Crowley, and Navya Kataria, 2021.

"2020 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report" with Daniel G. Hansen, 2021.

"2019 Load Impact Evaluation of San Diego Gas and Electric's Electric Vehicle Rates" with Daniel G. Hansen, and Nick Crowley, 2020.

"2019 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates" with Daniel G. Hansen, Nick Crowley, and David A. Armstrong, 2020.

"2019 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report" with Daniel G. Hansen and David A. Armstrong, 2020.

"2018 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates" with Daniel G. Hansen and Nick Crowley, 2019.

"2018 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report" with Daniel G. Hansen and David A. Armstrong, 2019.

"2017 Statewide Load Impact Evaluation of Non-Residential Critical Peak Pricing (CPP) Rates" with Daniel G. Hansen, Corey Lott, and Nick Crowley, 2018.

"2017 Load Impact Evaluation of California Statewide Base Interruptible Programs (BIP) for Non-Residential Customers: Ex-post and Ex-ante Report" with Daniel G. Hansen and Nick Crowley, 2018.

"2017 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates" with Daniel G. Hansen and Nick Crowley, 2018.

"2016 Load Impact Evaluation of Sacramento Municipal Utility District's No Opt-Out PowerStat Pilot Program" with Daniel G. Hansen, Michael J. Thacker, and Steven D. Braithwait, 2017.

"2016 Load Impact Evaluation of Sacramento Municipal Utility District's PowerStat Pilot Program" with Daniel G. Hansen, Michael J. Thacker, and Steven D. Braithwait, 2017.

"2016 Load Impact Evaluation of Pacific Gas and Electric Company's Residential Time-Based Pricing Programs: Ex-post and Ex-ante Report for Customers with Net Energy Metering," with Daniel G. Hansen and Nick Crowley, 2017.

"2016 Load Impact Evaluation of Pacific Gas and Electric Company's Mandatory Time-of-Use Rates for Small, Medium, and Agricultural Non-residential Customers: *Ex-post* and *Ex-ante* Report," with Daniel G. Hansen and Nick Crowley, 2017.

"2016 Load Impact Evaluation of San Diego Gas and Electric's Voluntary Residential Critical Peak Pricing (CPP) and Time-of-Use (TOU) Rates," with Steven D. Braithwait and Daniel G. Hansen, 2017.

"2015 Load Impact Evaluation of California Statewide Demand Bidding Programs (DBP) for Non-Residential Customers: Ex-post and Ex-ante Report," with Daniel G. Hansen, 2016.

Public Testimony

<u>New Hampshire Department of Energy, New Hampshire Public Utilities Commission Docket No. DE 23-039</u>: Testimony on behalf of the New Hampshire Department of Energy reviewing Liberty Utilities' marginal cost of service study and rate design issues relating to Time-of-Use, electric vehicles, and revenue decoupling, December 13, 2023.

<u>Alpena Power Company, Michigan Public Service Commission Case No. U-21488</u>: Testimony regarding the development of utility load forecast and Time-of-Use rate design on behalf of Alpena Power Company, December 11, 2023.

Conference and Workshop Presentations:

2024 EUCI Avoided Costs of Electricity Services Conference (Virtual)
2023 EEI Electric Rates Course (Madison, WI)
2023 DRMEC Load Impact Evaluation and Enrollment Workshop (Virtual)
2022 DRMEC Load Impact Evaluation and Enrollment Workshop (Virtual)
2021 EUCI TOU/Residential Demand Charges Workshop (Virtual)
2021 DRMEC Load Impact Evaluation and Enrollment Workshop (Virtual)
2017 EUCI Rate Design Post-Conference TOU Workshop (Baltimore, MD)
2017 DRMEC Load Impact Evaluation and Enrollment Workshop (San Francisco, CA)
2016 DRMEC Load Impact Evaluation and Enrollment Workshop (San Francisco, CA)
2014 Southern Economic Association (Atlanta, GA)
2011 Association of Private Enterprise Education (Nassau, Bahamas)

Journal Articles:

"The Law of the Taxi: Informal Property Rights Institutions in the Uninhibited State" with Diana W. Thomas, Humberto Alba Castillo, and Kevin D. Gomez), *Journal of Private Enterprise*, 35(3): 49-62, 2020.

Unpublished Papers:

"Passenger Welfare Effects from Post-Merger Route Adjustments," with Gary M. Fournier.

"Predicting Network Efficiency Gains in Airline Mergers for Antitrust Review," with Gary M. Fournier.

"Slot Transfers as a Remedy in Airline Mergers: UA-CO Divestitures at Newark," with Gary M. Fournier.

Fellowships & Awards:

Dec. 2014	Rockwood Teaching Award, Florida State University
2012-2015	Manuel and Mary Johnson Endowed Graduate Fellowship, Florida State University
2011-2012	Manly Johnson Doctoral Fellowship, Florida State University

Computer/Programming Skills: Stata, SAS, R, LaTex, MS Office suite

REPORT

LONG-TERM AVOIDED COSTS OF ELECTRICITY

for assessment of

RESOURCE OPTIONS INCLUDING CONSERVATION PROGRAMS AND LED LIGHTING

for

FLORIDA PUBLIC UTILITIES COMPANY

prepared by

Michael Ty Clark
Robert J. Camfield
Michael Vigdor
David Armstrong
CHRISTENSEN ASSOCIATES ENERGY CONSULTING, LLC

April 2, 2024

Table of Contents

EXECUTIVE SUMMARY

This report presents long-term projections of the avoided costs of electricity services provided by Florida Public Utilities Company (FPUC) for the years 2023-2050. FPUC's avoided cost study covers load-related costs including generation and transmission (G&T) services, as well as marginal line losses[1] within distribution services. Avoided costs are reported for these services, and also for FPUC's LED lighting program. Avoided generation costs include energy, operating reserves, and reliability cost components, while avoided transmission costs include marginal losses and capacity costs. For years 2023-2026, FPUC's avoided cost study reflects the commercial terms of FPUC's contract with Florida Power and Light (FPL) for G&T services. Projections of avoided costs for years 2027-2050 are estimated with electricity market simulation tools, which provide the means to estimate avoided costs over alternative scenarios of electricity demand and supply within Florida's wholesale electricity market region, organized under the Florida Reliability Coordinating Council (FRCC).

Avoided cost—also referred to as *marginal cost*—is the change in the total cost of electricity services associated with a change in the level of services provided. Avoided cost projections are forward-looking and serve as the benchmark to assess the net benefits from changes in demand- and supply-side resources such as conservation programs and gains in system-wide efficiency. Changes in the electricity services provided—e.g., higher peak loads because of unusually hot weather or reduced peak loads arising from customer response to time-of-use programs, or simply increased usage due to a rise in the number of customers served—have corresponding cost impacts, up or down. Viewed broadly, estimates of avoided cost are fundamental to electricity service providers such as FPUC: decisions to commit demand- and supply-side resources should take full account of impacts associated with the resources under consideration. Demand-side management (DSM) and conservation, and system-wide gains in energy efficiency, including conversion to LED lighting, cause the volume of electricity consumed, measured as kilowatt hours (kWh), to decrease; total electricity costs decline, thus providing overall net benefits to

---

[1] Marginal line losses in power delivery services (transmission and distribution, or T&D) are determined predominantly by the voltage levels of T&D circuits, load levels, and circuit distances. Marginal (and average) line losses are energy-related costs.

electricity consumers.[2] To the extent that electricity consumption decreases as a consequence of policy actions and resource choices, loads—and thus costs—are reduced or "avoided".

Avoided costs are estimated in hourly frequency using simulation modeling tools. For contract-based avoided costs (years 2023-2026), estimated avoided costs specific to FPUC's lighting program are as follows:

LED Lighting Avoided Costs of Generation and Transmission, 2023-2026 ($/MWh)

Month	Hours Per Month	2023	2024	2025	2026
1	744	55.36	67.64	71.44	74.21
2	672	49.14	68.48	72.79	75.37
3	744	41.72	57.04	59.36	62.87
4	720	41.52	48.86	52.09	53.37
5	744	40.82	46.20	49.15	50.67
6	720	42.57	47.93	50.43	51.03
7	744	44.54	48.92	51.95	53.21
8	744	45.37	48.53	51.58	51.91
9	720	46.07	49.11	52.04	53.61
10	744	47.75	51.37	53.15	55.88
11	720	61.72	64.98	69.44	73.30
12	744	64.80	67.74	71.87	72.92
Hourly Weighted Average ($/MWh)		48.45	55.49	58.69	60.61

As shown, avoided costs vary considerably with respect to month, predominantly as a consequence of load shape differences. In addition, the near-term outlook for natural gas prices—based on settled futures contracts observed during March 2023—rose significantly over the last year, leading to higher costs through the remaining term of the FPUC-FPL contract. In summary, estimates of avoided generation and transmission costs rise throughout the duration of the contract.

The longer-term outlook, covering years 2027-2050, is much more difficult to assess in view of technology advances and carbon policy favoring renewable resources. First, the long-term outlook for electricity

[2] Total costs decline because electricity costs are positively related to the level of services provided. However, if avoided costs are less than average system costs, average cost-based prices paid by retail consumers may rise as sales volumes decline.

demand reflects expectations of substantial electrification, where a central feature is fast-paced adoption of electric vehicles (EVs). Second, penetration of distributed resources, particularly solar energy in Florida, significantly offset baseline residential and commercial demand. Third, on the supply side, all-in facility costs of solar technology and battery storage have declined dramatically. Further gains in cost efficiencies are expected though at an attenuated pace; currently, the costs of solar energy and storage challenge that of fossil fuel generation technologies. In accordance with the appearance of these technologies, long-term projections of avoided costs incorporate the effects of these demand- and supply-side developments: high adoption of EVs and distributed solar systems on the demand side of electricity markets; similarly, solar power and storage technologies are expected to prove to be the dominant source of new electricity supply. Estimates of avoided costs specific to FPUC's lighting program for years 2027-2050 are as follows:

LED Lighting Avoided Costs of Generation and Transmission, 2027-2050 ($/MWh)

Month	Hours Per Month	2027	2029	2032	2035	2038	2041	2044	2047	2050
1	744	67.03	69.85	81.98	100.67	117.13	126.55	137.83	148.41	166.45
2	672	62.38	66.30	73.80	83.58	94.05	103.79	113.46	125.03	139.28
3	744	48.46	52.05	64.62	72.41	80.51	89.24	97.47	107.46	120.79
4	720	36.59	39.82	56.13	63.32	70.39	77.93	85.18	93.65	105.28
5	744	37.22	37.82	55.83	66.08	70.39	77.85	85.16	93.24	113.73
6	720	40.53	40.98	59.32	66.92	74.97	83.01	90.82	100.61	122.95
7	744	42.31	44.87	76.59	97.08	79.15	90.50	114.16	162.54	224.17
8	744	43.13	45.27	80.21	110.70	81.48	92.22	100.18	131.93	208.65
9	720	41.59	43.84	60.57	68.24	76.55	84.59	92.69	101.41	114.86
10	744	42.20	45.36	60.50	68.03	76.23	84.28	92.24	101.15	114.36
11	720	50.49	53.04	66.97	75.07	84.58	93.00	102.44	111.02	126.58
12	744	62.73	65.72	74.81	84.34	94.72	105.77	115.73	126.17	142.71
Hourly Weighted Average ($/MWh)		47.83	50.35	67.63	79.79	83.33	92.38	102.29	116.99	141.94

Differences in system reliability are the main cause of year-over-year estimates of avoided costs, which reveal substantial variation. However, cost variation across years is augmented by a steady increase in avoided costs over the long-term, mainly as a consequence of peak load hours shifting to later hours which increasingly overlap with LED lighting consumption.

To summarize, long-term avoided costs to serve LED load are expected to rise 4.8% annually from 2027 through 2050, stated in nominal dollar terms. This rising trend masks uncertainty inherent to the long-term outlook, covering several dimensions common to regulating prices for retail electricity services: long-term price escalation of inputs including fossil fuels and, potentially, rising capacity requirements. These aside, it is important to highlight potential changes driven by climate change. To the extent that climate change becomes a central concern to the public,[3] it is increasingly likely to precipitate substantive policy intervention by governing institutions. In turn, policy actions can assume multiple channels which affect electricity markets, such as carbon pricing tied to climate damage costs, intensive conservation, and technology mandates resulting in substantial advance of electrification.

[3] Foremost is the expedition with which climate change, manifest as rising global temperatures, increased frequency of violate storm activity, rising sea levels, and declining biodiversity, begins to take value from the daily lives of the peoples of Western economies.

INTRODUCTION

This report presents long-term projections of the avoided costs of electricity services provided by Florida Public Utilities Company (FPUC) for the years 2023-2050. FPUC's avoided cost study covers load-related costs, including generation and transmission (G&T) services, as well as marginal line losses[4] within distribution services. Avoided generation costs include energy, operating reserves, and reliability cost components, while avoided transmission costs include marginal losses[4] and capacity costs. For years 2023-2026, FPUC's avoided cost study reflects the commercial terms of FPUC's contract with Florida Power and Light (FPL) for G&T services. Projections of avoided costs for years 2027-2050 are determined with electricity market simulation tools, which provide the means to estimate avoided costs over alternative scenarios of electricity demand and supply within Florida's wholesale electricity market region, organized under the Florida Reliability Coordinating Council (FRCC).

Avoided cost—also referred to as *marginal cost*—is the change in the total cost of electricity services associated with a change in the level of services provided. Avoided cost projections are forward-looking and serve as the benchmark to assess the net benefits from demand- and supply-side resource changes such as conservation programs and gains in system-wide efficiency. Changes in electricity services provided—e.g., higher peak loads because of unusually hot weather, reduced peak loads arising from customer response to time-of-use programs, or simply increased usage due to increases in the number of customers served—have corresponding cost impacts, up or down. Viewed broadly, estimates of avoided cost are fundamental to electricity service providers such as FPUC: decisions to commit demand- and supply-side resources should take full account of impacts associated with the resources under consideration. Demand-side management (DSM) and conservation, and system-wide gains in energy efficiency, including LED lighting, cause electricity consumption measured as kilowatt hours (kWh) to decrease; total electricity costs decline thus providing overall net benefits to electricity consumers.[5] To

---

[4] Marginal line losses in power delivery services (transmission and distribution, or T&D) are determined predominantly by the voltage levels of T&D circuits, load levels, and circuit distances. Marginal (and average) line losses are energy-related costs.

[5] Total costs decline because electricity costs are positively related to the level of services provided. However, if avoided costs are less than average system costs, average cost-based prices paid by retail consumers may rise as sales volumes decline.

the extent that electricity consumption decreases as a consequence of policy, actions, and resource choices, loads—and thus costs—are reduced or "avoided".

The avoided cost report proceeds as follows:

Section I: Summary level estimates of FPUC's forward-looking avoided costs, reported separately for:

- *Years 2023-2026*, based on the commercial terms of the FPUC-FPL power supply contracts for G&T services; and,
- *Years 2027-2050*, based on market simulation for the FRCC region.

Section II: Detailed discussion of conceptual foundation underlying avoided cost estimates, highlighting alternative methods and the methodology applied in the immediate study.

Section III: Technical review of the applied methodology, including:

- General approach, and analysis process
- Analysis of Electricity Demand
    - historical hourly loads and selection of the baseline loads
    - conventional and electric vehicle (EV) loads
        - projections of EV counts and loads
    - solar generation for commercial and residential solar facilities
        - projections of commercial and residential solar adoption
- Analysis of Electricity Supply
    - generator unit retirements and additions
        - generator technology options and associated costs
    - fuel cost projections
    - estimates of generation reliability
    - generation expansion
        - technology selection: conventional and renewable resource options including battery storage
- Intermediate study results and diagnostics
- Gauging uncertainty and risks: range of potential outcomes

Section IV: Intermediate study results and diagnostics

- Technology selection
    - capacity additions: conventional and renewable resource shares
- Estimates of avoided costs of energy and operating reserves
    - count of loss of load events, 2027-2050
- Long-term avoided costs of generation services
- Avoided costs of transmission services
    - energy losses in power delivery services
    - marginal costs of transmission capacity

Section V: Report Summary Highlighting Major Findings

SECTION I: SUMMARY LEVEL ESTIMATES OF AVOIDED COSTS

Avoided costs of electricity services include the following cost components:

Generation Services: marginal energy, operating reserves, and reliability costs, the last measured as capacity costs.[6]

Transmission Services:[7] marginal energy and reliability costs, where energy costs are in the form of transmission line losses and reliability costs are measured as capacity costs.

Distribution Services:[7] marginal energy costs in the form of marginal line losses.

Long-term avoided electricity costs for FPUC are specific to timeframe and to load shape. For years 2023-2026, avoided costs are based on FPUC's contract for G&T services with FPL (*Contract-Based*). For years 2027-2050, avoided costs are based on the long-term outlook for electricity demand and supply within the FRCC region (*Market-Based*). Reported in nominal dollars, estimates of avoided costs are applied to the load shape of FPUC's lighting program, as simulated. Covering all services including generation, transmission, and distribution, projections of long-term avoided costs specific to FPUC's lighting program are as follows:

[6] Capacity costs are commonly interpreted as the shadow price of reliability costs, with reliability costs defined as outage costs, the value foregone by consumers resulting from unexpected power interruptions.

[7] Transmission and distribution services are often referred to as power delivery services.

Contract-Based Long-Term Avoided Costs to Serve LED Load, 2023-2026

LED Lighting Avoided Costs of Energy and Operating Reserves ($/MWh)

Month	Hours Per Month	2023	2024	2025	2026
1	744	44.80	56.54	59.81	61.90
2	672	35.30	54.02	57.76	59.69
3	744	36.47	51.39	53.33	56.44
4	720	39.79	46.83	49.75	50.60
5	744	40.70	46.01	48.86	50.24
6	720	42.53	47.85	50.29	50.72
7	744	44.34	48.66	51.65	52.84
8	744	45.36	48.50	51.52	51.76
9	720	45.62	48.50	51.25	52.57
10	744	46.38	49.68	51.04	53.21
11	720	49.43	51.73	55.24	57.98
12	744	54.30	56.72	60.24	60.53
Hourly Weighted Average ($/MWh)		43.81	50.53	53.38	54.85

LED Lighting Avoided Costs of Generation and Transmission Capacity ($/MWh)

Month	Hours Per Month	2023	2024	2025	2026
1	744	10.56	11.10	11.63	12.31
2	672	13.84	14.45	15.04	15.67
3	744	5.25	5.66	6.02	6.43
4	720	1.72	2.03	2.34	2.77
5	744	0.12	0.19	0.29	0.43
6	720	0.04	0.08	0.14	0.31
7	744	0.21	0.26	0.31	0.37
8	744	0.01	0.03	0.06	0.15
9	720	0.45	0.61	0.78	1.04
10	744	1.36	1.69	2.11	2.67
11	720	12.29	13.25	14.20	15.32
12	744	10.50	11.02	11.63	12.39
Hourly Weighted Average ($/MWh)		4.63	4.96	5.31	5.75

Market-Based Long-Term Avoided Costs to Serve LED Load, 2027-2050

LED Lighting Avoided Costs of Energy and Operating Reserves ($/MWh)

Month	Hours Per Month	2027	2029	2032	2035	2038	2041	2044	2047	2050
1	744	66.92	69.73	77.06	86.81	97.48	108.31	118.23	128.83	146.89
2	672	62.31	66.23	73.72	83.50	93.96	103.70	113.37	124.93	139.18
3	744	48.46	52.05	64.62	72.41	80.51	89.24	97.47	107.46	120.79
4	720	36.59	39.82	56.13	63.32	70.39	77.93	85.18	93.65	105.28
5	744	37.22	37.82	55.83	62.90	70.39	77.85	85.16	93.24	105.33
6	720	40.48	40.93	59.26	66.85	74.91	82.94	90.75	99.38	112.44
7	744	41.03	43.54	61.20	69.08	77.52	85.95	94.10	103.02	116.53
8	744	42.88	45.01	62.41	70.48	79.12	87.94	96.27	105.31	119.02
9	720	41.58	43.84	60.57	68.23	76.54	84.58	92.68	101.40	114.85
10	744	42.20	45.36	60.50	68.03	76.23	84.28	92.24	101.15	114.36
11	720	50.49	53.04	66.97	75.07	84.58	93.00	102.44	111.02	126.58
12	744	62.73	65.72	74.81	84.34	94.72	105.77	115.73	126.17	142.71
Hourly Weighted Average ($/MWh)		47.68	50.19	64.39	72.54	81.31	90.07	98.58	107.90	121.93

LED Lighting Avoided Costs of Generation and Transmission Capacity ($/MWh)

Month	Hours Per Month	2027	2029	2032	2035	2038	2041	2044	2047	2050
1	744	0.11	0.12	4.92	13.86	19.65	18.23	19.60	19.58	19.56
2	672	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.10	0.11
3	744	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	720	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	744	0.00	0.00	0.00	3.18	0.00	0.00	0.00	0.00	8.40
6	720	0.05	0.05	0.06	0.07	0.06	0.07	0.07	1.23	10.52
7	744	1.28	1.33	15.38	27.99	1.63	4.54	20.06	59.53	107.64
8	744	0.25	0.26	17.80	40.22	2.36	4.29	3.90	26.61	89.63
9	720	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10	744	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	720	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	744	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hourly Weighted Average ($/MWh)		0.15	0.16	3.25	7.25	2.02	2.31	3.71	9.09	20.00
Hourly Weighted Average, Smoothed		0.15	0.23	0.44	0.84	1.59	3.04	5.79	11.04	21.05

As shown above, marginal energy and reserves prices under FPUC's contract with FPL during 2026 (averaging $54.85/MWh) are above the estimates of FRCC market prices for 2027 ($47.68/MWh). Similarly, market-based G&T capacity costs beginning in 2027 ($0.15/MWh) are much lower than G&T costs for the terminal year of the FPUC-FPL contract for 2026 ($3.14/MWh). The lower G&T costs from 2027 through 2035 reflect that, as projected, total supply of generation resources (capacity) is comparatively *long* when gauged with to expected demand for the FRCC region. Consequently, scarcity value[8] has very limited presence during the hours when FPUC's LED lighting is drawing energy. However, thereafter G&T costs rise through 2050 as a result of hours of peak load shifting to later hours in the day and thus overlapping more with the hours when LED lighting is active. Further, capacity cost estimates reveal substantial year-over-year variation, reflecting the true nature of electricity markets: tight supply-demand balance conditions during some years and capacity-long conditions in others. It is important to

[8] Which reflects the value of reliability and, over years, approximates the marginal cost of capacity.

acknowledge that other scenarios can be constructed where the year-over-year pattern of tight and long conditions vary considerably from this baseline scenario. Stated in nominal terms, overall energy and capacity costs are expected to rise 4.1% annually from 2023 through 2050.

SECTION II: CONCEPTUAL FOUNDATION UNDERLYING AVOIDED COSTS

As mentioned, avoided cost refers to the change in total costs associated with a change in the level of services provided. Avoided/marginal costs are highly specific to industry and underlying production technology. For infrastructure industries—electric power in particular—avoided cost is broadly recognized as the appropriate basis to value demand- and supply-side resources used in the provision of services. In the case of electricity, avoided costs are determined by the demand for and supply of electric power and, over long-term forward timeframes, are estimated using model simulation tools.[9] For electricity services, viable estimates of avoided costs assume strategic importance, serving as the basis for short- and long-term resource decisions. Estimates of avoided costs can also inform the process of retail cost allocation and tariff design.

Avoided cost, *marginal cost*, and *incremental cost* constitute interchangeable terminology and have highly similar if not identical meaning: the cost impact arising from a change in the electricity services provided (i.e., the level of load served). Avoided and marginal costs are determined according to the expected level of services: what would be the cost impact if electricity services (load level) were somewhat lower or somewhat higher? Avoided costs are *at the margin*: cost changes, up or down, with respect to the expected load level. The notion of avoided costs implies *costs saved*; essentially, a lower level of cost expenditure because the service quantities (kWh) provided are reduced through conservation, or other causes.

For example, if the level of total system load across the FRCC region is expected to reach, say, 44,234 MW for a duration of one hour during a summer afternoon, avoided cost is the change in total costs if the total system load is reduced by 1 MW—from 44,234 to 44,233 MW. As a practical matter, the resulting avoided cost is also the answer to the question "what is the change in total cost if the system load were to rise by 1 MW—from 44,234 MW to 44,235 MW?" The resulting marginal cost might well be different if the baseline expected system load were 40,000 MW. In brief, avoided cost—which, again, is interchangeable with marginal or incremental cost—is determined for a change in system load and is specific to timeframe

[9] Observed electricity futures for selected transaction hubs within North American wholesale electricity markets can be used to gauge the expectations of prices (avoided costs) harbored by wholesale market participants.

such as peak-period hourly loads, off-peak loads, or longer duration periods including months and seasons.

Load level coupled with other data inputs come together within a model framework to estimate avoided costs. Avoided costs are specific to time and location, although the locational differences are usually modest across the numerous locations that constitute regional networks, for most regions of North America during most timeframes. On the other hand, cost variation in time domain can be very large, exceeding 30-to-1 in some instances. For some regions, forward-looking estimates of avoided costs should take account of cost variation in time domain as a matter of first approximation, and also incorporate locational and area differences as appropriate.

Retail electricity service is a bundle of upstream services, including:

- *generation services*, in the form of electric energy, operating reserves, and reliability costs;
- *transmission services*, in the form of capacity to provide the long- and medium-distance transport of generation services (energy, operating reserves, capacity) between production locations (generator sites) and delivery locations, including interconnections with distribution systems[10] and large industrial consumers served at high voltages. Transmission services are provided by high voltage electrical networks, configured as either meshed[11] or radial circuits; and,
- *interconnection services* involving the electrical interconnection of generator sites, power distribution, and large consumers within the transmission network. Interconnection involves voltage transformation, carried out at the various points of delivery. For FPUC, this includes large substations but, generally speaking, can potentially include large-scale pad mount transformers and associated control equipment.[12]

---

[10] Locations of power distribution would include substations where distributors such as FPUC takes delivery of generation and transmission services.

[11] The term "meshed systems" refers to parallel path electrical systems where power flows from production locations to delivery locations over multiple paths, including loop circuits and the many parallel paths that constitute vast interconnected networks such as those that make up the Eastern Interconnection.

[12] Marginal cost estimation may reflect wholesale power transactions where the measurement and billing of both the quantities of supply (power generation) and quantities of demand (electricity consumption of retail consumers) are accounted for.

Avoided/marginal cost analyses draw on *short-* and *long-run* concepts applicable to cost analyses for power systems and markets.[13] Estimates of marginal costs reflect expected cost impacts resulting from changes in the level of loads served, and include the several components of marginal costs.[14] The most relevant definition of avoided/marginal cost for resource valuation and pricing electricity services is *Short-Run Marginal Cost* (SRMC), estimated for both near real-time and longer-term forward periods. Properly executed, estimates of short-run marginal costs reflect projections of real-world conditions over future periods. As a practical matter, however, short-run marginal costs for transmission and interconnection services are not readily observable.[15] Thus, for these services, estimates of *Long-Run Marginal Costs* (LRMC) can serve as viable proxies for forward-looking short-run marginal costs.

---

[13] Short-run marginal cost is the change in short-run variable costs with respect to a change in load. Some costs remain unchanged in the short run and are thus referred to as fixed costs. That is, the timeframe—*e.g.*, week- month- or year ahead—is too short for physical facilities and other resources currently in place (the stock of physical capital and system infrastructure including information and control systems) to be altered or adjusted. In the short run, the capital-related charges and fixed operations and maintenance costs (FOM) associated with physical facilities system infrastructure do not vary as load varies.

In the long run, all costs, including capital charges and FOM associated with physical resources, vary in response to a change in load level. This means that, in the long run, a change in the expected load level precipitates adjustments to physical facilities in order to obtain the preferred (least total cost) resource configuration and mix. In the context of the real world, long-run adjustments—*i.e.*, the implementation of adjustments to the resource pool in order to obtain the least cost configuration—may take a very long time, years or a decade. Indeed, the process of implementing long-run adjustments to realize the optimal configuration is likely to be taking place *as the optimal configuration is also evolving*. As a practical matter, then, the long-run definition of marginal cost is more relevant as a conceptual view. In brief, long-run marginal cost is the change in total cost with respect to a change in load if all resources could be adjusted to the optimal configuration *overnight*.

In summary, the most useful marginal cost metric is forward-looking (*ex-ante*) short-run marginal cost, where forward-looking SRMC embody expected long-run adjustments. Accordingly, the immediate discussion is confined to SRMC although capacity cost proxies, which are essentially LRMC adjustments to SRMC, are incorporated in the analysis. These cost proxies, in the form of marginal capacity costs, are incorporated within SRMC as a surrogate for reliability costs, for both generation and power delivery (transmission and distribution, or T&D). For FPUC's avoided cost study, load-related capacity costs within power delivery services are limited to transmission.

[14] The notion of *conditions* is inclusive of all factors which have measurable impact on costs over forward periods including supply-demand balance and supply costs. Relevant factors include, for example, weather and level of electricity demand, changes in the portfolio of generation, incremental costs of new capacity including renewables, and primary fuel prices.

[15] The exception is unbundled locational electricity markets, wherein the short-run marginal cost of transmission is equal to the sum of the incremental impacts on locational prices (which incorporate marginal congestion and line

GENERATION SERVICES

Avoided costs of generation consist of *marginal energy* and *reserves costs*, where reserves include *operating reserves* and, separately, *planning reserves* manifest as the installed capacity. *Marginal energy cost* refers to the incremental fuel and, where relevant, variable operating and maintenance costs associated with a change in load level.[16]

The marginal costs of reserve services include two components: operating reserve costs and reliability costs. *Operating reserve costs* are set to the opportunity costs of the marginal generator providing operating reserves. Opportunity costs in turn reflect the difference between wholesale market energy price and the internal costs of production for the last generator committed to providing operating reserves. In the case of reserves for reliability, well-established least-cost planning criteria are used to determine the level of capacity necessary to ensure that retail electricity services are provided with the appropriate level of reliability.[17]

Marginal Reliability Cost refers to the cost associated with unexpected power interruptions—the likelihood and magnitude of electricity demand not served because of power outages. Reliability costs can be measured in several ways including the direct costs incurred because of unexpected power failures, referred to as *Consumer Outage Cost.* However, outage costs are difficult to objectively measure for forward-looking periods, although estimates of outage costs can be drawn from survey results. An alternative approach, referred to as *Capacity Cost*, determines reliability costs according to the incremental costs of generating capacity, under the assumption that, in equilibrium, the cost of capacity

---

losses) among the relevant locations. Essentially, a change in load at a specific location gives rise to changes in costs at multiple locations.

[16] As a practical matter, generator unit operations and maintenance costs (O&M) are assumed to be largely fixed over the relevant operating range and are thus not incorporated within the estimates of avoided costs.

[17] At least as planned. The level of reliability experienced by retail consumers—measured as the likelihood of the total load not being served—can vary widely month-to-month and from one year to the next. Varying reliability is largely a consequence of unanticipated load levels, generator maintenance schedules, and unit availability—which can be affected by weather events—and, for smaller power systems, large shares of total capacity invested in individual generator units and stations (an issue of capital indivisibility).

equals the value to customers of reliability. In brief, capacity cost is a proxy for reliability, measured as the likelihood of outage cost realization by electricity consumers.[18]

Marginal Energy and Operating Reserves Costs

Forward-looking estimates of marginal energy and operating reserves costs can be obtained in three ways, including *Contract-Defined Incremental Costs*, *Internal Marginal Production Costs*, and *Market-Based Opportunity Costs*. Marginal energy and operating reserves costs are stated in terms of dollars per megawatt hour (MWh) or per kWh (the immediate study reports marginal cost estimates in $/MWh terms).

Contract-Defined Incremental Cost: For the term of a power supply contract, often referred to as a *power purchase agreement* (PPA), the commercial terms of the contract determine avoided costs, provided that the contract is either a *full requirements* contract covering the several elements of generation services in full or, alternatively, a partial requirements contract which is used as the basis for balancing supply with hourly loads.

Internal Production Cost: An internal cost approach entails estimates of loads, including hourly peak and off-peak demands, along with supply-side data including primary fuel prices and parameters describing the individual units of the generation fleet. For estimation of internal production costs, key parameters[19] of generating units include installed capacity, maintenance schedules, and the availability of generation units.[20] Least cost dispatch procedures are simulated, thus obtaining estimates of internal production

---

[18] In the presence of competitive wholesale markets, incremental capacity costs can be set equal to the observed market prices for generation capacity, as obtained from regional capacity auctions.

[19] For specific generating units, selected operating parameters are not observed in which case are set according to general information reported for specific generating technologies.

[20] The full set of parameters incorporated in power system simulations can include, for individual units, effective capacity, marginal heat rates, fuel costs, variable operations and maintenance costs (VOM), maintenance time, forced outage rates, time to repair, and ramp rates.

costs—ideally including both energy and operating reserves—over future timeframes.[21, 22] Marginal cost is revealed by observing (or estimating) the change in total production cost for a given change in load. Alternatively, marginal energy cost can be defined as the incremental (or average) operating cost of the highest cost unit dispatched.

Market-Based Opportunity Costs: This approach sets marginal energy cost according to the expected electricity prices, as estimated for wholesale electricity markets over forward periods. Generally speaking, electricity prices so determined are the result of competitive auction procedures and reflect the highest-valued use of the participating generator units for the market as a whole. Properly designed, auctions simultaneously obtain least-cost short-run supply *and* set prices equal to the marginal cost of supply, including energy and operating reserves.

Under least-cost dispatch, internal production costs rise with increased demand. Competitive wholesale power markets present cost-minimizing opportunities not otherwise available: participating service providers and independent generators can maximize the short-run internal value of their generation resources which simultaneously yields least total cost for the region as a whole. This result is implicitly obtained through: 1) the sale of power within the market under the condition when internal costs are less than short-run market auction prices; and 2) the purchase of power from markets when internal costs are above auction prices. In the case of condition 1), it is appropriate to sell power up to the point where the internal marginal production cost approximates auction prices (*i.e.*, the market price). In the case of condition 2), it is appropriate to purchase power up to the point where the internal production cost savings approximates market prices.

In brief, in the presence of competitive wholesale markets, the prices obtained reflect opportunity costs, the highest-valued use of marginal resources. Such result is fully consistent with least cost dispatch. Generally speaking, an opportunity cost approach is the preferred methodology under the condition

---

[21] For a simulation, the marginal energy cost in some hour of, say 2026, is the marginal running cost of the highest cost unit dispatched in order to satisfy the total system load in the hour.

[22] In the case of energy-limited hydraulic power systems, marginal cost involves estimating the likelihood that incremental service to contemporary loads (next hour, day, or week) will impose higher costs on consumers in prospective periods.

where: 1) service providers are actively engaged in wholesale markets, and 2) such markets are workably competitive. As a practical matter, when applied over forward periods, the opportunity cost approach also involves dispatch simulation,[23] as applied to hourly loads and generation in the regional market. In this way, market prices are marginal costs—hence the notion of opportunity costs.

<u>The Approach Used In this Study to Determine the Avoided Costs of Energy and Operating Reserves</u>*:* For years 2023 -2026, the immediate study determines avoided costs according to the commercial terms of FPUC's power supply contract for generation services with FPL. For years 2027-2050, avoided costs are determined according to market opportunity cost, as simulated for the FRCC region.

Marginal Reliability Cost

Marginal reliability cost refers to the change in the likelihood of power outage and the associated costs incurred by consumers as a consequence of a change in the level of load served. The likelihood of power outages rises with respect to increases in load level and declines with respect to load decreases. As mentioned above, marginal reliability cost can be measured either directly via estimates of *Consumer Outage Costs* or indirectly via a *proxy value of Generation Capacity Costs*. Capacity costs can be the *Incremental Cost of Capacity* internal to the service provider or, in the presence of competitive wholesale markets for unbundled services, *Capacity Auction Prices*. Reliability costs including outage costs and capacity costs are stated in $/MWh terms; generation capacity costs and capacity auction prices are

[23] The estimation of forward-looking marginal energy costs is most applicable to thermal systems and can involve Monte Carlo simulation. This approach—which is the methodology applied within FPUC's avoided cost study—includes specific procedures covering maintenance scheduling, where individual units are scheduled for maintenance within the year according to the principle of least cost impact. Once generator maintenance is scheduled, the algorithm then commits sufficient available units and current status as a matter of chronology. For units which are committed, each model iteration represents a different forced outage realization for the various units individually, leading to different sets of generators and reserve levels across iteration draw and hours. The set of available generators is then ordered into a supply function according to running costs (fuel and possibly variable O&M). Marginal energy cost—measured at the generator bus bar—is equal to the intersection of the estimated level of demand and the supply function. Note that the analytical procedures used to simulate future wholesale market prices of generation services is similar to the simulation of internal production costs. The end result is forward-looking estimates of marginal energy and operating reserve costs.

typically stated in $/MW-year terms,[24] though for determining avoided and marginal costs of generation services expressed as $/MWh.

Marginal capacity cost is the annual fixed charges related to the installation of capacity.[25] Capacity costs can serve as the shadow price of consumer outage costs, providing that generation supply reasonably approximates least total cost. Marginal generation capacity costs are load-related costs.

Direct Estimation of Reliability Costs: As mentioned, outage cost refers to the value or economic worth foregone by consumers as a consequence of not having electricity service available on demand—essentially, an unexpected service interruption.[26] Marginal outage cost is measured as $/kWh not served. Annual outage cost can be measured as the product of two metrics: the *Expected Unserved Energy* (EUE) or *Loss of Load Hours* (LOLH), and the outage costs incurred by consumers during power outages, referred to as *Value of Lost Load* (VOLL). In the context of hourly frequency, consumer outage cost is often measured as the product of the likelihood of an outage event, typically measured as *Loss of Load Probability* (LOLP) or *Loss of Load Expectation* (LOLE), and VOLL. Generally speaking, EUE is the preferred

---

[24] RTO capacity auctions may also report auction prices as $/MW-day.

[25] Estimates of carrying charges should assume a so-called all-in perspective, including an economic carrying charge rate on incremental investment in capital and operating and maintenance expenses. Capital includes facilities, general plant, materials and supplies, working capital, and possibly fuel inventory. Operating and maintenance expenses include direct O&M, property and other taxes such as labor taxes, labor-related benefits, insurance, and administrative and general overhead expenses.

[26] This definition advances a comparatively narrow interpretation of generation reliability, where the level of realized reliability is measured with respect to load level: realized reliability is a function of total capacity installed with reference to peak demands. However, numerous elements contribute to realized reliability, including:

- committed units capable of satisfying operating reserve requirements—total generation matches real-time load changes (ramp speed);
- sufficient network observability using system monitoring equipment situated at various locations of power systems. System monitoring provides the means for system operators understand the status of the power system in real time;
- satisfaction of real-time operating parameters, such that supply-side events do not precipitate transient oscillations that challenge system-wide stability limits; and
- realized voltages that remain within acceptable operating limits, both during peak and off-peak timeframes.

It is useful to mention that, historically, observed breaches of reliability often take place during timeframes of comparatively modest load levels.

outage cost metric for purposes of cost estimation insofar as the frequency, duration, and depth of power outages (MWs) are implicitly captured.

Internal Capacity Costs: As touched on above, marginal capacity costs can be viewed as the shadow price of outage costs—the cost associated with incremental changes in capacity installed in response to changes in expected peak demands. Additional capacity is necessary in order to maintain reliability in the face of rising demand.

Marginal capacity costs are typically measured as $/kW-year. The annual charges associated with marginal generating capacity can be assigned to the hours and seasonal timeframes (peak hours) within an annual period where reliability costs are present on an expected value basis. Power systems consist of integrated, highly specialized facilities and equipment, implemented on a large scale. Substantial planning and analysis underscore resource decisions because of the sheer scale of the investment. Properly executed, resource decisions are driven by least cost principles:[27] expand total capacity up to the point where, over forward years, the decline in expected outage costs incurred by consumers is just enough to offset the increase in total resource costs. In essence, the notion of least cost planning is an inherently marginal cost concept.

Decisions to commit resources are based on expectations of the demand for and the cost of capacity. Necessarily, resource commitments are made in advance, and involve considerable risk with respect to electricity demand and, to a lesser extent, capacity costs. As with all decisions regarding costs and benefits in the future, resource decisions by electricity service providers are subject to forecast error. For generation capacity, resource commitment may take place several years prior to installation. By the time new capacity has been placed into service, demand levels—driven by regional economic activity and weather—may prove to be higher or lower than expectations at the time of commitment. Therefore, realized outage costs of consumers, and the value of incremental capacity to arrest power outages, may

[27] Generation expansion planning is typically carried out with specialized optimization software. Resource decisions, however, are well grounded in practical considerations and take account of institutional constraints, siting limitations, regulatory policy, and the preferences and views of electricity consumers. Also, the analytics—least cost optimization—should arguably explicitly incorporate estimates of the technology-specific climate damage costs attending resource options.

deviate substantially from the expectations implicit in expansion plans, for both the current period and near-term years following the installation (or acquisition) of new capacity.[28]

Capacity Auction Prices: This second approach to capacity costs draws upon capacity auction prices as the basis for determining the marginal cost of capacity. Capacity prices obtained from competitive auction processes are a conceptually plausible basis to determine the economic worth of capacity. ISOs/RTOs across the U.S. grid periodically execute capacity auctions. Under properly structured auction procedures, capacity auction prices capture the market worth of capacity, and implicitly reflect the supply-demand balance condition expected for the commitment (delivery) year—typically, three years ahead.

As a practical matter, the estimation of the effective cost of generation capacity costs in the future incorporates marginal line losses and ensuring that transmission throughput capability is available to accommodate net injections at the point of interconnection, on the margin.

Methodology for Determining Reliability Costs: Marginal reliability costs incorporated within FPUC's 2023 avoided cost study are specific to the contract-based and market-based periods over which avoided costs are estimated. For the contract-based years, 2023-2026, generation reliability costs reflect the commercial terms of the FPUC-FPL contract. For years 2027-2050, reliability costs are based on consumer outage costs, as estimated. For these later years, the market simulation of reliability takes account of capacity additions over prospective years in order to appropriately balance total supply with peak loads, based on consumer outage costs, as simulated. Simulation of reliability costs is carried out by constructing an operating reserve demand curve, where outage costs are driven by the level of operating reserves available in the FRCC power system.[29]

[28] Recent history chronicles several timeframes with supply-demand imbalance, including the comparative capacity-short position of the Eastern Interconnection during 1997-2001, California during 2002-2003, ERCOT during 2011-2015, and New England since 2004; and the comparative capacity-long position of the overall Eastern Interconnection for 2009 forward. Energy prices, scarcity rents, and capacity prices follow accordingly, with observed short-term wholesale prices reaching exceptional levels (*e.g.*, >$700/MWh) in capacity-short conditions.

[29] Dynamic, short-run marginal cost pricing of electricity, where the marginal prices facing consumers change frequently—*e.g.*, hourly real-time pricing, critical-peak pricing—take account of short-term changes in supply-demand balance, as a consequence of weather, generator unit outages, and other random events.

Marginal reliability costs are exclusively load-related costs and, generally, are strongly centered in a few days over the course of the year and vanishingly small during most hours, *on an expected value basis*. That is, in most hours a change in load level has no measurable impact on the capability of the system to satisfy total loads. Under expected value conditions of load levels and available supply, reliability costs with respect to loads are concentrated during peak load timeframes. However, changes in load levels, either load increases or decreases, can have a pronounced impact on realized reliability under unexpected circumstances. Even at modest load levels, changes in system conditions—*e.g.*, loss of large generator units, or unexpectedly high levels of load during off-peak seasons—can give rise to reliability concerns. In brief, load-related reliability is a matter of available supply with reference to load level, regardless of timeframe; power systems can on occasion be capacity constrained during off-peak hours of days and during off-peak seasons.

Under the condition of complete foresight and knowledge regarding the future need for capacity and the costs of resources, and where resource indivisibility is not present, optimal least cost planning yields marginal capacity costs which approximate marginal outage costs.[30] Other considerations often weigh on resource decisions and may, appropriately, influence the issue of least cost and, thus, estimates of marginal costs.[31]

---

[30] However, resource indivisibility is often present in small power systems. The process of sizing facilities often favors, during the process of construction, oversizing beyond that which is needed during the early years of capacity life, as doing so reduces total facility costs in the long run over extended future years.

[31] The concerns and views of regulatory authorities and interested stakeholders may favor certain resource choices, when compared to the resource set determined with sophisticated analytical tools. As an example, strong social externalities may surface as a consequence to the announced siting of new generation within or near urban locales, in turn precipitating organized pushback.

Finally, risks associated with potential outcomes matter considerably; resource choices that obtain somewhat higher total costs, stated on an expected value basis, may be preferred to alternative lower cost choices, providing that the dimensions of risks are lower. Moreover, risks may be highly asymmetric and laced with low-probability high-cost events. To the degree that these events are uncertain and not easily observably within historical experience, it is appropriate for resource decisions to be founded on: 1) model results obtained from well-grounded analytical methods, as well as 2) informed intuition and *ad hoc* analysis and peripheral studies where relevant. In short, resource decisions need not necessarily be driven exclusively by the formal analysis implicit to generation planning tools and methods.

It is useful to mention that, in lieu of direct estimation of reliability costs, estimates of capacity auction prices over planning years in other regions of the Eastern Interconnection could potentially be utilized as the measure of reliability costs, but for the practical consideration of limited transfer capability.

TRANSMISSION SERVICES

Similar to generation, the true avoided costs of transmission services include energy and reliability cost elements, with reliability costs gauged within the outage cost-capacity cost paradigm. Unlike generation, marginal energy costs for transmission are in the form of network congestion and losses.[32]

As mentioned, transmission services refer to the capability to transport energy from the locations where it is produced—i.e., generator sites—to load centers where it is consumed. Generator locations are often described as *points of injection* of electricity into the transmission network; consumer locations, sometimes referred to as delivery points, are often described as *points of withdrawal* of electricity from the network. Transmission facilities can assume both radial and parallel path configurations; parallel paths can be in the form of either loop or meshed networks.

Avoided Transmission Cost, A Definition

The marginal cost of transmission service[33] is equal to the change in the total cost of providing transport services, with respect to a change in the level of load served and consisting of energy, congestion, and reliability cost components.

Energy costs result from the physical loss of energy and consist of both thermal and, to a lesser extent, non-thermal reactive losses. Thermal losses are largely in the form of electrical resistances within transmission conductors and, for extended distances, capacitive and inductive reactance. Losses are a function of voltage, electric current, transport distances, and ambient temperatures. Together with the

---

[32] Congestion costs are manifested as increased energy costs, referred to as the costs of redispatch. In order to limit the flow of energy on constrained lines, system operators engage in redispatch: raising the output (MWs) of comparatively high-cost generators and lowering the output of lower cost generators (MWs). In others, operators adhere to line flow limits by managing the flows through redispatch procedures. Congestion costs are determined by 1) the operating cost differences for generators involved in redispatch, and 2) the change (MWs) associated with redispatch. For selected network locations, congestion costs can be comparatively modest or very large, several times higher than the marginal cost of energy for an unconstrained network grid.

[33] As noted earlier, the discussion will use *avoided cost* and *marginal cost* terminology interchangeably.

characteristics of the existing network, these factors largely define the requirements for long-term expansion of transmission networks. Marginal losses can be significantly above average losses for selected locations and areas and, depending on power flow patterns, can assume negative values. The cost impact of physical losses is manifest in the avoided generation costs and, to a lesser extent, avoided transmission capacity costs.

Transmission costs are differentiated by time and by location. While time-varying cost patterns are well known, costs also vary by location: a change in load (increase or decrease) at a specific location will have impacts on the total costs of serving all locations within the network. This result, location-specific marginal costs, is a direct result of the strong network externalities inherent in network grids, a consequence of the physical properties of power systems.[34]

The demand for transmission capability is driven predominantly by loads and the spatial configuration of load centers and generation sites. Transmission capacity is expanded in order to reduce line losses, to mitigate network congestion, and to satisfy expected peak load (reliability) prospectively. The capability of the network will be expanded up to the point that the decrease in total costs associated with decline in line losses, network congestion, and outage costs (increases in reliability) approximates the incremental costs of expanding the network.[35] In the context of planning, the marginal capacity cost of transmission is the shadow price of reliability. As mentioned, marginal energy costs are manifested as changes in network losses and congestion, with respect to a change in load level.

Much like generation, transmission service providers operate and plan bulk transmission networks in a manner that satisfies established reliability standards identified by the North American Electric Reliability Corporation and adopted by quasi-regional coordination authorities including the FRCC. Reliability standards are typically expressed in terms of contingency survival—typically referred to as N-1 and N-2

---

[34] As mentioned above, the locational differences in marginal costs inherent to transmission networks may, within some regions, be fairly small during most timeframes. Under these conditions, locational differences in marginal costs can be captured as static adjustments—essentially, a common multiplicative factor applicable to all timeframes.

[35] The *in situ* configuration and voltages of existing networks limit expansion options and it is not uncommon for network additions of have substantial levels of unused capacity. Essentially, the physical properties of meshed networks impose, on the margin, capital indivisibility.

criteria—and transient stability criteria, the capability of the generation set to remain synchronous under sudden unexpected events such as a large loss of load, the switching (close or open position) of major circuits, and fault clearance. Highly specialized transmission planning software is used to gauge the capability of networks to satisfy standards under expected future power system states, which include these events under peak load conditions. The proper expansion of transmission networks increases the capability of the power system[36] at least cost, while satisfying reliability standards.

Transmission network expansion is often driven by the expansion of generation facilities and can, in selected cases, involve major reconfiguration of both the generation and transmission systems.[37] Marginal load-related transmission costs are common to the network grid and the loads served. Generally speaking, transmission investment costs associated with generation interconnection are not on the margin with respect to changes in expected system-level peak loads and, arguably, should be excluded from analytical procedures underlying estimates of transmission marginal costs.

Methodology for Estimating Avoided Transmission Energy Costs (Line Losses)

Marginal transmission line losses can be estimated in three ways. First, load flow simulations can be used to determine the changes in flows on transmission facilities (MW, MVA) with respect to changes in loads served. Typically, a set of load flow cases is simulated for various load levels and seasons, over future years.

The second methodology uses regional market assessment tools, referred to as security constrained economic dispatch (SCED) to simulate regional markets. Estimates of marginal line losses are reported within model solutions along with congestion and, possibly, reliability costs.

[36] Under selected conditions, transmission facilities can substitute for generation. Similarly, it is common for generators situated in fairly electrically isolated locations to provide must-run reliability, because of limited capability of the transmission network to serve load in such locations with other less costly sources of power generation.

[37] Examples include, at the time of its closure in 1998, the conversion of the Zion nuclear station to synchronous condensers; and the expansion in 2004 of the Path 15 interface separating the north and south regions of the California ISO service area.

A third approach draws on recent historical records of power injections and withdrawals within transmission networks. Power injections and withdrawals provide the means to determine both average and marginal line losses. Average line losses are used, typically, to set the line loss factors with Open Access Transmission Tariffs (OATT), stated as a percentage of load (MW) associated with wholesale power transactions. The differences between total injections and total withdraws, calculated for hourly snapshots at, say, selected load levels of a recent annual period can be used to infer thermal line losses within the transmission network. Noting the differences in losses between peak hours and off-peak hours provides the means to estimate how total losses change with respect to changes in the total load served.

Methodology Used in the Long-Term Avoided Cost Study: The immediate study utilizes the line loss factor of FPL's Open Access Transmission Tariff (OATT), which reflects the injections and withdrawals for the FPL power system, the third methodology identified above. This official line loss rate is stated as a percentage of load served and measured on an average basis. Across the FPL power system, the OATT-based line loss rate likely understates FPL's marginal line losses. However, the true underlying losses within transmission networks are highly specific to location and are further differentiated according to peak and off-peak periods and across seasons. Viewed in this context, the average line loss factor specific to FPL's OATT can be viewed as an untested proxy for the true losses. Because transmission losses are modest in scale, differences between true transmission losses and the OATT-based average line loss factor is unlikely to materially affect projections of long-term avoided costs, at least within the FRCC.[38]

Methods for Determining Avoided Transmission Reliability Costs

In principle, marginal transmission reliability costs are similar to generation, as a matter of approach options. Transmission reliability costs can be estimated directly with forward-looking simulation methods: estimate the impact on reliability—and line losses and congestion—as a result of an incremental expansion of the transmission network under higher (or lower) load levels over future years.[39] Marginal

---

[38] The magnitude of marginal line losses is worthy of further exploration, potentially starting with a discussion with FPL.

[39] Note that this approach presumes the presence of a contemporary transmission expansion plan, which is viewed as the *status quo* plan. Marginal cost-based impacts are determined by simulating the change in costs (reliability, line losses, congestion) which results from incorporating changes (increases, decreases) to the *status quo* plan.

transmission capacity costs are the incremental costs associated with the installation of new facilities, stated on a $/kW-year basis.[40] The simulations can involve region-wide wholesale electricity markets, where transmission expansion needs are gauged with respect to the potential future path of loads.[41] Essentially, model-based simulations provide the basis for determining the least cost path for expanding transmission networks while ensuring the benefits (improved reliability, reduced congestion, lower line losses) are not less than all-in charges on investment in the incremental facilities.

Alternatively, marginal transmission costs can be measured in terms of implied *shadow prices*, a capacity cost metric which captures the all-in annual carrying costs associated with transmission investment.[26] Transmission shadow prices are implicit within the historical records of transmission network investment and peak loads over years. Historical investment expenditures constitute changes to the stock of capital, which changes (increases) over years in response to year-over-year changes (rising) in electricity demand. In short, the change in the capital stock is gauged with respect to the increases in peak loads served, where investment is measured in terms of the real terms—net of cost escalation attributable to ongoing price inflation.

Approach Used to Determine Transmission Reliability Cost in this Study: The immediate avoided cost study determines transmission reliability costs based on its shadow price, marginal capacity cost. For avoided cost years 2023-2026, transmission capacity costs are set according to the monthly transmission charges of FPL's OATT.[42] For years 2027-2050, transmission capacity costs are based on a historical assessment of transmission investment with respect to changes in peak loads of FPL. For prospective years 2023-2050, marginal transmission capacity costs are stated on $/kW-year basis and assigned to loads based on a non-linear max function.

---

[40] As mentioned above, estimates of capacity costs should assume an all-in perspective, covering all charges associated with investment including an economic carrying charge basis for determining carrying charges, and operating and maintenance expenses. Capital includes facilities, general plant, materials and supplies, working capital, and possibly fuel inventory. Operating and maintenance expenses include direct O&M, property and other taxes such as labor taxes, labor benefits, insurance, and administrative and general overhead expenses.

[41] Simulation studies are typically carried out using some combination of load flow software, such as *PSSE* (Siemens) and Security-Constrained Economic Dispatch software, such as *Grid View* and *ProMod* (ABB Group Ltd. previously known as ASEA Brown Boveri).

[42] The analyses incorporate an assumed level of escalation in FPL's OATT transmission charges, 2023-2026.

SECTION III: TECHNICAL REVIEW OF APPLIED METHODOLOGY

AVOIDED GENERATION COSTS

CONTRACT-BASED GENERATION COSTS, 2023-2026: Avoided generation costs over near-term years (2023-2026) are based on the FPUC-FPL power supply contract, as mentioned. While the terms of the contract are confidential, the structure of terms incorporates separate prices for intermediate and load-following types of services, each with fixed and variable cost components, and the contemporary outlook for natural gas market prices.

MARKET-BASED GENERATION COSTS, 2027-2050: Longer-term avoided costs are estimated with the tools of model simulation, as applied to both electricity demand and supply. The underlying analyses draw on observed historical and contemporary experience, including:

- Hourly system loads for key members of the FRCC region;
- Generator unit parameters for power generators within the FRCC region;
- Costs of selected new generating technologies, including combined- and single-cycle gas generators, solar facilities, and utility-scale battery storage facilities;
- Power generator scheduled maintenance time and unit outage experience, by technology; and,
- Estimates of parameters determining operating reserve costs, drawn from regional studies.

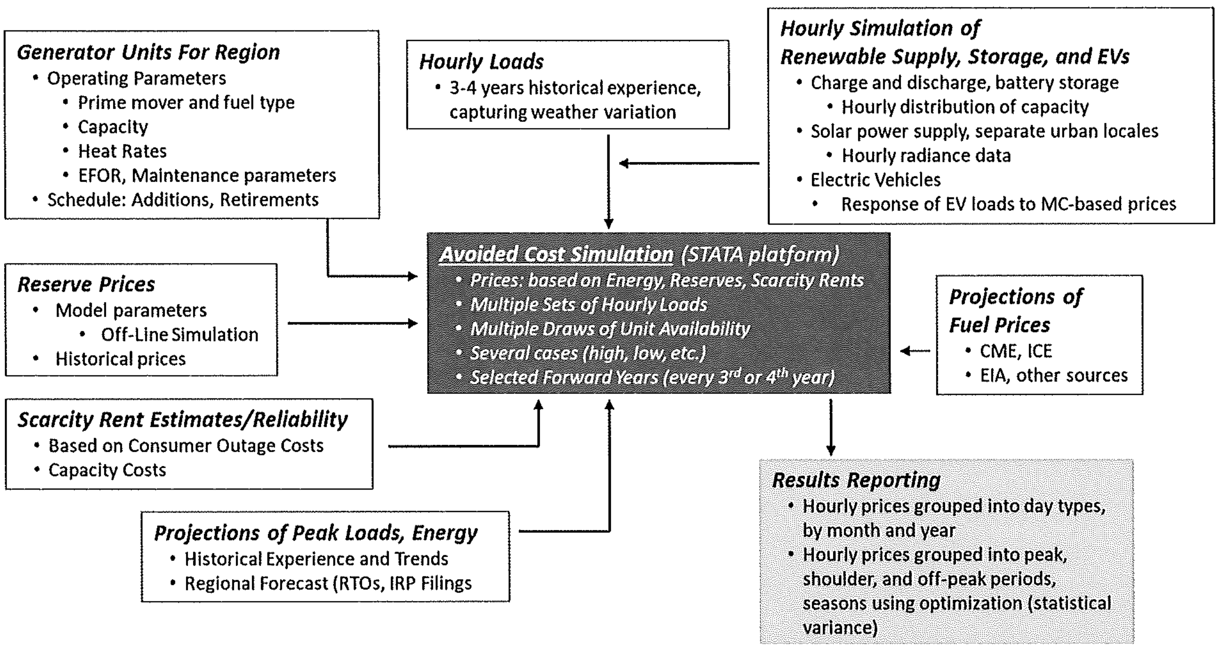
In addition, the avoided cost analyses rely on market information and forecasts for key model inputs, including:

- Generator unit additions and retirements, as projected by the FRCC region through year 2031;
- Projections of system-level demand for electricity and accompanying peak loads, as projected by the FRCC region through 2030;
- Futures prices for primary fuels, stated on a $/MMBTU basis;
- Longer-term price projections of primary fuel prices, also stated on a $/MMBTU basis;
- Historical investment and operating expenditures for bulk power transmission facilities;
- Purchase prices and operating costs of conventional internal combustion (IC) and electric (EV) passenger vehicles;
- Purchase prices and costs of distributed solar systems;
- Historical vehicle registrations for Florida;
- Historical and projected trends in population, for Florida and the U.S.;

- Charging cycles for electric vehicles, estimated for the FRCC region with simulation tools;
- Output cycles for solar energy, estimated for the FRCC region with simulation tools; and,
- Charge and discharge cycles for battery storage, estimated with simulation tools.

The analysis of the functions of electricity demand and supply is described in the following process diagram:

Process: Estimation of Avoided Generation Costs Over Future Years[43]



The analysis process obtains forward estimates of avoided costs through simulation of electricity demand and supply over projection years 2023-2050. Projections of electricity demand include simulation of electric vehicle loads and the penetration of solar energy facilities in the residential and commercial sectors. The projection of supply anticipates the closure of much fossil generation—including coal fired generation and inefficient gas generators—which is supplanted by rapid adoption of solar energy and battery storage capability. Estimation of demand and supply is detailed in the following discussions.

[43] The simulation process can entail long solution times because of multiple draws of the main factors for estimation of uncertainty and risks (unit availability, weather in the case of solar energy, and hourly load levels from one day to another). Avoided costs for generation, reflected here, are supplemented with transmission and distribution cost components (line losses).

Electricity Demand

RECENT HISTORY: With the inclusion of the Gulf Power service territory, the FRCC region constitutes all of the State of Florida. Florida's regional economy has advanced substantially faster than the U.S. macro economy in recent years, a consequence of an attractive climate, a favorable business environment and, until recently, a cost-of-living advantage compared to the U.S. overall. Comparative rates of growth in regional economies also reflect differences in sector composition. The following table compares Florida's long-term historical changes to other areas and the U.S., along with projections for Florida and the U.S.

State, Regional, and National Trends in Population[44]

	History and Long-Term Projections (000s)									
	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050
Florida	4,952	6,789	9,746	12,938	15,982	18,801	21,538	23,399	24,844	25,645
Georgia	3,943	4,590	5,463	6,478	8,186	9,688	10,712			
Southeast	54,973	62,795	75,372	85,446	100,237	114,556	126,266			
United States	179,323	203,212	226,546	248,710	281,422	308,746	331,449	347,467	359,522	366,068
	Annual Rates of Change Over Previous Ten Years, By Decade (%)									
Florida		3.21%	3.68%	2.87%	2.14%	1.64%	1.37%	0.83%	0.60%	0.32%
Georgia		1.53%	1.76%	1.72%	2.37%	1.70%	1.01%			
South		1.34%	1.84%	1.26%	1.61%	1.34%	0.98%			
United States		1.26%	1.09%	0.94%	1.24%	0.93%	0.71%	0.47%	0.34%	0.18%

Over the most recent two decades, retail prices for electricity services provided by FRCC members have followed prices across the U.S., despite long transportation distances for primary fuels used in electric power production, at least through 2010.

Residential electricity prices for Florida and the U.S. are shown below.

Residential Electricity Prices Over Recent Years, Florida and U.S. ($/kWh)[45]

	2000	2003	2006	2009	2012	2015	2016	2017	2018	2019	2020
Florida	7.77	8.55	11.33	12.39	11.42	11.58	10.98	11.61	11.54	11.70	11.27
U.S.	8.24	8.72	10.40	11.51	11.88	12.65	12.55	12.89	12.87	13.01	13.15

Beginning in approximately 2010, Florida retail residential electricity prices have gained comparative advantage relative to average U.S. prices, an advantage which appears to have steadily widened through 2020. Declining real prices for natural gas combined with an increasing share of Florida's total generation

[44] Source: Bureau of the Census.

[45] Source: Energy Information Administration.

fueled by natural gas—made available by expanded pipeline capacity including the Gulf Stream facility—have undoubtedly contributed to Florida's favorable retail price trend.

<u>LONG-TERM OUTLOOK FOR CONVENTIONAL LOADS</u>: For estimation of long-term avoided costs, projections of long-term growth in electricity demand extend through 2050, some two and a half decades. For years 2023-30, projections of electricity demand closely approximate the expectations incorporated in the expansion plan released by the FRCC in early 2022. Demand is reported by the FRCC on a net basis, thus accounting for curtailable loads during peak load hours.

For years 2031-50, projections of overall system demands are based on the paths of two major components of electricity demand: first, baseline electricity demand associated with conventional electricity use and second, electric vehicle charging loads and distributed solar facilitates located at retail customer sites. The outlook for conventional loads is substantially less than load projections by the members of the FRCC for 2023-2030 but in keeping with the expectation of advancing DSM including the implementation of further conservation. This trend is consistent with macro trends across the U.S., which implicitly reflect slowing growth in population. The long-term baseline outlook is also consistent with expectations of gradually slowing growth in Florida's regional economy, driven mainly by attenuated population growth nationwide, compared to the long-term history.[46]

Estimation of avoided costs utilizes load profiles, selected from the observed hourly loads for Florida's major service providers over years 2018-2021. Summarized below are energy consumption and maximum hourly load, presented on a seasonal basis, including winter (Dec, Jan-Feb), off-peak (Mar, Nov), spring-fall (Apr-May, Oct), and summer (Jun-Sep) for selected years.

[46] Nonetheless, it is important to recognize that, in sharp contrast to slowing growth for the Nation as a whole, that Florida along with Texas and the Southwest U.S. region may experience ongoing long-term robust growth in both population and the respective regional economies.

Seasonal Energy Consumption, 2018-2021 (GWh)

Year	Dec, Jan-Feb	Mar, Nov	Apr-May, Oct	Jun-Sept	Total
2018	50,234	33,214	56,881	89,499	229,829
2019	48,376	33,002	60,558	90,299	232,235
2020	49,827	35,773	59,034	92,045	236,678
2021	49,457	33,604	59,511	90,787	233,360
Average	49,473	33,898	58,996	90,658	233,025

Maximum Hourly Load by Season, 2018-2021 (MW)

Year	Dec, Jan-Feb	Mar, Nov	Apr-May, Oct	Jun-Sept	Total
2018	42,212	36,254	41,698	44,330	44,330
2019	34,018	35,889	43,896	46,817	46,817
2020	37,560	38,869	41,876	46,575	46,575
2021	33,082	37,744	43,842	46,410	46,410
Average	36,718	37,189	42,828	46,033	46,033

The process underlying the long-term avoided cost study includes a detail review of the historical load profiles of FRCC members, including monthly peak hourly load and energy consumption for contemporary years, 2016-2021, and settled on the 2021 profile as the most representative annual load experience among these years. The 2021 load profile is scaled to approximate the baseline energy consumption associated with Florida's conventional loads for each projection year, 2023-2050.

ELECTRIC VEHICLES: For purposes of avoided cost estimation over projection years 2023-2050, conventional electricity demands are supplemented by electric vehicle (EV) charging loads, which are expected to assume a major share of total system loads beginning in the second half the current decade—2027 and beyond. Estimation of EV charging loads over the long term is based on the penetration of EVs within Florida's fleet of passenger vehicles. Electric vehicle penetration is estimated using a variant of the *constant elasticity of substitution* (CES) framework. The CES approach is applied to the comparative all-in annual costs of internal combustion vehicles (ICs) and EVs, as incurred by households should they select IC or EV propulsion technologies. In turn, the hourly charging loads of EVs are simulated, using specialized software made available by the National Renewable Energy Laboratory (NREL). Analysis steps to determine annual EV charging loads are as follows:

- Estimate annual residential automobile purchases based on automobile registrations and population trends, both historical and projected.

  - The analysis incorporates Florida's automobile fleet and trends in automobile density per household.

- Develop projections of annual "ownership costs" of automobiles, for both IC and EV propulsion technologies.
  - The analysis incorporates:
    - trends in purchase price and maintenance costs based on parameterized logistic functions.
    - expected operating costs, including projection of fuel costs (gasoline) for ICs, and electricity service prices for charging EVs.
    - annual purchase costs that are based on projected purchase prices and levelized capital charge rates.

- Apply CES the function to determine the share[47] of annual residential automobile purchases attributable to electric vehicles.[48]
  - The total number of EVs within Florida's automobile fleet reflects the year-over-year accumulation of annual EV purchases.[49]

- Simulate hourly EV charging loads.

- Determine total EV charging load for the FRCC region.
  - Hourly EV charging load is equal to the product of the number of EVs and charging load for the hour.

Projections of annual automobile purchases and total registrations for the State of Florida are shown below. Note that, because of retirement, abandonment, and automobile accidents, annual purchases are greater than the annual change in total registrations.

History and Projections of the Total Stock of Automobiles, State of Florida (000s)

[47] Baseline parameters used in the CES models are drawn from the synthesis of discrete choice studies and reflect attribute preferences for electric vehicles, compared to propulsion technologies.

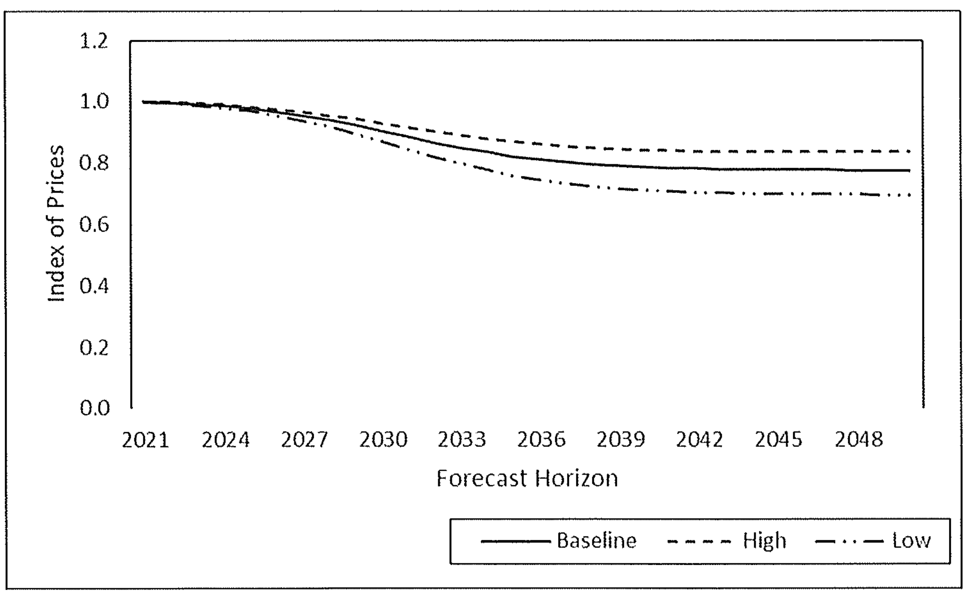
[48] For purposes of the immediate study, limitations of the CES approach are empirical: there is no readily apparent basis for determining CES parameters over the long-term future. As a consequence, the evolution or path of parameters over years is ad hoc, a stylized best guess guided by other studies and analyses. Accordingly, it is useful to explore a range of plausible scenarios for EV selection, each determined by an alternative set of parameters. Further to this point, the immediate study recognizes that other approaches for determining EV selection are readily available, including parameterized logistic functions and models of diffusion processes such as the well-known Bass model.

[49] This approach presumes that retired EVs are replaced with the EV technology at the end of life and, second, EVs which are destroyed during traffic collisions are also replaced with electric propulsion vehicles.

	2010	2025	2030	2035	2040	2045	2050
Auto Registration	15,708	19,366	20,086	20,621	20,935	21,255	21,388
Population	18,653	22,872	24,307	25,538	26,565	27,635	28,518
Auto/Pop	0.8421	0.8467	0.8263	0.8075	0.7881	0.7691	0.7500
New Vehicles		1,176	1,234	1,191	1,190	1,192	1,166

Purchase costs and annual maintenance costs for electric vehicles are based on an assessment of contemporary costs and guidance provided by various sources with respect to the future path for prices and maintenance costs. Generally speaking, electric propulsion technology is fully developed and far simpler than IC technology, including both source of propulsion and drivetrain components. In addition, electric vehicle technology is likely to realize substantial scale economies within automobile design and assembly processes. Nonetheless, the study does not presume to have a full understanding of the future path, and thus assumes a scenario approach. To this point, below are the alternative potential paths of EV purchase prices and maintenance costs.

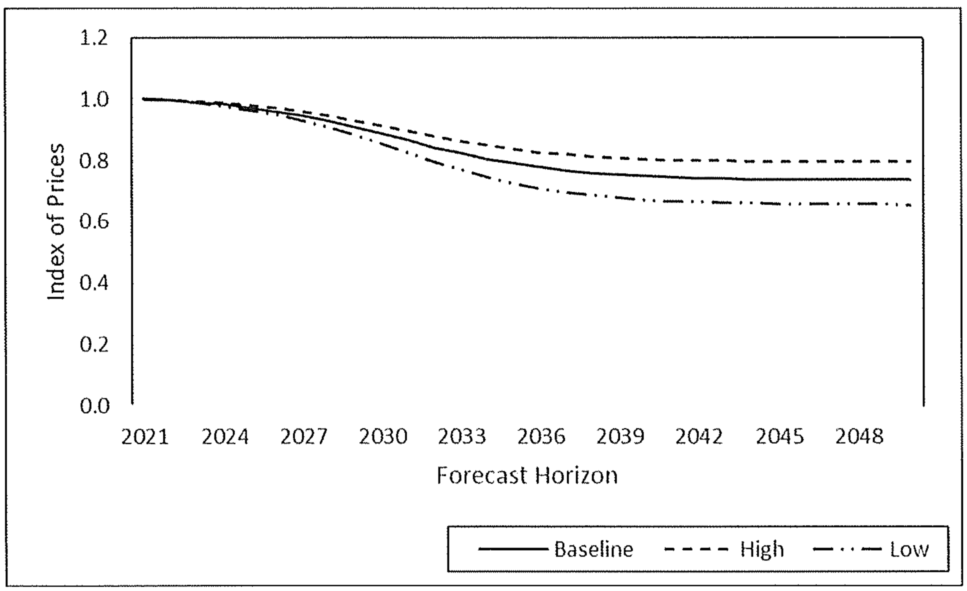
Scenarios of Electric Vehicle Prices
Indexes (Real Terms), 2021-2050



As shown above, the cumulative decline in the baseline real price of electric vehicles is projected to reach 22.5% by 2050 compared to the index year (2021=1.0); similarly, the low and high scenarios of purchase prices cumulatively decline by 16.6% and 30.4%, respectively. Note that these cumulative percentage changes are in real terms, and thus offset nominal inflation of approximately 2% annually.

The path of annual charges for maintenance on EVs assume similar patterns, as shown below. The maintenance path assumes a remarkably similar pattern to that of the prices for electric vehicles, although the pace of cost decline is slightly less for the Baseline Scenario.

Scenarios of Electric Vehicle Maintenance Cost Indexes (Real Terms), 2021-2050



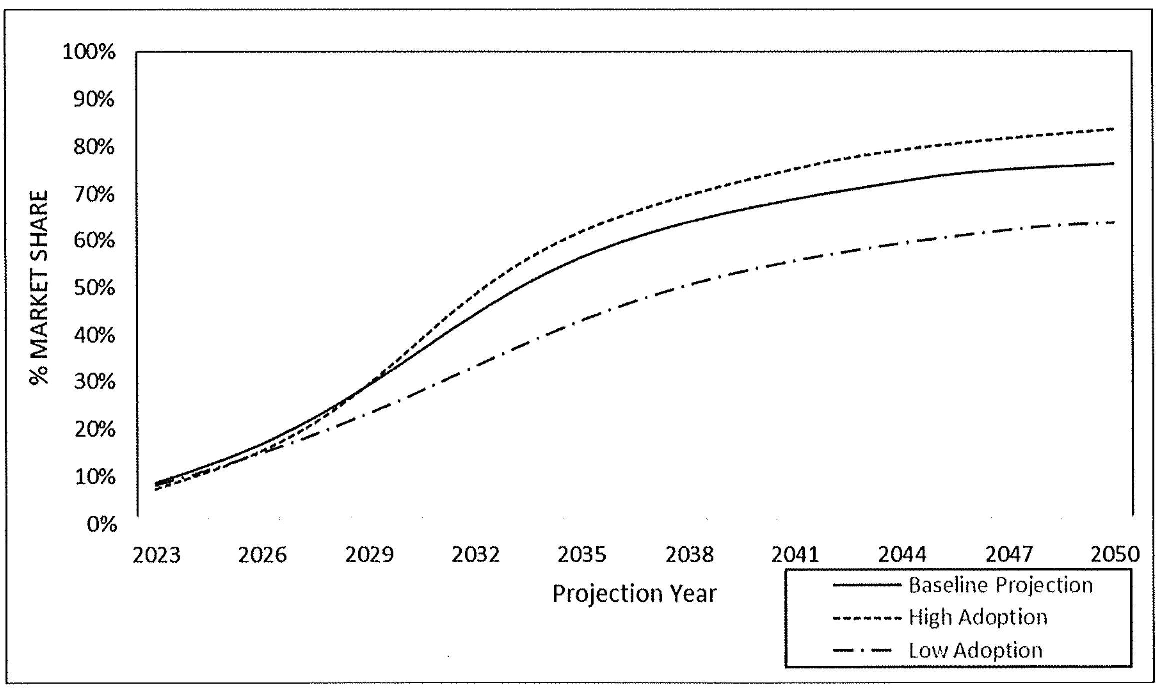
Projections of ownership costs associated with ICs and EVs incorporate the annual carrying charges on purchase costs, annual maintenance costs, and operating costs in the form of annual charges for fuel in the case of ICs, and electricity tariff rates in the case of EVs. All-in annual ownership costs are presented below.

Projections of Ownership Costs of Internal Combustion and Electric Vehicle Technologies ($/year)

IC POWERED	2022	2025	2030	2035	2040	2045	2050
Baseline	5,466	5,324	5,375	5,462	5,495	5,527	5,529
High	5,866	6,162	6,269	6,325	6,371	6,413	6,522
Low	5,163	4,917	4,888	4,941	4,926	4,894	4,872
ELECTRIC VEHICLES							
Baseline	3,434	3,345	3,144	2,898	2,793	2,762	2,755
High	3,628	3,552	3,399	3,208	3,128	3,105	3,102
Low	3,233	3,119	2,844	2,517	2,368	2,315	2,292

Based on the above projections of all-in ownership costs, the CES framework for technology selection obtains the following scenarios of EV adoption (baseline, high, low) over forward years 2021-2050.

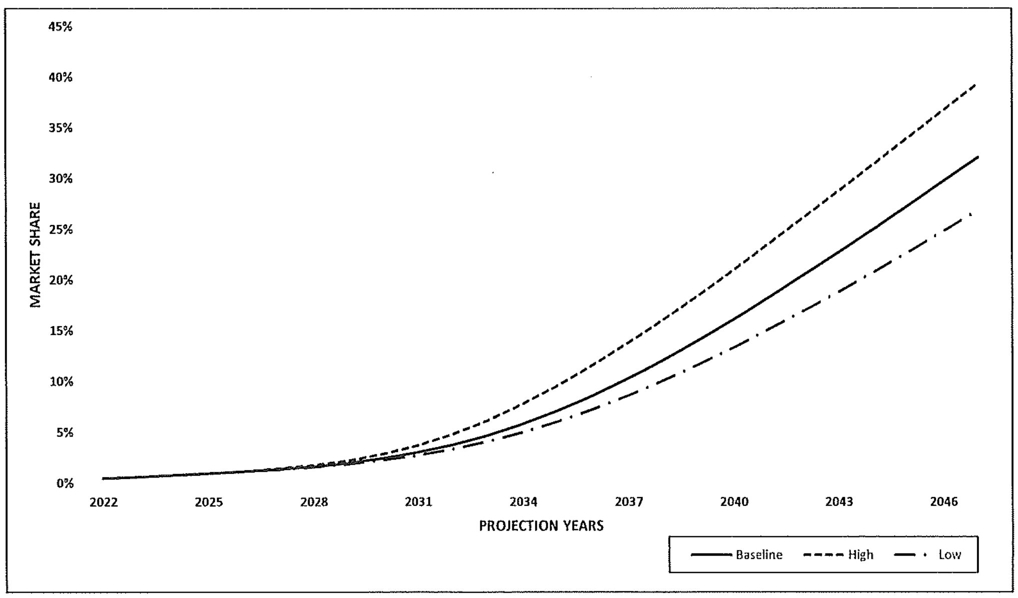
Scenarios of Adoption of Electric Vehicles



As mentioned, main drivers within the CES framework include: 1) projections of the total demand for passenger vehicles, and 2) life-cycle cost estimates (fuel use, monthly auto loan payments, maintenance) for EVs and conventional vehicles (ICs).

Survey studies provide an empirical foundation to support both analysis and intuition: auto sales penetration reflects cost differences, household preferences, and capital depletion/life of automobiles. Latent attitudinal factors weigh in on selection decisions: consumers and households with high sensitivity to issues of environmental quality and climate change are more favorable to electric vehicles, other factors constant.[50] However, the path of EV share of annual auto sales is not as important for utility planning purposes as the share of EVs within the automobile fleet. The EV share of the total automobile fleet rises substantially more slowly than sales penetration. Below are the projections of EV fleet share (baseline, high, low) corresponding to the EV sales penetration shown above.

Scenarios of Electric Vehicle Shares Within Florida's Automobile Fleet



For forecast year 2050, the baseline projected EV fleet share approximates 32.1%, as sales penetration reaches 72.1%. Capital depletion and obsolescence driven by technological advance contribute to fleet turnover and, in the above scenarios, may be understated.

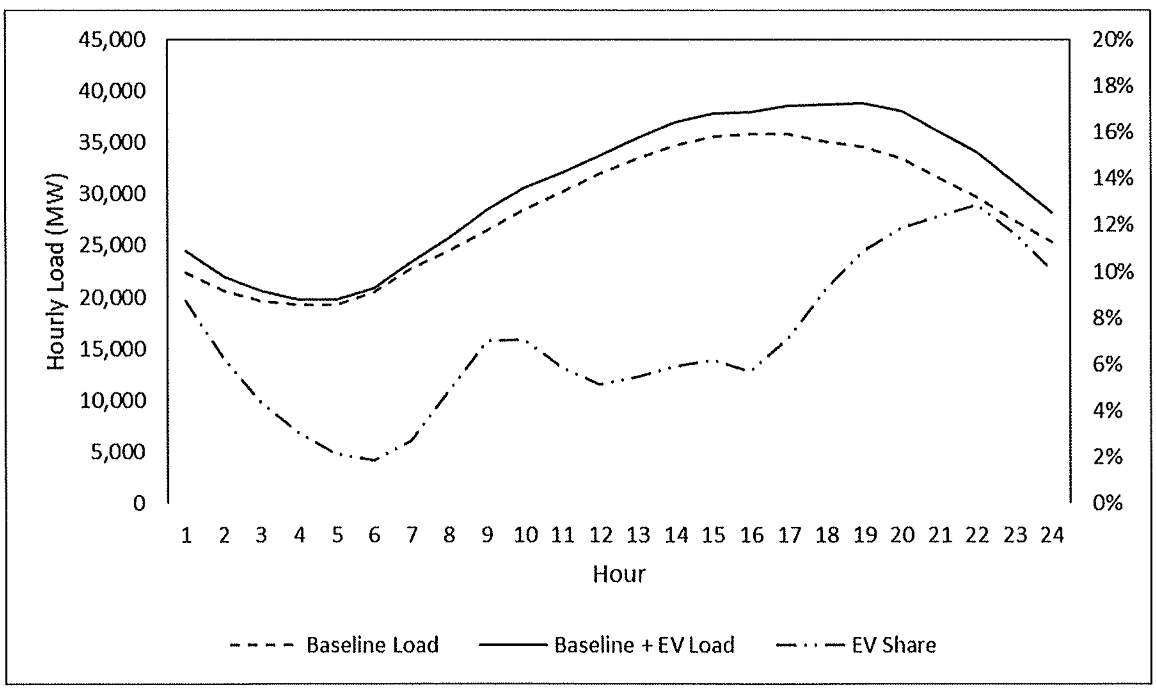
---

[50] The CES framework includes exceptionally high substitution parameters in order to capture both the sensitivity of vehicle selection but also the evolution in the preferences of households. Recent evidence suggests that, going forward, households may have steadily rising preferences for electric vehicles, and may select electric propulsion technology even in the absence of the steadily rising cost advantage of EVs, as expected.

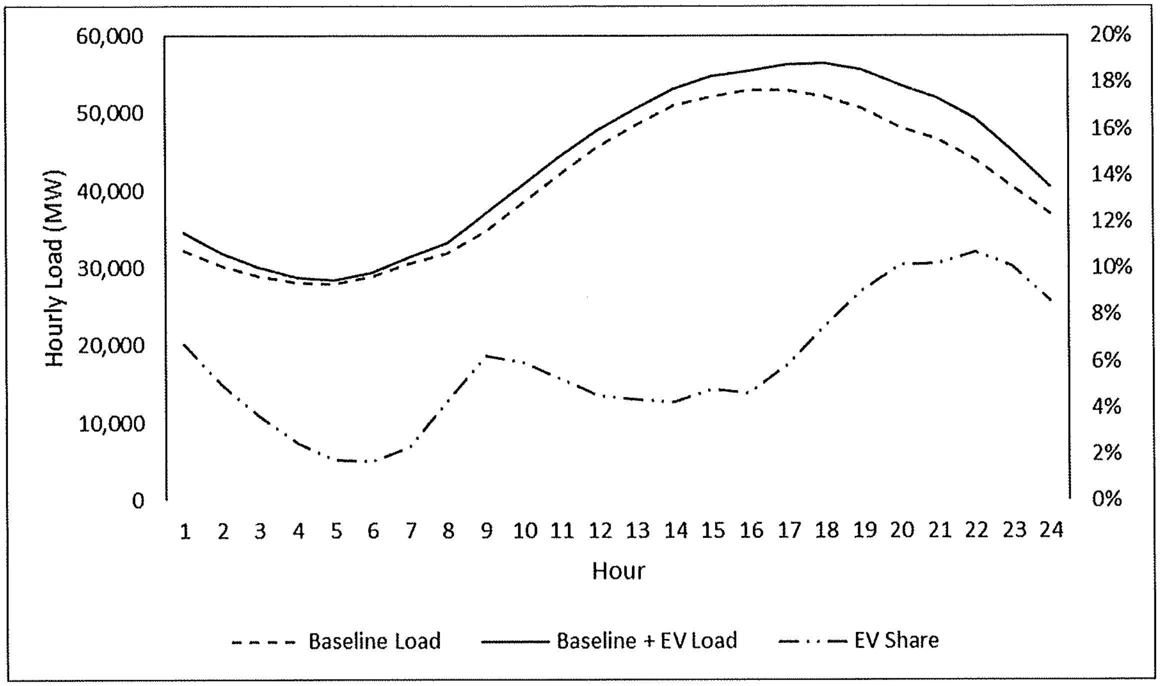
Electric vehicle penetration reflects rising awareness of climate change and international climate agreements which in turn contribute to policy initiatives at the national level. Credible projections of potential EV penetration have been developed by the U.S. national laboratories, universities, and non-profit organizations focused on climate change. The EV scenarios used herein for long-term avoided cost estimation are broadly consistent with the contemporary policy direction and with other studies, though may be conservative. There is nonetheless considerable uncertainty with respect to the pace of adoption of EVs.

The adoption path for EVs matters. Studies by NREL, PNNL, and New England simulating possible impacts on power systems confirm our regional analyses: high penetration of EVs can have a dramatic impact on the hourly levels of loads and potentially, marginal/avoided costs. Presented below are conventional and EV load patterns for Florida, simulated for February and August of 2045. (Hourly load totals are referenced on the left axis while EV shares are referenced on the right axis.)

Hourly Load Profile for Florida, Simulated for February 2045



Hourly Load Profile for Florida, Simulated for August 2045



As simulated, the February and August EV charging loads are similar though July EV loads are slightly higher and appear to reach the peak load levels later in the day (7 pm)—a consequence of higher total miles driven and longer daylight hours during summer months.[51] Because the typical conventional loads for January are significantly less than July conventional loads, EV loads constitute a higher share of the total system loads during January than in July. Specifically, for year 2045, the estimated share of EV loads during peak hours reaches 12.9% in February, and 10.7% in August.

<u>DISTRIBUTED SOLAR</u>: For purposes of avoided cost estimation over projection years 2027-2050, conventional electricity demands and EV charging loads are offset by the expected adoption of distributed solar energy systems. Estimation of distributed solar generation is based on the adoption of solar panels in Florida, a state with fairly high radiant energy, even during winter months. For the immediate study, market penetration of distributed is also estimated using a variant of the (CES) framework mentioned above. The CES approach is applied to the all-in annual costs of solar systems, as incurred by households

[51] Also, cooler temperatures imply larger storage losses within batteries—and thus higher EV charging loads in January than in July.

and commercial businesses should they choose to install solar panels, with reference to expected retail electricity prices. In turn, the hourly generation profile of solar systems is simulated, using specialized software made available by the National Renewable Energy Laboratory (NREL). Analysis steps to determine solar generation, as follows:

- Estimate annual solar installations purchases based on solar installation data and population trends, both historical and projected.
- Develop projections of annual "ownership costs" of solar technology, for both residential and commercial owners.
  - The analysis incorporates:
    - trends in purchase price and maintenance costs based on parameterized logistic functions.
    - expected operating costs, including projection of fuel costs (gasoline) for IC vehicles, and electricity service prices for charging EVs.
    - annual purchase costs that are based on projected purchase prices and levelized capital charge rates.
- Apply CES the function to determine the share of annual solar purchases.
- Simulate hourly generation profiles.
- Determine total distributed solar generation for the FRCC region.
  - Hourly solar generation is equal to the product of the number of solar installations and generation per installation for the hour.

Projections of annual automobile purchases and total registrations for the State of Florida are shown below. Note that, because of retirement, abandonment, and automobile accidents, annual purchases are greater than the annual change in total registrations.

<u>SUMMARY OF LONG-TERM DEMAND OUTLOOK FOR AVOIDED COST ESTIMATION FOR FLORIDA</u>:
Projections of conventional demand coupled with charging loads for EV and sustainable technologies obtain the long-term path of electricity demand through 2050. The extended energy outlook decreases over the long term due to large scale solar availability which offsets the growth in demand from the EV market. Peak demand continues to rise at a slightly slower rate over the extended forecast period.

Projected Growth in Energy and Peak Loads (Annual % Change)

Timeframe	Energy	Peak Loads
2023-2030	0.62%	0.91%
2030-2050	-0.15%	0.42%

Electricity Supply

GENERATION IN THE FRCC REGION: The FRCC 2021 generation expansion plan identifies expected generator unit additions and retirements by type of technology and capacity through 2030. Avoided cost estimation utilizes unit-specific data for conventional thermal generators, which continue to constitute the main source of supply through 2030 and are reported at a general level within the public domain. Unit-specific data include commercial operating date, expected retirement data, prime mover technology, type of fuel, installed capacity, effective capacity by season, and heat rates.[52]

UNIT AVAILABILITY: Thermal generator units are subject to down time, including scheduled outages for maintenance and randomly determined forced outage events, both of which are specific to season. The parameters used to determine maintenance schedules and unexpected outages are drawn from the reported experience for thermal generation within the PJM region.[53] Planned and unplanned outage experience of generators in the PJM region is summarized below.[54]

Outage Experience of Generating Units within the PJM Region, 2007-2021

Technology Type	EFOF	EPOF	EMOF	EAF	Total
Coal	0.087	0.098	0.062	0.753	1.00
Combined Cycle	0.021	0.099	0.020	0.859	1.00
Combustion Turbine	0.031	0.059	0.020	0.898	1.01
Internal Combustion	0.073	0.005	0.025	0.897	1.00
Hydroelectric	0.025	0.083	0.028	0.865	1.00
Nuclear	0.011	0.055	0.009	0.925	1.00
Other	0.063	0.127	0.054	0.757	1.00

Outage Factors: EFOF=expected forced outage factor; EPOF= expected planned outage factor; EMOF=expected maintenance outage factor; EAF=expected availability factor

AVOIDED COSTS OF ENERGY: The process of simulating electricity supply involves, for each day, the construction of a short-run production cost function. The starting point is the regional portfolio of

[52] The heat rate is commonly recognized as the overall metric of the thermal efficiency of individual generator units and is measured as the quantity of fuel consumed per kWh of electricity production, stated in BTU. Comparatively high thermal efficiency is manifested in comparatively low heat rates. Modern gas-fueled generating technologies can realize very high efficiency, reaching 6,300 BTU/kWh approximately.

[53] Generation within the PJM region reflects a broad sample of outage experience across the various generating technologies, and thus serves as a reasonable proxy for the unit availability experience in Florida.

[54] Generator outage experience of the PJM region, reflected as outage factors and availability (EAF), are calibrated to the structure of the outage algorithms of the avoided cost simulation model.

generator units. As implied above, individual units are subject to maintenance schedules which, along with randomly drawn unit outages, determine the daily availability of individual generator units. Units which are expected to be available and subject to dispatch are ranked according to operating costs from lowest to highest.[55] This procedure obtains a daily generation stack for the region; individual generator units are dispatched according to operating costs, given hourly system loads.[56]

Simulation of the dispatch process is region-wide and is carried out in hourly frequency. Unit-specific energy cost is equal to the product of the heat rate and fuel cost of the unit. Region-wide, the total energy cost for an hour is equal to the sum product of the output (MW) and energy cost of individual units, for all dispatched units in the region. The region's marginal energy cost for the hour is equal to the energy cost of the highest-cost unit dispatched during the hour, stated on a $/MWh basis.

<u>AVOIDED COSTS OF OPERATING RESERVES</u>: Estimates of the marginal costs of operating reserves are based on an opportunity cost methodology: for units participating in the provision of operating reserves, opportunity cost is equal to the foregone operating profits which result from holding back a certain share of the capacity of the unit from participation in energy markets. The opportunity cost of operating reserves for each participating unit is equal to the difference between marginal energy cost (or price) for the region (or regional market) and the marginal energy cost for the unit. The unit under dispatch which incurs the highest opportunity cost determines the marginal cost of operating reserves for the region, estimated hourly. The marginal cost of operating reserves is specific to reserve type, consisting of *regulation reserves*, *10-minute reserves including spin and non-synchronized reserves*, and *backup reserves*.[57] For avoided cost estimates, marginal costs of operating reserves originate with an off-line analysis of the Midwest region of the Eastern Interconnection, and are reflected as a set of parameters; marginal energy costs are a main driver of the value operating reserves. The parameters generated from

---

[55] The energy output of nuclear generating units is determined outside the dispatch process.

[56] The marginal cost of operating reserve services is based on opportunity costs. The marginal generator unit providing operating reserves (by type of reserve service) is different from the marginal generator unit which provides energy supply.

[57] The specification of operating reserve services is specific to region and can include variation on this standard definition. Also, regulation reserves provided by ISO/RTOs can include separate *regulation up* and *regulation down* market services.

the analysis are adjusted in order to obtain operating reserve cost estimates which are more closely aligned with the technology mix and relevant regional wholesale prices.[58]

<u>AVOIDED CAPACITY COST, SCARCITY RENTS</u>: As discussed previously, least cost-based generation expansion planning focuses on the estimation of system-level reliability, measured as the likelihood of power outages as a consequence of insufficient generation supply, often characterized as an issue of generation adequacy. Generation plans are driven by electricity demand, projected by season and month over future timeframes. Under least cost criteria, the supply of generation within a region—or service territory—is expanded up to the point where the incremental improvement in reliability approximates the incremental cost of capacity, after taking account of maintenance schedule and estimates of forced outage rates of individual generators for the region.

Physical reliability of power generation can be measured as loss of load hours (LOLH), which is the sum of loss of load probability (LOLP) summed over hours. The incremental cost of capacity should be broadly interpreted as the *all-in annual costs of capacity* including the annual carrying charges on a unit of capacity, stated on a $/kW-year basis. Under this principle, service providers can be viewed as having in place adequate generation if, over future years, loss of load hours total to approximately one day in ten years,[59] after accounting for uncertainty of future loads and available generation supply.

This essential point is that, on the margin, capacity cost is the shadow price of reliability costs. Reliability costs can be measured as the costs incurred by electricity consumers as a consequence of unanticipated power outages. Contemporary survey studies using contingent valuation methods suggest that consumer outage costs (Value of Loss Load) can reach upwards of $10/kWh.[60]

Estimates of the avoided cost of capacity over future years is determined by estimating reliability costs on the basis of the likelihood of outage events. The analyses of the underlying estimates of avoided costs

---

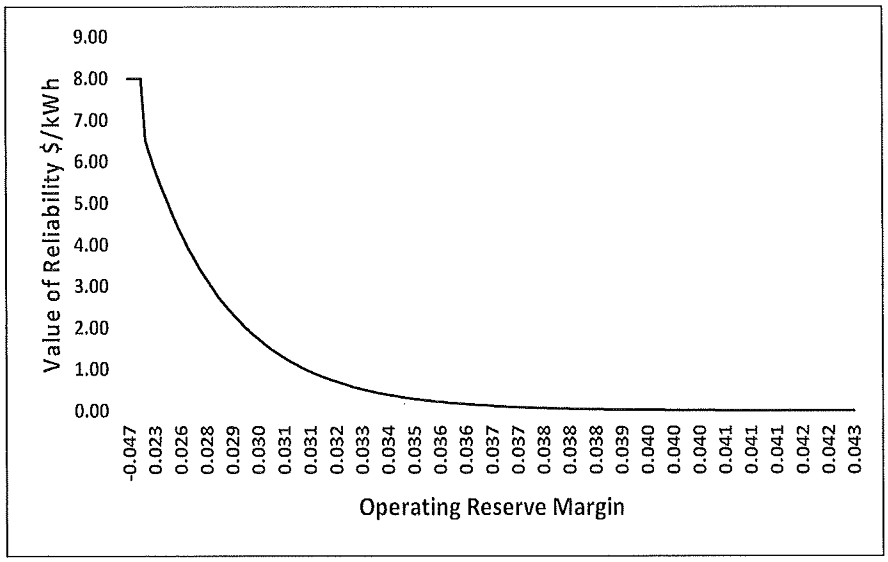
[58] Estimates of the marginal operating reserve costs, obtained from the original analysis, are significantly above observed ISO/RTO operating reserve prices over recent years. The difference is most likely a result of substantial changes in resource mix and much reduced fuel costs, heat rates, and unit-specific operating constraints.

[59] Or equivalently, 2.4 hours per year. *One day in ten years* is a commonly used industry criterion.

[60] As an example, until recently the ERCOT region sets the value of reliability at $9,000/MWh.

simulate an *operating reserve demand curve* (ORDC), where reliability costs are expressed as an inverse schedule of available operating reserves. Therefore, the ORDC used to determine avoided capacity costs—again, the shadow price of reliability—increases as the reserve margin decreases.[61] The figure below provides an example of the ORDC.

Operating Reserve Demand Curve



The ORDC methodology[62] for determining reliability costs—which can be described as the cost of scarce resources (*scarcity rents*)—sets the value of capacity equivalent to the worth of reliability to electricity consumers: foregone value given up as a consequence of unexpected power outage events. The ORDC approach has been implemented in recent years by ISO/RTOs. The distinction herein is that reliability costs are reflected as a continuous function of available reserves, with scarcity rents equal to zero during most hours of annual period (when operating reserves are greater than approximately 4.7% of hourly loads).

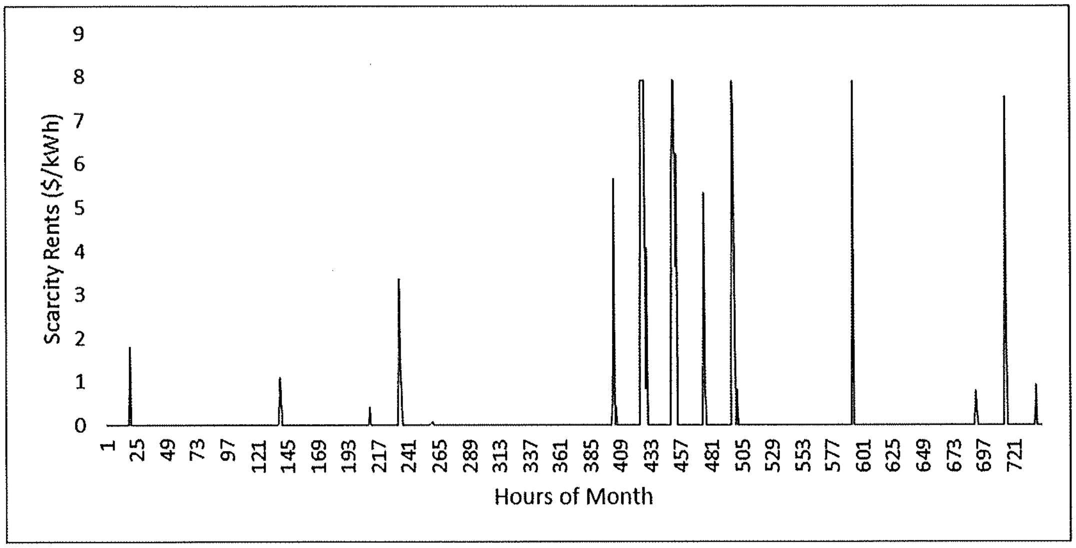
---

[61] The ORDC used incorporates a maximum reliability price of $8/kWh when the reserve margin is less than 2.1%.

[62] The ORDC methodology is inherently an administrative approach for valuing the marginal worth of capacity, manifested as scarcity rents. The implementation of the ORDC approach for determining reliability value within energy prices has proved unusually challenging and ISO/RTOs have been subjected to much criticism by market monitors and stakeholders. In particular, ORDC scarcity prices administered by ISO/RTOs are step functions in lieu of continuous functions, as applied in the immediate analysis.

As observed across regional wholesale electricity markets organized under North American ISOs/RTOs,[63] high scarcity rents within wholesale LMP prices are isolated events. Scarcity rents assume zero magnitudes during many hours and unusually high levels during a few hours. To this point, shown below are simulated reliability costs for the August hours of a typical year for a wholesale market region facing capacity constraints.

Simulated Scarcity Rents for Hourly Regional Loads for August 2035



Simulated scarcity rent content is zero in most hours. Scarcity rents across the 744 hours of August is summarized in the following table; as shown, scarcity rent content was present in 40 of the 744 hours for the month of August.

[63] Near-term examples are reflected in LMP prices within the regions of the California ISO (Cal ISO), ISO New England (NE ISO), and the Electric Reliability Council of Texas (ERCOT).

Frequency and Magnitude of Scarcity Rents, Results of Operating Reserve Demand Curve

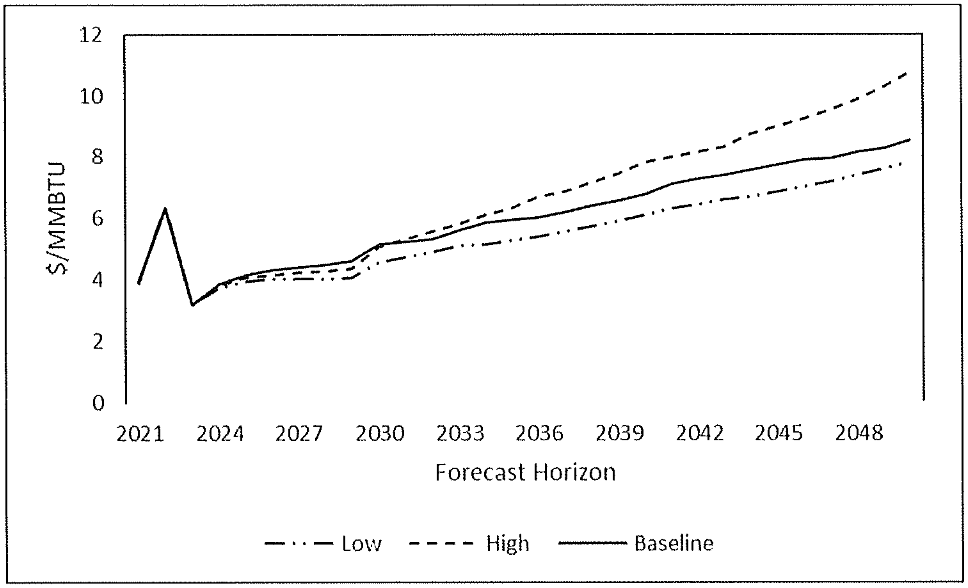
	Scarcity Rents	
Stated $/kWh Basis		*Stated $/MWh Basis*
Count if = $0.00	704	Count if = $0.00
Count if > $0.00	40	Count if > $0.00
Count if > $0.50	28	Count if > $5,000
Count if > $1.00	21	Count if > $1,000
Count if > $2.00	18	Count if > $2,000
Count if > $3.00	16	Count if > $3,000
Count if > $4.00	14	Count if > $4,000
Count if > $5.00	13	Count if > $5,000
Count if > $6.00	10	Count if > $6,000
Count if > $7.00	9	Count if > $7,000

PRIMARY FUEL PRICES: In the absence of repowering, the heat rates of thermal generating units of the portfolio of regional generators remain more or less constant, year over year. As a consequence, avoided energy costs, and to a lesser extent avoided operating reserve costs, are determined by the position of the production cost function with reference to electricity demand and, second, primary fuel prices. For purposes of avoided cost estimation, primary fuel prices are stated on a $/MMBTU basis, though spot (and futures) prices for for coal and oil are stated on a $/ton and $/barrel basis.

Primary fuel prices have substantial variation, as history reveals. As an example, the prompt month price for natural gas for the well-known Henry Hub delivery point in Louisiana closed at a low of $1.52/MMBTU for delivery in April 2020. By contrast, settled spot prices for the first two weeks of October 2021 were $5.78/MMBTU, reflecting the combination of increasingly constrained worldwide supply, notably in Western Europe and Southeast Asia, and modest buildup of gas inventories in storage reservoirs over the course of the summer months of 2021 but then reached over $9/MMBTU at one point in 2022.

For estimation of long-term avoided costs, projections of the price paths for natural gas and oil are based on a combination of CME-observed settlement prices, and EIA's long-term fossil fuel projections, as released with the *Annual Energy Outlook* (AEO) in early 2023. Price projections of natural gas and oil include a baseline price trajectory flanked by scenarios of high- and low-price paths. Presented below in nominal terms are the alternative scenarios of natural gas prices, 2021-2050.

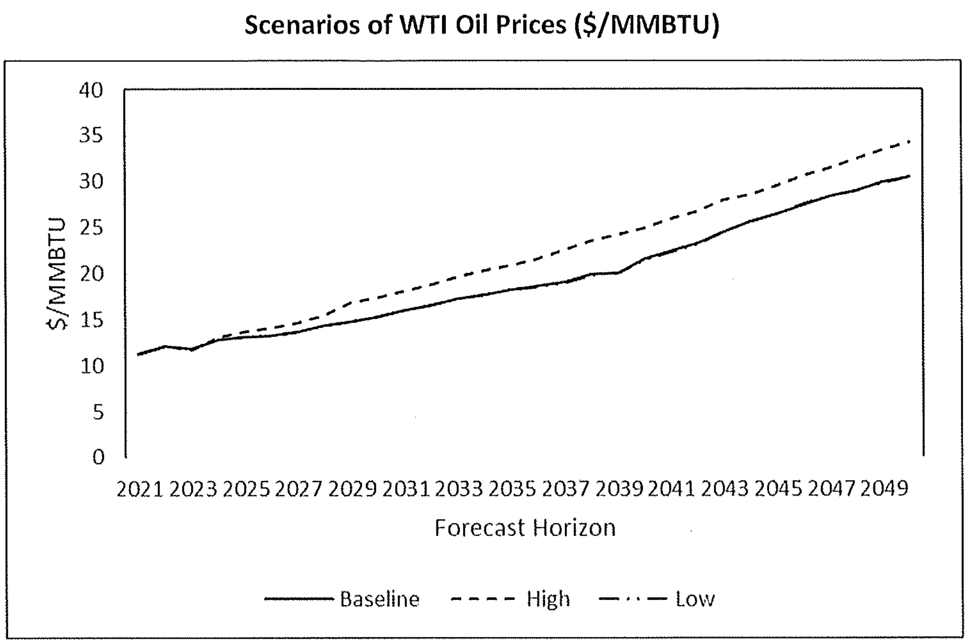
Scenarios of Natural Gas Prices ($/MMBTU)



The baseline outlook through 2033 is based on CME natural gas futures prices observed in March 2023 and assumed escalation of 2.0% annually over subsequent years through 2050. The high scenario rises slightly above CME futures prices after 2030 and, for subsequent years, follows EIA's natural gas price path, as reflected in the 2023 AEO. The low natural gas price scenario presumes a slower pace of escalation vis-à-vis CME futures through 2033, and escalation of 1.6% over subsequent years.[64]

Long-term projections of oil prices proceed similarly: near-term years reflect CME WTI oil prices while "out years" reflect variants of EIA oil prices. The scenarios for oil prices are presented below.

[64] The long-term path under the low scenario of prices implies a continuation of the natural gas price experience beginning in approximate 2010. Driven by a combination of hydraulic fracturing and horizontal drilling, production of natural gas has risen by over 40%, reflecting an approximately threefold decline in real prices which, in turn, has resulted in major increases in market share within electric power generation.



As shown above, long-term projections of oil prices assume a rising price path over the long term through 2050, driven by steady increases in the world demand for crude oil.[65]

Coal-based primary fuels are projected to rise steadily from $2.01/MMBTU in 2021 to $3.21/MMBTU in 2050. This 1.8% annual rate of change, if accurate, implies that coal prices are expected to assume, in real terms, a modestly declining path over the long term, reflecting abundant supply and attenuated demand for coal as a consequence of the environmental challenges associated with coal-fired generation.

Baseline estimates of long-term avoided costs incorporate the high scenario of natural gas prices, in view of the recent, sharp increase in natural gas prices; and the baseline projections of oil prices. For two reasons, the projection of coal prices is not differentiated into multiple scenarios. First, coal-fired

[65] As with most other commodities, the history of oil prices reveals substantial price variation. Since the turn of the century, several points are notable. First, spot prices for crude oil reached a high near $150/barrel during the 3rd quarter of 2008. Oil prices declined fast during the ensuing 6 months as the deep recession of 2009 set in across Western democracies, and subsequently settled in the range of $85-$105/barrel. In July/August of 2015, world oil prices declined precipitously, reach $30-$40/barrel, with prices remaining within the range of $45-$65/barrel through late 2019 prior to briefly plummeting to $16/barrel at one point during the first half of 2020.

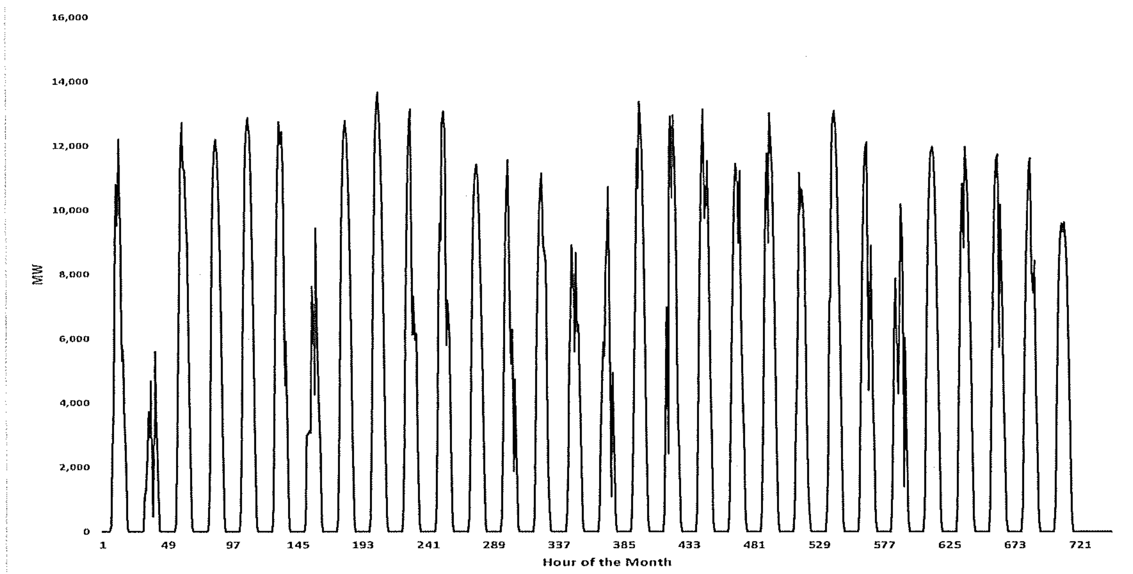
generation in Florida generally has comparatively high transportation costs. Second, coal generation is projected to be on the margin only rarely in the FRCC region.

SOLAR ENERGY: As reported in the 10-year site plans of the FRCC region, solar energy is expected to be a major source of electricity over the ensuing two to three decades. For purposes of near-term avoided cost estimation, the underlying analysis incorporates the FRCC projections of solar energy over the plan outlook period, through 2030. For purposes of long-term avoided cost estimation beyond 2030, the analysis adds solar and combined cycle generation in order to satisfy projected energy requirements within the FRCC region for inclusive years 2031-2050. The analysis uses a *constant elasticity of substitution* (CES) framework to help guide the determination of the shares of capacity additions for the two candidate technologies. The CES function estimates the shares of the annual capacity additions to serve energy based on the comparative costs of the two competing technologies, stated on a $/MWh basis. The costs of capacity are *all-in*, inclusive of all costs associated with the investment and operation of new facilities during an annual period. The technology selection process takes account of capital indivisibility—essentially, the installation of capacity additions can result in larger increments, as installed, than necessary to satisfy reliability—in the case of combined cycle generation.[66]

The amount of electricity produced by solar facilities, as installed, is simulated using the RE-OPT software of the NREL. The quantities of output (MW) are based on radiance data, as estimated in hourly frequency using LIDAR technology. Simulations of hourly solar energy supply are carried out for several defined locations in the Florida Peninsula. Shown below is a scenario of simulated solar electricity supply.

[66] Modern multi-shaft combined cycle generators are often large, with recently installed units reaching approximately 1,200 MW of nameplate capacity. As a result of the large incremental additions, projected MW of installed solar and combined cycle capacity during an annual period varies from the results implied by the CES analysis.

Simulation of Solar Electricity Output, April 2036



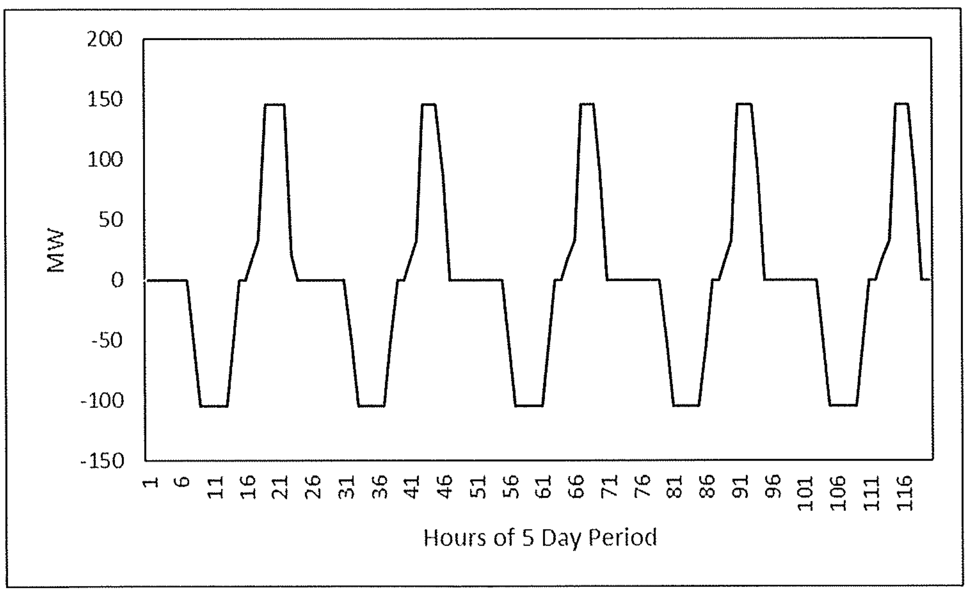
<u>STORAGE CAPACITY</u>: Battery storage facilities provide capacity to serve reliability but do not provide net energy to power systems. Battery storage, moreover, is not renewable energy per se; rather, storage capability provides the means to mitigate the effects of resource intermittency by normalizing the power output of renewable facilities on both the demand and supply sides of electricity markets. Battery storage also helps satisfy the general reliability needs of power systems. While battery storage can serve as an alternative to single cycle combustion turbines (CTs), storage can also supplement conventional technology—i.e., CTs—for purposes of system reliability.

Battery storage facilities are charged during low-cost hours and discharged during high-cost hours when capacity is most likely needed. The capacity parameters of storage facilities are MWh of electricity storage and the expedition with which electricity can be discharged. As an example, a 200 MWh – 4-hour discharge cycle translates into 50 MW of capacity available over 4 hours; similarly, a 200 MWh – 2-hour discharge cycle translates into 100 MW of capacity, but for only two hours duration.

FPUC's forward-looking avoided cost estimates presume that installed storage capacity facilities within the FRCC region are 50 MW – 4-hour discharge units.[67] The selection process for determining the shares of capacity for reliability is CES, similar to the approach to determine technology selection to satisfy energy requirements: technology shares are based on comparative all-in capacity costs, stated on a $/kW-year basis. Capacity additions to serve energy requirements (solar facilities, combined cycle generators) also provide capacity for purposes of reliability. Thus, the process for selection of capacity additions for the purpose of reliability (storage, CTs) is subsequent to the provision of capacity for purposes of energy.

Storage charge-discharge cycles are determined using optimization software of the NREL. An example cycle is shown below. Charging is represented by values less than zero, while discharging is represented by values greater than zero.

Storage Cycle of 200 MW of Storage Facilities (common cycle) for a 5 Day Stretch



[67] The study recognizes that, going forward, the process of regional planning will likely select storage units in various MWh-MW discharge combinations.

Note that the charging quantities (MW) are generally larger than the discharge quantities; the differences reflect the frequency and duration differences of the cycles, as well as energy losses inherent in battery storage.

BASELINE GENERATION EXPANSION PLAN: As reviewed above, long-term avoided costs are a consequence of electricity demand and supply, where a model-based selection process serves to guide capacity additions. The starting point is long-term projections of electricity demand, measured as energy consumption and peak loads over the forecast period. Supply plans are determined accordingly: given projections of demand and driven by least cost criteria, service providers determine future supply needs measured in terms of capacity requirements. The analysis process accounts for generator unit retirements; cost projections of primary fuels; and the evolution of the system load shape including demand-side management and load relief.

FPUC's long-term avoided cost study draws on the summary-level 10-year supply plans of the FRCC region, released in early 2022. The avoided cost study extends the FRCC outlook for electricity demand, including projections of energy and peak loads through 2050. The extended outlook should be interpreted as a scenario: one plausible outlook among many. Projections of demand and supply for purposes of estimating avoided costs are displayed below.

Projections of Electricity Demand and Generation Supply, for the FRCC Region, 2022-2050

Year	Energy	Demand (MWs)	Storage	Combined Cycle	Single Cycle	Gas Turbine	IC	Nuclear	Import and Purchases	PV	Steam	Total Supply Installed	Planning Reserve Margin
2022	246,534	49,092	435	10,700	21,871	7,019	100	3,646	4,533	1,665	10,007	58,311	19%
2023	249,224	49,677	435	10,700	21,871	7,739	100	3,646	3,838	2,119	9,882	60,329	21%
2024	251,892	50,241	435	10,836	22,072	8,193	237	3,646	3,393	2,790	9,380	60,982	21%
2025	254,097	50,720	435	10,836	22,614	8,010	237	3,646	2,703	3,327	8,904	60,711	20%
2026	255,650	51,079	480	10,836	22,614	8,444	237	3,646	2,510	3,619	8,904	61,289	20%
2027	257,168	51,540	525	10,836	22,614	8,069	237	3,646	1,896	3,932	8,904	60,658	18%
2028	257,949	51,930	930	10,836	22,614	8,069	237	3,646	1,783	4,425	7,250	59,789	15%
2029	259,323	52,514	2,088	10,836	22,828	7,616	237	3,646	1,815	4,783	4,718	58,566	12%
2030	260,351	53,128	2,752	10,836	22,828	7,169	329	3,646	1,762	5,186	3,383	57,889	9%
2031	257,614	53,062	3,686	10,836	22,828	6,664	329	3,646	1,605	5,566	2,441	57,599	9%
2032	254,849	53,084	3,776	10,836	25,348	6,274	329	3,646	1,605	5,566	2,106	59,484	12%
2033	252,371	53,335	3,866	10,836	25,348	6,038	329	3,646	1,605	5,566	2,106	59,338	11%
2034	250,771	53,613	3,956	10,836	26,713	5,659	329	3,646	1,605	5,566	2,106	60,415	13%
2035	249,797	53,924	4,496	10,836	26,923	5,226	329	3,646	1,605	5,611	2,106	60,777	13%
2036	249,024	54,167	5,036	10,836	27,343	4,882	329	3,646	1,605	5,611	2,106	61,393	13%
2037	248,564	54,420	5,576	10,836	27,973	4,443	329	3,646	1,605	5,611	2,106	62,124	14%
2038	248,372	54,693	6,116	10,836	28,078	4,183	329	3,646	1,605	5,611	2,106	62,509	14%
2039	248,433	54,973	6,431	10,836	29,128	3,120	329	3,646	1,605	5,611	2,106	62,810	14%
2040	248,527	55,269	6,971	10,836	29,968	2,658	329	3,646	1,605	5,656	2,106	63,773	15%
2041	248,475	55,515	7,511	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	64,523	16%
2042	248,637	55,767	8,321	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	65,333	17%
2043	248,794	56,025	9,131	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	66,143	18%
2044	249,152	56,291	9,941	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	66,953	19%
2045	249,403	56,568	10,211	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	67,223	19%
2046	249,596	56,809	10,841	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	67,853	19%
2047	250,032	57,059	11,741	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	68,753	20%
2048	250,525	57,311	12,371	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	69,383	21%
2049	251,093	57,566	13,001	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	70,013	22%
2050	252,211	57,837	14,081	10,836	30,178	2,658	329	3,646	1,605	5,656	2,106	71,093	23%

While the technology selection process utilizes a CES framework,[68] such approach serves only as a guideline. Capacity additions for individual years are based on simulations of scarcity rents and the general "fit" of specific technologies within the existing portfolio of generation in the FRCC region.

[68] The CES framework can assume several variants. The approach used for technology choice is as follows:

$$Capacity^{Technology\ A} \Big/ Capacity^{Technology\ B} = \left(\frac{1-\alpha}{\alpha}\right)^{\left(\frac{\rho}{1-\rho}\right)} \left(\frac{Cost^{Technology\ B}}{Cost^{Technology\ A}}\right)^{\left(\frac{\rho}{1-\rho}\right)}$$

where,

$\alpha = resource\ distribution\ parameter$

$\rho = \left({(\sigma - 1)}/{\sigma}\right)$ $where\ \sigma = resource\ substitution\ parameter$

AVOIDED POWER DELIVERY COSTS: TRANSMISSION AND DISTRIBUTION

Power delivery including transmission and distribution functions entails avoided energy and reliability cost components, where energy costs reflect marginal line losses. As discussed in Section II, avoided transmission and distribution costs can be determined using several approaches. The methods adopted by the immediate study are as follows:

- Avoided Transmission Energy Costs (line losses) are based on the line losses set forth in FPL's Open Access Transmission Tariff.
- Avoided Transmission Reliability Costs are set according to transmission capacity costs, as estimated and stated in terms of $/kW-year.
- Avoided Distribution Costs are exclusively energy-related, manifested as line losses, set at assumed levels.

AVOIDED TRANSMISSION ENERGY COSTS: Physical line losses are reflected as the difference between injections and withdrawals across the network and are largely a function of transport distances, current levels, ambient temperatures and line voltages. Network-wide losses measured simultaneously are often reported for monthly and annual timeframes. However, losses can be accurately measured for specific locational pairs. Average and marginal line losses are generally positive, though losses can be negative on specific transmission lines, and in the case of counterflows on specific paths. Because much of FPL's generation is in South Florida and FPUC's service territories are located some 300-350 miles to the north, net flows on Florida's transmission network (FRCC), in response to an increase (decrease) in loads within FPUC's electricity service divisions (both East and West), may constitute a net counterflow on lines should the general flow pattern within the FRCC network assume a north to south direction. In essence, true marginal losses could be negative, at least in some hours of a typical year. In view of these considerations, FPUC's long-term avoided cost study sets transmission energy costs (line losses), according to the average line loss percentage specific to FPL's OATT, which is applicable to all loads regardless of location and timeframe. In summary, for purposes of the immediate study, marginal transmission line losses are set at a uniform 1.85% of load, regardless of load level.

AVOIDED TRANSMISSION RELIABILITY COSTS:

For Years 2023-2026: Avoided costs for these near-term years are based on FPUC's contracts with FPL, including both generation and transmission services. Avoided transmission costs are set according to projections of the transmission reservation charges under FPL's OATT, which are essentially average transmission capacity costs, stated on a $/kW-month basis.

For Years 2027-2050: Transmission reliability costs are estimated using a capacity cost proxy methodology: observed historical cost records for transmission investment and fixed operations and maintenance expenses for FPL. This approach implicitly presumes that, over years, FPL's planning process expands the capability of the transmission network according to least-cost criteria. The analysis implicitly presumes that FPL's network will be expanded at least cost while also fully satisfying established reliability standards and that such standards will be in place over prospective years.

Estimates of the transmission capacity cost, as a proxy for transmission reliability, are based on FPL's experience over years 2006-2016.[69] Underlying cost data for these years are reported in FPL's financial statements covering transmission, including its balance sheet (gross and net plant, accumulated depreciation, general plant, materials and supplies inventory) and operating expenditures (fixed O&M expenses, administrative and general expenses, insurance, and property taxes).

For the analysis years, these official financial cost data including capital expenditures and operating expenses are converted to real dollars. In the case of capital expenditures, well-known Handy-Whitman cost indexes (South Atlantic region) and the real estate price index for the State of Florida are used to restate cumulative investment expenditures to 2016 dollars. Similarly, operating expenses are converted to real dollars using the Bureau of Labor Statistics employment cost index "Total Compensation for Private Industry Workers in Utilities." Because of the exceptionally long life of transmission facilities and ongoing capital depletion, investment expenditures are converted to a real capital stock data series using the well-known Christensen-Jorgenson methodology of capturing economic depletion in a year-over-year function

[69] FPL's transmission network is comprised of 500 kV, 230 kV, 138 kV, 115 kV, and 69 kV facilities. Stated in miles of conductors, these facilities include 1,179 miles at 500 kV, 3,001 miles at 230 kV, 1,530 miles at 138 kV, 742 miles at 115 kV, and 209 miles at 69 kV.

of geometric decay. The end result is estimates of the transmission capital stock and operating expenses for FPL are stated in 2016 dollars, shown below according to FERC transmission account categories.

Transmission Real Capital Stock and Operating Expenditures for FPL 2006-2016, ($2016 000s)

FACILITY CATEGORY	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
(350) Land and Land Rights	195,412	275,010	245,752	220,772	205,481	192,575	191,536	209,186	232,164	260,132	293,848
(352) Structures and Improvements	72,307	258,926	24,577	90,057	79,249	90,960	99,523	102,242	104,374	116,640	134,974
(353) Station Equipment	1,094,031	895,187	1,058,916	1,138,890	1,194,846	1,248,613	1,372,496	1,414,040	1,503,491	1,630,785	1,760,994
(354) Towers and Fixtures	271,347	218,064	242,118	250,285	254,413	262,516	267,356	268,818	271,794	278,266	283,264
(355) Poles and Fixtures	559,877	522,457	595,458	649,384	686,972	729,011	763,832	804,433	879,631	982,712	1,156,987
(356) Overhead Conductors	543,296	480,749	492,686	532,505	539,232	558,627	589,695	610,230	640,091	666,218	701,475
(357) Underground Conduit	42,685	41,638	44,887	67,390	79,582	73,567	76,156	63,847	56,827	60,007	59,670
(358) Underground Conductors	51,935	37,824	45,552	47,836	50,765	54,063	57,534	69,898	75,449	74,199	79,325
(359) Roads and Trails	77,322	106,977	93,111	81,939	77,117	73,958	73,652	79,766	87,535	96,368	107,993
(359.1) Asset Retirement Costs	0	0	0	0	56	90	78	81	81	81	82
TOTAL Transmission Plant	2,908,212	2,836,833	2,843,057	3,079,058	3,167,713	3,283,981	3,491,858	3,622,541	3,851,437	4,165,409	4,578,609
O&M EXPENSES											
Total (000's)	87,941	74,231	85,188	71,804	92,437	103,451	112,095	97,190	78,668	79,609	78,459
% of Real Capital Stock	3.0%	2.6%	3.0%	2.3%	2.9%	3.2%	3.2%	2.7%	2.0%	1.9%	1.7%

As mentioned, the capital expenditures and operating expenses are adjusted for ancillary cost elements including A&G, insurance, property taxes, and employee benefits. These adjustments increase operating expenses by 6.21% to cover capital-related ancillary costs, and by 36.64% to cover operating-related ancillary costs. As shown above, FPL's transmission operating expenses have declined substantially beginning in 2014, stated on a per-unit-of-investment basis.

AVOIDED ENERGY COSTS, DISTRIBUTION: As with transmission, distribution energy costs are manifested as physical line losses: the difference between injections (MW) into primary feeders and load withdrawals (MW) along primary and secondary lines. Also, much like transmission, distribution losses are specific to transport distances, electrical current (amperage), ambient temperatures, and line voltages. A sizable share of distribution losses is associated with voltage transformations, between high-voltage transmission conductors and primary distribution feeders and, second, between primary and secondary lines and the facilities of electricity consumers.

Unlike transmission losses, distribution line losses are not directly observable or easily estimated at an overall system level. Power losses for individual distribution circuits can be simulated, however. Power systems often consist of many distribution systems with much variation among circuits: primary circuits configured as both loop and radial systems, short lines and other circuits extending over long distances.

As a practical matter, it is appropriate to consider procedures which average, in some way, estimates of the marginal line losses for the various distribution systems in place. Generally speaking, it is important for the procedures to account for the differences between average and marginal losses, while recognizing that transformer losses have small losses for charging unrelated to load levels (no-load losses).[70]

In the absence of a quantitative assessment, marginal distribution line losses are benchmarked to an assumed level of average losses within FPUC's distribution systems in both the Eastern and Western Divisions.

[70] Conductor losses largely follow current squared-resistance principles and, to a large extent, increase/decrease at two times the change in average losses.

SECTION IV: STUDY RESULTS

AVOIDED GENERATION COSTS, 2023-2026

As discussed above, avoided costs of generation for these near-term years are set according to the commercial terms of FPUC's contract for generation services with FPL. Terms of the contract consist of fixed and variable non-fuel cost elements for intermediate and load-following capacity blocks and fuel costs determined according to observed market prices for natural gas in the Southeast region. Contract terms are used to simulate the marginal costs of generation, years 2023-2026. Contract terms are confidential.

AVOIDED GENERATION COSTS, 2027-2050

Long-term avoided costs for the Florida region are simulated for selected years[71] over the projection years 2027-2050 and cover the marginal costs of energy, operating reserves, and scarcity rents[72] which reflect reliability and its shadow price counterpart, marginal capacity costs. Simulations of avoided costs of generation involve the preparation of sizable data files, intermediate analyses, diagnostic assessment and review of the variation input cost components to the estimation process, and a structured procedure to verify the calculations to gauge the plausibility of summary results. Selected intermediate analyses are discussed below.

GENERATION ADEQUACY: TECHNOLOGY SELECTION TO SATISFY ENERGY AND CAPACITY REQUIREMENTS:

Avoided costs of generation over forward years 2027-2050 reflect capacity additions to satisfy steadily rising demand for electricity, changes in both increased energy consumption and rising peak loads. Generation adequacy is a particular concern for two reasons:

- The intermittency of renewable resources—predominantly demand- and supply-side solar facilities—implies higher levels of planning and operating reserves, other factors constant. This is a particular issue insofar as solar facilities are highly likely to constitute a rising share of total installed capacity, both nationally and in Florida.

---

[71] Simulation years include 2027, 2029 and every third year ('32, '35, ..., '50) thereafter.

[72] As discussed earlier in this report, scarcity rents capture the implied reliably costs in the form of consumer outage costs, and are implicit within the supply-demand balance, as reflected in available operating reserves.

- Decreasing load factor resulting from the charging loads of electric vehicles—and electrification, generally speaking—which are expected to have rapidly rising market penetration.

As discussed, technology selection employs a CES framework to guide the selection of capacity for energy and, separately, capacity to serve peak loads. The reason for this sequential approach is that *cost-viable* capacity to serve peak loads, including single-cycle combustion turbine (CT) and battery storage (storage) technologies, are not economically viable options to serve energy requirements, compared to combined-cycle combustion turbines (CC) and solar facilities. In addition, the two technology options available to serve energy requirements (CC, solar) also satisfy capacity needs. Thus, the underlying methodology first selects solar and CC capacity necessary to satisfy the demand for energy. The second step selects the shares of additional capacity (CT, storage) necessary to satisfy peak loads after accounting for the incremental capacity made available by CC and solar additions to serve total peak load-driven capacity requirements. In short, the approach accounts for the capacity benefits for serving peak loads, made available from the installation of capacity additions to serve energy requirements.

The CES framework estimates technology shares according to the comparative costs of the technology choice options based on model parameters including two main factors: *starting point resource allocative parameters*; and *substitution parameters*. Projections of comparative costs of competing technologies include carrying charges on investment,[73] fixed operating costs, and the fuel costs associated with conventional generation in the two choice sets (solar, CC; storage, CT).[74] The costs of technologies are all-in inclusive.[75]

---

[73] Economic Carrying Charge refers to the annual all-in carrying charges on capital including depreciation, payback of principal, interest charges, corporate income taxes where appropriate, and return on capital including investor perceptions of risk. Stated on a discounted basis the derived form of the ECC rate is equal to:

$$I * \{[(k-i+t)(1+i-t)^n] / (1+k)^n\}\{(1+k)^m / [(1+k)^m - (1+i-t)^m]\}$$

where *I=investment*, *k=capital charge rate*, *i=expected inflation*, *t=technological advance*, *n=year*, and *m=expected life of capital.*

[74] Fuel costs associated with single- and combined cycle generation are determined according to projections of natural gas prices, heat rates, and capacity factors.

[75] For the purposes herein, the all-in incremental cost envelope includes carrying charges on direct investment expenditures, interest during construction, working capital, materials and supplies, general plant, and fuel inventory if applicable, plus annual expenditures for direct operations and maintenance services, employee benefits, insurance, property taxes, and administrative and general expenses (overheads).

For purposes of technology selection, comparative all-in costs and CES-based technology selection shares associated with capacity to provide energy are as follows:

Marginal Capacity Costs for Energy Supply ($/MWh)

	2027	2029	2032	2035	2038	2041	2044	2047	2050
Resource Costs									
Combined Cycle	$64.76	$67.48	$73.82	$79.24	$85.43	$92.68	$98.85	$106.19	$114.35
Battert Storage	$59.26	$60.92	$63.48	$66.16	$68.94	$71.85	$74.88	$78.03	$81.33
Resource Shares									
Combined Cycle	-0.5259	-0.5412	-0.5964	-0.6302	-0.6694	-0.7160	-0.7431	-0.7787	-0.8175
Battery Storage	0.2977	0.3050	0.3308	0.3463	0.3637	0.3840	0.3955	0.4105	0.4263

Similarly, comparative all-in costs and CES-based technology selection shares associated with capacity to provide reliability are as follows:

Marginal Capacity Costs for Reliability ($/MW-year)

	2027	2029	2032	2035	2038	2041	2044	2047	2050
Resource Costs									
Combined Cycle	$123.07	$129.98	$144.48	$162.52	$182.81	$205.64	$231.32	$260.20	$274.64
Battery Storage	$139.93	$143.89	$150.03	$156.44	$163.12	$170.09	$177.37	$184.95	$188.74
Resource Shares									
Combined Cycle	0.0512	0.0557	0.0662	0.0780	0.0891	0.0996	0.1095	0.1188	0.1235
Battery Storage	-0.0411	-0.0455	-0.0564	-0.0699	-0.0840	-0.0988	-0.1141	-0.1301	-0.1381

As mentioned, the CES-based resource shares shown above are used for general guidance with respect to technology choice.

AVOIDED ENERGY COSTS: Estimates of long-term avoided energy costs over forecast years are determined from the projections of hourly loads and the simulation of the short-run supply function. Hourly loads are the sum of the conventional load profile scaled to future years along with projections of the charging loads of electric vehicles. For each simulation year, the short-run supply function, referred to as the generator stack, is based on economic dispatch of net available generation, accounting for planning and forced outage experience of the portfolio of generator units for the Florida region. Avoided (marginal) energy costs are the result of several iterations of random draws of planning and unforced outage experience, as applied to all thermal units which comprise the generation portfolio. Presented below is a summary of the average avoided energy costs, by month and year for selected simulation years.

Avoided Energy Costs for Selected Years, 2027-2050 ($/MWh)

	2027	2029	2032	2035	2038	2041	2044	2047	2050	Annual % Change
Jan	59.94	62.09	66.34	73.30	82.27	90.94	98.83	107.83	123.86	3.2%
Feb	56.94	60.16	64.90	71.79	80.36	88.29	96.85	106.64	118.17	3.2%
Mar	43.45	45.60	54.67	60.50	67.13	74.49	81.55	89.63	100.46	3.7%
Apr	32.51	33.59	45.21	50.44	56.20	62.43	68.14	74.76	83.97	4.2%
May	34.05	33.42	46.48	51.64	57.61	63.85	69.67	76.09	85.87	4.1%
Jun	37.57	37.66	52.83	58.39	65.14	72.05	78.88	86.29	97.97	4.3%
Jul	38.12	41.08	55.13	60.92	68.06	75.30	82.56	90.36	102.66	4.4%
Aug	39.98	43.76	56.67	62.86	70.10	77.55	85.01	92.94	105.37	4.3%
Sep	38.76	40.53	54.85	60.72	67.77	74.85	82.05	89.70	101.85	4.3%
Oct	38.56	40.46	51.69	57.35	64.09	70.98	77.56	84.96	96.17	4.1%
Nov	45.27	46.91	56.85	62.46	70.12	77.32	85.20	92.62	106.42	3.8%
Dec	57.52	59.95	66.61	73.46	82.10	91.52	100.54	109.52	124.95	3.4%
Average	43.56	45.43	56.02	61.99	69.25	76.63	83.90	91.78	103.98	3.9%

As observed above, the monthly averages of marginal energy costs are comparatively small, with somewhat lower values during off-peak months including April, May, and October. For Florida, region-wide simulation of marginal energy costs demonstrates that gas-fueled generators, including combined- and single-cycle units, are often on the margin. Florida's current fleet of gas generators includes several modern units with stated heat rates near 7,500 BTU but also with heat rates well above 9,000 BTU. Averages of marginal energy costs mask the underlying variation. Off-line simulations over multiple draws of unit availability and peak hourly loads suggest that marginal energy costs can range from less than $23/MWh to over $300/MWh. The exceptionally high marginal costs, as simulated, result from the combination of unexpectedly high load levels and low availability, after accounting for planned generator unit down time.

<u>MARGINAL COST OF OPERATING RESERVES</u>: As discussed in Section III, operating reserve services assume the classic categories including regulation, 10-minute synchronous (spin), 10-minute non-synchronous

(non-spin), and 30-minute backup reserves. Operating reserves accommodate unit ramp rate limits and account for unexpected events including variation in the level of demand and generator unit availability over the commitment period. Operating reserves are vital to the day-to-day operation of power systems.

The initial estimates of operating reserves result are obtained from an off-line study of operating reserves based on opportunity costs. Parameters obtained from the study are incorporated within the simulation software. For projection years 2027-2050, the marginal costs of operating reserves are displayed below.

Average and Range: Marginal Operating Reserve Costs, 2027-2050 ($/MWh)

	Regulation	10-Minute Spinning	10-Minute Non-Spin	Backup
Minimum	0.48	0.07	0.01	0.00
Maximum	8.58	4.29	4.29	4.29
Average	3.41	1.13	1.02	0.96

The above table presents summary-level results for years 2027-2050. Generally speaking, the costs of operating reserves rise as opportunity costs, measured as the foregone operating profits from the production of electricity, rise. Higher marginal energy prices translate into higher operating reserve costs stated on an expected value basis. Accordingly, the rising trend in marginal energy costs presented earlier implies that a similar rising trend in operating reserve prices is implicit within the above summary results.

<u>CAPACITY COSTS, APPROXIMATED BY SCARCITY RENTS</u>: Year-over-year differences in supply-demand balance can result in sizable variation in scarcity rents across months and days. For simulation years, presented below are total scarcity rents by month and year.

Total Avoided Capacity Costs (Scarcity Rents) by Month and Year ($)

	2027	2029	2032	2035	2038	2041	2044	2047	2050
Jan	0	0	1,941	5,555	7,896	7,320	7,869	7,857	7,846
Feb	0	0	0	0	0	0	0	0	0
Mar	0	0	0	1	16	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0
May	0	7,331	7,969	11,648	7,349	6,597	2,372	0	2,885
Jun	0	1,263	1,748	1,280	31	436	172	1,794	3,817
Jul	0	43,330	55,667	43,200	34,026	29,779	20,836	28,464	45,335
Aug	4,081	83,495	123,933	120,252	100,466	73,605	53,710	42,442	58,198
Sep	0	88	5	5	16	0	0	0	0
Oct	0	0	0	0	0	0	0	0	818
Nov	0	0	0	0	0	0	0	0	0
Dec	0	0	3,499	13,096	31,422	30,697	32,909	47,985	51,872
Total	6,108	137,536	196,793	197,073	183,259	150,473	119,912	130,590	172,820

The annual scarcity rents for each simulation year shown above—for example, the sum of the scarcity rents across months for year 2035 totals to $197,073—should approximate shadow prices, the marginal cost of capacity stated on a $/MW-year basis. As discussed in Section III, the underlying methodology assumes an operating reserve demand curve: the implicit worth of operating reserves within an hour is equal to the likelihood that not all load in the hour will be served. The value of scarcity rents in the hour is equal to the product of the probability of incurring lost load and the value of reliability to electricity consumers ($8.00/kWh). For a power system with supply well balanced to projections of demand, the sum of the hourly scarcity rents over the course of a year approximates the marginal cost of capacity measured as $/kW-year.

Accounting for planning reserves of approximately 20-23%, the incremental worth of capacity to mitigate power outages *on the margin*, is likely to be somewhat less than the cost of generating capacity, stated on an installed $/kW-year basis during 2027.

Because of the indivisibility of capacity coupled with uncertainty with respect to future demands, it is very difficult for power systems to precisely balance supply with demand within individual years. However, appropriate analytics and planning procedures provide the means for regional power systems to obtain supply-demand balance conditions which approximate optimal levels on average, year-over-year. The above simulations constitute a scenario which yields this result. Scarcity rents are somewhat less than capacity costs for the near-term years, suggesting that, for the above scenario of long-term avoided costs, the Florida region is somewhat *long in capacity*. To this point, presented below are the number of hours where the level of demand is greater than the level of supply.

Count of Loss of Load Events, 2027-2050

	2027	2029	2032	2035	2038	2041	2044	2047	2050
Jan	0	0	1	1	1	1	1	1	1
Feb	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0
May	0	2	2	2	1	2	1	0	1
Jun	0	0	0	0	0	0	0	1	1
Jul	0	9	8	11	7	7	7	8	9
Aug	0	13	21	20	19	14	9	8	11
Sep	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0
Dec	0	0	1	5	8	6	7	8	8
Total	0	24	33	39	36	30	25	26	31
Average	2								

The implication of the market scenarios is that for these shortage hours, Florida's power system will need to shed load, likely in the form of curtailment calls. Note that loss of load events are concentrated during summer months.

Over projection years 2027-2050, avoided costs of generation services,[76] including energy, operating reserves, and reliability (scarcity rents) are displayed below.

[76] Does not include marginal losses incurred with power delivery (transmission, distribution).

Long-Term Avoided Costs of Generation Services ($/MWh)

	2027	2029	2032	2035	2038	2041	2044	2047	2050	Annual % Change
Jan	65.09	67.54	74.99	87.76	101.12	110.18	119.87	130.05	148.14	3.6%
Feb	61.66	65.33	70.74	78.59	88.34	97.35	107.07	118.17	131.20	3.3%
Mar	46.27	48.73	59.07	65.72	73.29	81.66	89.68	98.87	111.15	3.9%
Apr	34.03	35.23	48.32	54.22	60.81	67.92	74.42	81.96	92.43	4.4%
May	35.68	44.85	60.47	71.24	72.29	78.39	79.35	83.47	98.46	4.5%
Jun	39.55	41.39	59.40	65.09	71.07	79.49	86.90	97.58	113.63	4.7%
Jul	40.16	101.66	134.38	124.23	120.04	122.57	118.83	137.92	174.49	6.6%
Aug	47.75	158.51	227.84	229.91	211.60	183.98	165.72	159.61	194.82	6.3%
Sep	40.89	43.03	59.28	65.99	74.03	82.08	90.27	98.97	112.75	4.5%
Oct	40.70	42.89	55.67	62.12	69.81	77.66	85.16	93.57	107.39	4.3%
Nov	48.33	50.21	61.55	67.95	76.69	84.87	93.84	102.26	117.90	4.0%
Dec	62.32	65.10	77.40	98.08	132.50	142.22	155.41	185.80	208.44	5.4%
Average	46.87	63.71	82.43	89.24	95.97	100.70	105.54	115.69	134.23	4.7%

The above results reveal substantial variation in avoided generation costs across months. The comparatively high avoided costs taking place during January and February are a direct result of planned maintenance outages which result in less efficient generator units being used to supply energy.

AVOIDED POWER DELIVERY COSTS, TRANSMISSION AND DISTRIBUTION

AVOIDED ENERGY COSTS, TRANSMISSION: FPUC's long-term avoided cost study sets transmission energy costs (line losses), according to the average line loss percentage specific to FPL's OATT, which is applicable to all loads regardless of location and timeframe. In summary, for purposes of the immediate study, marginal transmission line losses are set at a uniform 1.85% of load, regardless of load level.

AVOIDED CAPACITY COSTS, TRANSMISSION: Avoided transmission capacity costs are stated on a $/kW-year basis, equal to the annual carrying charges on capital and operating expenses for the analysis period 2006-2016. Annual carrying charges are equal to the product of investment expenditures and the estimated economic carrying charge rate[77] (7.85%) plus operating expenses adjusted for ancillary costs.

---

[77] Inclusive of Federal and State income taxes.

This *all-in cost* metric is then normalized by the change in peak load for the analysis period, to obtain avoided transmission capacity costs presented below.[78]

Avoided Transmission Capacity Costs, 2006-2016 ($/kW-year)

Changes in the Capital Stock and Peak Loads, 2006-2016		Investment Expenditure (kW-year)	
Capital Stock (000's)	Loads (MW)	Expenditures/Peak Demand ($/kW):	$819.22
$1,670,396	2,039	Adjusted for Ancillary Cost Elements ($/kW):	$870.09
Economic Carrying Charge Rate:	7.85%	Share Attributed to Peak Loads ($/kW):	$391.54
O&M Cost/Unit of Investment (%)		Marginal Cost of Transmisison Capacity ($/kW-year)	
Unadjusted:	1.84%	Capital-Related	$30.72
All-In Adjusted:	2.51%	O&M-Related	$9.82
Peak Load Attribution Factor:	0.45	Total	$40.54

As shown, the 2006-2016 estimated marginal cost of transmission capacity is $40.54 per kW-year, stated in 2021 dollars.[79]

<u>AVOIDED ENERGY COSTS, DISTRIBUTION</u>: In the absence of detailed analysis, the avoided cost study presumes that, across FPUC's distribution circuits, marginal distribution losses are set equal to 7.5% for timeframes relevant to lighting systems.

[78] Stated in real terms, the trend in Florida Power and Light's (FPL) expenditures for capital and operations and maintenance expenses appears to assume a more-or-less steady state, 2006-2016 and further into 2018, followed by a sharp rise during 2019. Over the longer term, FPUC's avoided cost presumes that FPL's transmission expenditure levels will return to the longer-term trend, for a couple of reasons. First, high-voltage transmission enjoys substantial scale economies providing that electric utilities have largely completed transmission "build out"; to a large extent, existing corridors can accommodate the demand for increased transfer capability. Second, demand-side simulations within FPUC's avoided cost study have fast rising behind-the-meter supply of solar energy, thus containing peak loads across the FRCC region and attenuating the need for out-sized year-over-year transmission expenditures, for capacity. Nonetheless, the study understands that this view may be challenged by alternative long-term perspectives.

[79] Note that the avoided cost study employs a slightly lower value: $38.18/kW-year for year 2021.

SECTION V: CONCLUSIONS AND SUMMARY REMARKS

Several important findings arise from FPUC's long-term avoided costs study, as follows:

> Long-term avoided costs of LED lighting are expected to rise: The marginal cost of G&T services within the FRCC region are likely to rise in real terms. Specifically, we anticipate that, for years 2023-2050, marginal G&T costs will rise 4.1% per annum.
>
> Renewable resource and storage are a major share of new generation: The consensus view reflected by major service providers and stakeholders calls for the generation portfolio the FRCC region to undergo significant change, as new technology (solar power, storage) is likely appear to hold large cost advantages over conventional generation. The long-term estimates of avoided costs reflect this evolution of Florida's generation mix. Indeed, renewable sources and storage assume a substantial share of total supply to satisfy both energy and peak load capacity requirements, particularly beyond 2030.
>
> Electric vehicles can have major impacts: Fast-rising penetration of electric vehicles within Florida's automobile fleet will have substantial impact on the system load shape of the FRCC region. Our demand analysis reveals that, by 2050, EV penetration constitutes a maximum load of over 11,000 MW, much of which is coincident with FRCC's maximum summer demands. Effectively implemented, dynamic pricing can significantly mitigate the impact of EV loads on system demands. Empirical evidence suggests that EV charging loads are highly sensitive pricing options; to this end, our simulations suggest that, effectively implemented, dynamic pricing can reduce EV loads during critical supply-demand conditions.
>
> Intermittency inherent to solar energy coupled with high EV penetration may impose higher reserve margins: The system load factor of the FRCC region is likely to decline, perhaps significantly, as a result of rising EV penetration coupled with intermittent power supply from solar facilities. Supply adequacy will likely be a rising concern for planners across the FRCC region. The implementation of dynamic pricing and the diversification of solar facilities across areas of Florida can substantially mitigate the need for higher planning (and operating reserve) margins.

Contemporary projections of long-term avoided costs harbor considerable uncertainty covering key dimensions which contribute to the determination of regulated prices for retail electricity services: long-term price escalation of inputs including fossil fuels and, potentially, rising capacity requirements to satisfy an increasing share of generation provided by intermittent supply, and other concerns. Foremost among long-term concerns is climate change and the path with which changes are realized: rising global temperatures; increased frequency of violent storm activity; rising sea levels; and declining biodiversity.

To the extent that climate change becomes a central concern to the public, it is increasingly likely to precipitate substantive policy responses by governing institutions. In turn, policy actions can assume several key dimensions which affect electricity markets, such as carbon pricing tied to climate damage costs, intensive conservation, tax incentives, and technology mandates.

Second, long-term avoided costs are sensitive to ongoing growth in the macroeconomies of regions including the South Atlantic region of the U.S. The assumed path of economic activity over the long-term determines the pace of electricity demand in two ways. First, rising demand reflects increases in population, manifested as increased expenditure for resources within the power delivery systems of electricity service providers. Second, rising demand appears to be most significant within large- and mid-sized urban areas which are increasing congested with various types of infrastructure. Together, the congestion of infrastructure can contribute significantly to avoided costs, mainly the elements of capacity costs, particularly in power delivery.

Further electrification of economic activity—particularly within the transportation sector—coupled with renewable resources can attenuate carbon and methane emissions, the main source of climate change. Policy actions encouraging greater electrification can accelerate the path of electricity demand significantly. However, impacts of various policy actions can be offsetting, and the increases in electricity demand resulting in higher overall electricity prices does not necessarily imply higher avoided capacity costs.

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

IN RE: COMMISSION REVIEW OF NUMERIC CONSERVATION GOALS

DIRECT TESTIMONY OF JIM HERNDON

DOCKET NO. 20240012-EG (Florida Power & Light Company)

DOCKET NO. 20240013-EG (Duke Energy Florida, LLC)

DOCKET NO. 20240014-EG (Tampa Electric Company)

DOCKET NO. 20240015-EG (Florida Public Utilities Company)

DOCKET NO. 20240016-EG (JEA)

DOCKET NO. 20240017-EG (Orlando Utilities Commission)

APRIL 2, 2024

TABLE OF CONTENTS

I. INTRODUCTION

Q. Please state your name, position of employment, and business address.

A. My name is Jim Herndon. I am Vice President in the Advisory Services Practice within the Utility Services business unit of Resource Innovations, Inc. (RI). My business address is 2500 Regency Parkway, Suite 220, Cary, North Carolina 27518. A statement of my background and qualifications is attached as Exhibit No. JH-1.

Q. Please discuss your areas of responsibility.

A. I am responsible for providing consulting services for RI clients in the field of Demand-Side Management (DSM) initiatives, which include energy efficiency (EE), demand response (DR), and demand-side renewable energy (DSRE). In this capacity, I primarily focus on DSM planning, including analysis of DSM market impacts, and assisting utilities in the identification of DSM opportunities and the development and design of DSM program initiatives. This includes the development of market baseline and potential studies, cost-benefit analyses, and design of comprehensive DSM programs and portfolios.

Q. Please describe RI including its history, organization, and services provided.

A. RI was founded in 2016, and is a globally recognized consulting, software, and services firm that provides innovative DSM solutions to utilities, energy enterprises, and government entities worldwide. RI merged with Nexant, Inc., in 2021, which provided similar DSM consulting services since its founding in 2000. RI's Utility Services business unit provides DSM engineering and consulting services to government agencies and utilities, and helps residential, commercial, and industrial facility owners manage energy consumption and reduce costs in their facilities. RI also conducts development and implementation services of DSM programs for public and investor-owned utilities, governments, and end-use customers. Our range of experience in the field of EE includes, but is not limited to:

- Market potential studies
- Program design
- Program implementation
- Marketing
- Vendor outreach, education, and training
- Incentive processing and fulfillment
- Turnkey customer service
- Online program tracking and reporting
- Evaluation, measurement and verification (EM&V)

Q. What specific projects or studies has RI done to assess DSM potential?

A. RI has conducted over 50 Market Potential Studies (MPS) to identify opportunities for DSM in the United States and Canada. Examples of recent clients include New York Power Authority (NYPA), Duke Energy (Indiana, North Carolina, and South Carolina), Santee Cooper, El Paso Electric, the Independent Electricity System Operator (IESO) of Ontario, Canada, and Sacramento Municipal Utility District (SMUD). In addition, Nexant performed the market potential study for the Florida Energy Efficiency and Conservation

Act (FEECA) utilities in the DSM goals proceeding conducted in 2019 before this Commission.

Q. Please summarize your experience with studies assessing DSM potential.

A. I have been involved in conducting or managing over 30 DSM potential studies over the past 17 years. In addition to these studies, I have led the development of numerous DSM programs and portfolios, managed implementation of residential, commercial, and industrial DSM programs, and conducted third-party evaluations of utility DSM programs, providing extensive experience and expertise regarding market analyses, DSM measures and technologies, and utility program structures and best practices that inform the assessment of DSM potential.

Q. Have you previously testified before the Florida Public Service Commission or in other state regulatory proceedings?

A. Yes, I provided testimony in the 2019 DSM goals proceeding before this Commission in support of our market potential studies for each FEECA utility in that case. I have also submitted testimony before the Virginia State Corporation Commission, the North Carolina Utilities Commission, the South Carolina Public Service Commission, the Public Utilities Commission of Ohio, and the New Jersey Board of Public Utilities.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony is to introduce and summarize the methodology and findings of the Technical Potential Study (TPS) we conducted for each of the six utilities subject to the requirements of FEECA, collectively the FEECA

Utilities, as well as the additional DSM planning support we provided for a subset of the FEECA Utilities.

Q. Please describe your role and responsibilities with respect to RI's work for this proceeding.

A. I served as the project manager for RI's work, directly overseeing all phases of our analysis.

Q. Are you sponsoring any exhibits in this case?

A. Yes. I am sponsoring Exhibits No. JH-1 through No. JH-16, which are attached to my testimony:

- Exhibit No. JH-1 – Herndon Background and Qualifications
- Exhibit No. JH-2 – TPS for Florida Power & Light
- Exhibit No. JH-3 – TPS for Duke Energy Florida
- Exhibit No. JH-4 – TPS for Tampa Electric Company
- Exhibit No. JH-5 – TPS for Florida Public Utilities Company
- Exhibit No. JH-6 – TPS for JEA
- Exhibit No. JH-7 – TPS for Orlando Utilities Commission
- Exhibit No. JH-8 – 2024 Measure Lists
- Exhibit No. JH-9 – Comparison of Comprehensive 2019 Measure Lists to the 2024 Comprehensive Measure Lists
- Exhibit No. JH-10 – DEF Measure Screening and Economic Sensitivities
- Exhibit No. JH-11 – FPUC Measure Screening and Economic Sensitivities

- Exhibit No. JH-12 – JEA Measure Screening and Economic Sensitivities
- Exhibit No. JH-13 – OUC Measure Screening and Economic Sensitivities
- Exhibit No. JH-14 – FPUC Program Development Summary
- Exhibit No. JH-15 – JEA Program Development Summary
- Exhibit No. JH-16 – OUC Program Development Summary

Q. What was the scope of work for which RI was retained?

A. As described in Section 2 of RI's TPS report for each utility, RI was retained by the FEECA Utilities to independently analyze the Technical Potential (TP) for EE, DR, and DSRE across their residential, commercial, and industrial retail customer classes. This work included disaggregation of the current utility load forecasts into their constituent customer-class and end-use components, development of a comprehensive set of DSM measures and quantification of the measures' impacts, and calculation of potential energy and demand savings at the technology, end-use, customer class, and system levels.

In addition, RI was retained by four of the six utilities to conduct an economic analysis of EE, DR, and DSRE measures, designed to determine which measures are cost-effective from different test perspectives and to develop estimates of potential impacts if these measures were adopted in each of these four utility service areas. RI also supported three of the six utilities in developing DSM proposed goals through bundling individual DSM measures into preliminary program concepts and estimating the impacts, including participation, savings, and utility budgets, for these programs.

Q. How, if at all, did the work performed by RI differ across the six FEECA Utilities?

A. The assessment of TP, including the utility forecast disaggregation and customer segmentation, and development of a DSM measure list, was the same for all six FEECA Utilities. The subsequent economic analysis, measure adoption forecasts and development of proposed DSM goals varied in the work RI conducted for individual FEECA Utilities, as follows:

- Tampa Electric Company (TECO) conducted their own economic analysis and DSM goal development.
- Florida Power & Light (FPL) conducted their own economic analysis and provided RI with the results. RI then developed measure adoption estimates, and FPL conducted their own DSM goal development.
- Duke Energy Florida (DEF) contracted with RI to conduct the economic analysis and measure adoption forecast, and DEF conducted its own DSM goal development.
- JEA, Orlando Utilities Commission (OUC), and Florida Public Utilities Company (FPUC) contracted with RI to conduct the economic analysis and measure adoption forecast, and RI worked collaboratively with each utility to develop the proposed DSM goals.

Q. What reports have been produced in the scope of RI's work?

A. RI has produced six separate TPS reports, one for each FEECA Utility under this scope of work.

Q. What were the major steps in the analytical work RI performed?

A. The two major steps in RI's scope of work included development of technical potential and, for applicable utilities, creation of proposed DSM goals that aligned with utility program concepts. These steps included the following tasks:

<u>Step 1: Technical Potential</u>. The TP analysis established the basis for the development of proposed DSM goals. As summarized in Section 2 of each utility's TPS report, and illustrated in Figure 1 of each report, the key tasks in assessing the technical potential consisted of the following:

- *Load Forecast Disaggregation*. To disaggregate the load forecast, RI collected utility load forecast data, relevant customer segmentation and end-use consumption data, and supplemented this with existing secondary data to create a disaggregated utility load forecast broken out by customer sector and segment as well as by end-use and equipment type, and calibrated to the overall utility forecast.
- *Comprehensive Measure Development*. RI worked collaboratively with the FEECA Utilities, who also sought input from various external stakeholders, to develop a comprehensive list of DSM technologies that are currently commercially available in Florida.

For all measures included in the study, RI developed estimates of energy and demand savings, useful life, and incremental cost.

- *TP Analysis*. Using the disaggregated utility load forecast and the DSM measure impacts, RI analyzed the TP for the application of all measures to each utility's retail customers.

Step 2: Development of Proposed DSM Goals. The development of proposed goals built on the TP analysis, and included several interim steps, as follows:

- *Economic Analysis*. For a subset of the FEECA Utilities, RI conducted an economic analysis to determine which measures and technologies were preliminarily cost-effective under a Rate Impact Measure (RIM) test scenario or the Total Resource Cost (TRC) test scenario. This step produced a set of measures, and associated energy and demand savings, for each scenario before applying program costs and adoption rates. Key tasks included the following:
    - Collect utility economic forecast data: RI received current and forecasted avoided energy and avoided capacity costs from each utility.
    - Apply measure impacts: including energy savings, summer and winter demand savings, incremental cost, and measure useful life to determine total avoided cost benefits, measure costs, and lost revenues.

- Determine measures passing RIM test scenario and TRC test scenario: measures with a benefit/cost ratio of less than 1.0 were screened from the economic analysis.
- RI also performed this economic screening analysis using a set of economic sensitivities.

- *Measure adoption forecasts*. For a subset of the FEECA Utilities, RI updated the economic analysis and developed market adoption estimates for passing measures under each cost-effectiveness test scenario. This step produced an updated "RIM Scenario" and a "TRC Scenario" of passing measures and associated energy and demand savings. Key tasks included:
  - Applying estimated representative program costs, based on current FEECA program data and other secondary sources, and rerunning the economic analysis for both the TRC and RIM scenarios, including screening these passing measures from the Participant Cost Test (PCT) perspective for each scenario.
  - Incorporating free ridership screening based on payback analysis, removing measures with a payback of less than two years.
  - Applying estimated market adoption rates for passing measures for each scenario, based on economic and market

parameters, including payback acceptance, maturity of DSM technology, and current utility offerings.

- *Measure bundling and program development*. For a subset of utilities, RI supported the development of program concepts that formed the basis for proposed DSM goals. Key tasks included:
    - Measure bundling: RI worked collaboratively with the FEECA Utilities to identify measures that aligned with current programs or logically made sense to offer as a program.
    - Estimating program metrics, including annual participation, savings, and utility budgets.

II. MEASURE IDENTIFICATION AND SELECTION

Q. Please explain the process by which DSM measures were identified.

A. The starting point for measure identification was the list of measures included in the 2019 Florida TP Studies. Using this set of measures, the FEECA Utilities initially reviewed and added proposed measures, and provided the combined list to RI. RI compared the preliminary list to its DSM measure library, compiled from similar studies conducted in recent years, as well as from other utility DSM programs that RI has designed, implemented, or evaluated. The FEECA Utilities also reached out to interested parties and received input with recommendations on measure additions to the 2019 measure list. Their measure suggestions were reviewed and incorporated into the study, as appropriate, as detailed in Appendix D of each TPS report.

Through months of rigorous discussion with the FEECA Utilities, the parameters for measures to be considered were established. The evaluation of measures to include examined whether the measure was technically feasible and currently commercially available in Florida; additionally, behavioral measures without accompanying physical changes or utility-provided products and tools were excluded, as were fuel-switching measures, other than in the context of DSRE measures. The process to identify DSM measures is more fully described in Section 4 of each TPS report.

Q. Was the process of measure identification and selection appropriate for the objectives of the study?

A. Yes. The measure identification process was robust, comprehensive, and appropriate for the objectives of the study. The final measure list was developed to account for DSM measures that had been considered in prior Florida studies and took full account of current Florida Building Code and federal equipment standards, current FEECA Utilities' program offerings, and the incorporation of DSM measures considered in other potential study reports and other utility DSM program offerings around the country.

Q. Did the process allow for the assessment of the full TP for FEECA Utilities?

A. Yes. The thorough process for developing the list resulted in a comprehensive set of over 400 unique EE, DR, and DSRE measures that fully addressed DSM opportunities across all electric energy-consuming end-uses at residential, commercial, and industrial facilities in the FEECA Utilities' service areas. The final measure list is provided in Exhibit No. JH-8.

Q. How does the final DSM measure list compare with the measures included in the 2019 TP Study?

A. Exhibit No. JH-9 compares the comprehensive measure list for 2024 to the measure list for the Florida Public Service Commission (Commission) 2019 Goals Dockets (Docket Nos. 20190015-EG – 20190021-EG). Compared to the 2019 TP, the 2024 TP update added 191 unique measures and eliminated 24 unique measures.

Q. What changes to the measure list were associated with changes to building code or appliance standards?

A. The following measures changes were included in the 2024 TP study based on Florida Building Code and federal equipment standards updates:

- Residential central air conditioner and heat pump baseline efficiency was updated based on current U.S. Department of Energy, Energy Conservation Standards for Residential Central Air Conditioners and Heat Pumps
- Residential room air conditioner baseline efficiency was updated based on current U.S. Department of Energy, Energy Conservation Standards for Room Air Conditioners
- Two speed pool pump and variable speed pool pump measures were eliminated based on current Florida Building Code and U.S. Department

of Energy, Energy Conservation Standards for Dedicated-Purpose Pool Pump Motors.

Q. Once measures were selected, what was the next step in RI's analysis?

A. Once measures were selected, the next step in RI's analysis was to develop individual impacts for each measure. These impacts included quantifying summer demand (kW), winter demand (kW), and energy savings (kWh), equipment useful life, and incremental costs of the measure. The measure impacts were subsequently applied to the disaggregated utility load forecasts to estimate TP in each utility service area.

III. TECHNICAL POTENTIAL

Q. Please define Technical Potential.

A. Section 366.82(3) of FEECA requires the Commission to "…evaluate the full technical potential of all available demand-side and supply-side conservation and efficiency measures, including demand-side renewable energy systems." Therefore, a TP analysis is the first in a series of steps in the DSM Goals development process. Its purpose is to identify the theoretical limit to reducing summer and winter electric peak demand and energy. The TP assumes every identified potential end-use measure is installed everywhere it is "technically" feasible to do so from an engineering standpoint, regardless of cost, customer acceptance, or any other real-world constraints (such as product availability, contractor/vendor capacity, cost-effectiveness, normal equipment replacement rates, or customer preferences).

Therefore, the TP does not reflect the MW and GWh savings that may be potentially achievable through real-world voluntary utility programs, but rather it establishes the theoretical upper bound for DSM potential.

Q. Do RI's TPS reports provide a detailed description of RI's methodology, data, and assumptions for estimating TP?

A. Yes. As stated earlier, RI developed individual TPS reports for each of the six FEECA Utilities. The reports described RI's overall methodology, data, and assumptions for disaggregating each utility's baseline load forecast, development of DSM measures, and determination of TP.

Q. Do these TPS reports identify the full TP for the FEECA Utilities?

A. Yes. Each utility report identifies the full TP for the DSM measures analyzed against the utility's baseline load forecast.

Q. Please summarize the methodology, source of data, and assumptions used to develop the TP for EE measures for the FEECA Utilities.

A. As stated above, TP ignores all non-technical constraints on electricity savings, such as cost-effectiveness and customer willingness to adopt EE. RI's methodology for estimating EE TP begins with the disaggregated utility load forecast. For the current analysis, RI used the 2023 load forecast from each FEECA Utility, which, for all except FPUC, was based on the most recent Ten-Year Site Plan available at the time the MPS was initiated, which were the 2023 Ten-Year Site Plans.

Next, all technically feasible measures are assigned to the appropriate customer segments and end-uses. The measure kW and kWh impact data collected during DSM measure development are then applied to the baseline forecast, as illustrated in the following equation for the residential sector:

The savings factor, or percentage reduction in electricity consumption resulting from application of the efficient technology, is applied to the baseline energy use intensity to determine the per-home impact, and the other factors listed in the equation above inform the total number of households where the measure is applicable, technically feasible, and has not already been installed. The result of this equation is the total TP for an EE measure or technology.

The final component of estimating overall TP is to account for the interaction between measures. In some situations, measures compete with each other, such as a 16 SEER air source heat pump and an 18 SEER air source heat pump. For TP, the measure with the highest savings factor is prioritized. The other interaction is measure overlap, where the impacts of one measure may affect the savings for a subsequent measure. An example of measure overlap would be the installation of an 18 SEER air source heat pump as well as a smart thermostat that optimizes the operation of the heat pump. To account for overlapping impacts, RI's model ranks measures that interact with one another and reduces the baseline consumption for the subsequent measure based on savings achieved by the preceding measure. For TP, interactive measures are ranked based on the total end-use energy savings percentage, with the measures having a greater savings treated as being implemented first.

Q. Please summarize the methodology, source of data, and assumptions used to develop TP for DR measures for the FEECA Utilities.

A. TP for DR is effectively the total of customer loads that could be curtailed during conditions when utilities need capacity reductions. Therefore, RI's approach to estimating DR TP focuses on the curtailable load available within the time period of interest. In particular, the analysis focuses on end-uses available for curtailment during peak periods and the magnitude of load within each of these end-uses, beyond that of existing DR enrollment for each utility.

Similar to the estimation of EE TP, the DR analysis begins with a disaggregation of the utility load forecast. RI's approach for load disaggregation to identify DR opportunities is more advanced than that used for most potential studies. Instead of disaggregating annual consumption or peak demand, RI produced end-use load disaggregation for all 8,760 hours of the year. This was needed because customer loads available at times when utility system needs arise can vary substantially. For this study, curtailable load opportunities, coincident with both the summer system peak and winter system peak, were analyzed. Additionally, instead of producing disaggregated loads for the average customer, the study produced loads for several customer segments. RI examined three residential segments based on customer housing type, four different small commercial and industrial (C&I) segments, and four different large C&I customer segments, for a total of 11 different customer segments. Next, RI identified the available load for the appropriate end-uses that can be curtailed. RI's approach assumed that large C&I customers would forego virtually all electric demand temporarily if the financial incentive was large enough. For residential and small C&I customers, TP for DR is limited by loads that can be controlled remotely at scale. For this study, it was assumed that summer DR capacity for residential customers was comprised of air conditioning (A/C), pool pumps, water heaters, and electric vehicle charging. For small C&I customers, summer capacity was based on A/C load and electric vehicle charging.

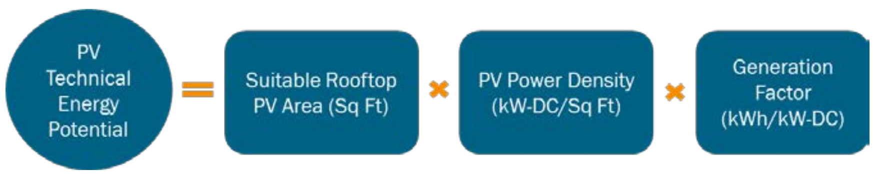
For winter capacity, residential DR capacity was based on electric heating loads, pool pumps, water heaters, and electric vehicle charging. For small C&I customers, winter capacity was based on heating load and electric vehicle charging. For eligible loads within these end-uses, the TP was defined as the amount coincident with system peak hours for each season. System peak hours were identified using 2023 system load data. For DR TP, no measure breakout was necessary because all measures targeted the end-uses estimated for TP.

Finally, RI accounted for existing DR by assuming that all customers currently enrolled in a DR program did not have additional load that could be curtailed. As a result, all currently-enrolled DR customers were excluded from the analysis.

Q. Please summarize the methodology, source of data, and assumptions used to develop TP for DSRE measures for the FEECA Utilities.

A. TP for DSRE measures was developed using three separate models for each category of DSRE: rooftop photovoltaic (PV); battery storage systems charged from PV systems; and combined heat and power (CHP).

For PV systems, RI's approach estimated the square footage of residential and commercial rooftops in the FEECA Utilities' service areas suitable for hosting PV technology, and applied the following formula to estimate overall TP:



The analysis was conducted in five steps, as follows:

Step 1: Building stock characterization: Output of data from the forecast disaggregation conducted for the EE and DR TP analysis were used to characterize residential, commercial, and industrial building stocks.

Step 2: Estimate of feasible roof area: Total available roof area feasible for installing PV systems was calculated using relevant parameters, such as unusable area due to other rooftop equipment and setback requirements, shading from trees, and limitations of roof orientation.

Step 3: Expected power density: A power density of 200 watts per square meter (W/m^2) was assumed for estimating technical potential, which corresponds to a panel with roughly 20 percent conversion efficiency, a typical value for current PV installations.

<u>Step 4: Hourly PV generation profile</u>: Hourly generation profiles were estimated using the U.S. Department of Energy National Renewal Energy Laboratory's solar estimation calculator, PVWatts©.

<u>Step 5: Calculate total energy and coincident peak demand potential</u>: RI's Spatial Penetration and Integration of Distributed Energy Resources (SPIDER) Model was used to estimate total annual energy and summer and winter peak demand potential by sector.

For battery storage systems, the TP analysis considered the fact that battery systems on their own do not generate power or create efficiency improvements; they simply store energy for use at different times. Therefore, battery systems energized directly from the grid do not produce additional energy savings, but may be used to shift or curtail load from one period for use in another. Because the DR potential analysis focused on curtailable load opportunities, RI concluded that no additional TP should be claimed. Similarly, battery systems connected to rooftop PV systems do not produce additional energy savings; they do, however, create the opportunity to store excess PV-generated energy during hours where the PV system generates more than the home or business consumes, then uses the stored power during peak periods.

Therefore, to determine additional peak demand reduction available from PV-connected battery storage systems, RI used the following methodology:

- Assumed that every PV system included in the PV TP analysis was installed with a paired storage system.

- Sized the storage system to peak PV generation and assumed energy storage duration of three hours.
- Applied RI's hourly dispatch optimization model in SPIDER to create an hourly storage dispatch profile that flattened the individual customer's load profile to the greatest extent possible, accounting for (a) a customer's hourly load profile; (b) hourly PV generation profile; and (c) battery peak demand, energy capacity, and roundtrip charge/discharge efficiency.
- Calculated the effective hourly impact for the utility using the above storage dispatch profile, aligned with the utility's peak hour (calculated separately for summer and winter).

TP for CHP systems was based on identifying non-residential customer segments with thermal load profiles that allow for the application of CHP, where the waste heat generated can be fully utilized. First, minimum size thresholds were determined for each non-residential segment using a segment-specific thermal factor that considered the power-to-heat ratio of a typical facility in each segment. Next, utility customers were segmented into industry classifications and screened against the size thresholds. Premises with annual kWh consumption that met or exceeded the thresholds were retained in the analysis. Finally, facilities of sufficient size were matched with the appropriately sized CHP technology. RI assigned CHP technologies to customers in a top-down fashion, starting with the largest CHP generators, which yielded the estimated quantity of CHP TP in each utility's service area.

Q. Did your TP analysis account for interaction among EE, DR, and DSRE technologies?

A. Yes. While TP was estimated using separate models for EE, DR, and DSRE, RI did recognize that interaction occurs among the TP for each, similar to the interactions between EE measures applied to the same end-use. For example, the installation of more efficient A/C would reduce the peak consumption available for DR curtailment. Therefore, to account for this interaction, RI incorporated the following assumptions and adjustments to the identified TP:

- EE TP was assumed to be implemented first, and therefore was not adjusted for interaction with DR and DSRE.
- DR TP was applied next, and to account for the impact of EE TP, the baseline load forecast for applicable end-uses was adjusted by the EE TP, reducing the available load for curtailment.
- DSRE technologies were applied last and incorporated EE TP and DR TP. For PV systems, the EE potential and DR potential did not impact the amount of PV TP. However, for PV-connected battery systems, the reduced baseline due to EE TP resulted in more PV-generated power available from storage and usable during peak periods. For CHP systems, the reduced baseline, as a result of EE, resulted in a reduction in the number of facilities that met the annual energy threshold for CHP. Installed DR capacity was assumed to not impact CHP potential as CHP system feasibility was determined based on the energy consumption and thermal parameters at the facility.

Q. Once TP estimates were developed, what was the next step in your analysis?

A. Upon completion of the TP estimates, the next analysis step for a subset of the utilities was to apply the measure economics (incremental cost) and utility system economics (avoided supply cost, utility electric revenues, and customer bill impacts) to conduct the economic analysis.

IV. ECONOMIC ANALYSIS

Q. For which FEECA Utilities did RI conduct economic analyses?

A. RI worked collaboratively with DEF, OUC, JEA, and FPUC on the economic analysis, as follows:

Each utility provided RI with utility-specific economic forecast data, including avoided supply costs and retail rate forecasts. RI incorporated these data into our economic screening module to analyze the cost-effectiveness for individual measures under the cost-effectiveness tests required by the Commission's Order Consolidating Dockets and Establishing Procedure (Order No. PSC-2024-0022-PCO-EG).

Q. What cost-effectiveness tests were included in the economic analysis?

A. When analyzing DSM measures, different cost-effectiveness tests are considered to reflect the perspectives of different stakeholders. The Ratepayer Impact Measure (RIM) test addresses an electric utility customer perspective, which considers the net impact on electric utility rates associated with a measure or program. The Total Resource Cost (TRC) test addresses a societal perspective, which considers costs of a DSM measure or program relative to the benefits of avoided utility supply costs. The Participant Cost Test (PCT) addresses a participant perspective, which considers net benefits to those participating in a DSM program.

The calculations were conducted consistent with the Cost Effectiveness Manual for Demand Side Management and Self Service Wheeling Proposals; Florida Public Service Commission, Tallahassee, FL; adopted June 11, 1991. Specific costs and benefits allocated within each cost-effectiveness test (RIM, TRC, and PCT), include the following:

Ratepayer Impact Measure (RIM) Test	
Component	**Definition**
Benefit	Increase in utility electric revenues Decrease in avoided electric utility supply costs
Cost	Decrease in utility electric revenues Increase in avoided electric utility supply costs Utility program costs, if applicable Utility incentives, if applicable

Total Resource Cost (TRC) Test	
Component	**Definition**
Benefit	Decrease in avoided electric utility supply costs
Cost	Increase in avoided electric utility supply costs Customer incremental costs (less any tax incentives) Utility program costs, if applicable

Participant Cost Test (PCT)	
Component	**Definition**
Benefit	Decrease in electric bill Utility incentives, if applicable
Cost	Increase in electric bill Customer incremental costs (less any tax incentives)

Q. What economic screening criteria were applied for this study?

A. For this study, economic screening was conducted for two Base Case scenarios: the RIM Scenario and TRC Scenario. In both scenarios, all measures that achieved a cost-effectiveness ratio of 1.0 or higher were considered cost-effective from that test's perspective.

For RI's cost-effectiveness screening for DEF, JEA, OUC, and FPUC, additional considerations included the following:

- Individual measures did not include any utility program costs (program administrative or incentive costs), and therefore were evaluated on the basis of measure cost-effectiveness without any utility intervention.

- Both scenarios required the measures to pass the PCT. Similar to the TRC and RIM perspectives, the PCT screening was conducted without any utility's incentive costs applied to the measure.

Q. What was the next step in the economic analysis?

A. Once the list of passing measures was identified under each Base Case scenario, the measures were reanalyzed in RI's TEA-POT model to estimate demand and energy savings for each utility. The updated modeling included updated measure rankings to account for changes in measure interaction and overlap. For the economic analysis, the ranking was based on the applicable test perspective in each scenario (RIM or TRC), with the more cost-effective measures being ranked first.

Q. Were any additional economic sensitivities considered?

A. Yes. As specified in Appendix B of the Order Consolidating Dockets and Establishing Procedure (Order No. PSC-2024-0022-PCO-EG) in this docket, economic sensitivities were performed as follows:

- Avoided fuel cost sensitivity, analyzing the number of measures passing the economic screening based on higher and lower fuel prices.
- Payback period sensitivity, analyzing the number of measures passing the economic screening based on shorter (one year) and longer (three year) free ridership exclusion periods.
- For OUC, RI performed an additional sensitivity that reflected the number of measures passing the economic screening when including costs associated with carbon dioxide emissions.

The methodology for each sensitivity was consistent with the analysis of the Base Case scenarios. DEF, JEA, OUC, and FPUC provided RI with avoided supply cost forecasts for the higher and lower fuel price scenarios. The results of these sensitivities are provided in Exhibits No. JH-10 through No. JH-13.

Q. After these additional screenings were performed, what was the next major activity?

A. After the economic screening was conducted for the Base Case scenarios and the sensitivities for each utility, the next step in the study was to develop measure adoption estimates for a subset of the utilities.

V. MEASURE ADOPTION FORECASTS

Q. Were any additional economic screening criteria applied for estimating measure adoption forecasts?

A. Yes. The associated program costs, including program administrative costs and customer incentives, were included in the economic analysis used for estimating measure adoption forecasts. Because this step occurred prior to each utility developing specific programs aligned with their proposed goals, representative administrative costs were developed using average FEECA Utility program cost data, where available from current programs, and supplemented with other utility program cost data where needed. In order to evenly apply these representative costs to measures with a variety of savings impacts, typical costs were estimated on a variable basis per kWh saved.

In addition, consistent with prior DSM analyses in Florida, free ridership was addressed by applying a two-year payback criterion, which eliminated measures having a simple payback of less than two years.

All measures were rescreened for the RIM Scenario and TRC Scenario with the inclusion of these parameters.

Q. How were measure incentives determined for this study?

A. Measure incentives were developed for both the RIM Scenario and TRC Scenario. Under each of these scenarios, the maximum incentive that could be applied while remaining cost-effective was calculated for each measure.

- For the RIM Scenario, the RIM net benefit for each measure was calculated based on total RIM benefits minus total RIM costs. Next, the amount required to result in a simple payback period of two years for each measure was calculated. The maximum incentive was based on the lower of these two values.
- For the TRC Scenario, since the TRC test does not include utility incentives as a cost or benefit, the maximum incentive was based on the amount required to result in a simple payback period of two years for each measure.

Q. Please explain the methodology used by RI to develop measure adoption forecast estimates for the cost-effective EE measures.

A. RI's methodology consisted of applying estimates of market adoption, based on utility-sponsored program incentives for all cost-effective EE measures in each Base Case scenario. RI's market adoption estimates used a payback acceptance criterion to estimate long-run market shares for measures as a function of measure incremental costs and expected bill savings over the measures' effective useful life (inclusive of utility incentives). Incremental adoption estimates were based on the Bass Diffusion Model, which is a mathematical description of how the rate of new product diffusion changes over time. For this study, adoption curve input parameters were developed for each measure based on specific criteria, including measure maturity in the market, overall measure cost, and whether the measure was currently offered through a utility program. RI's TEA-POT model then calculated demand and energy savings by applying these adoption curves to each cost-effective measure.

Q. Please explain the methodology used by RI to develop adoption forecast estimates for the cost-effective DR measures.

A. Similar to EE measures, RI's methodology for DR included calculating market adoption as a function of the incentives offered to each customer group. For DR measures currently offered by each utility, RI used the current incentive level offered to estimate market adoption. For measures not currently offered by a utility, RI used representative incentive levels offered for similar measures in other markets to estimate market adoption. The utility-specific incentive rates for each DR measure, along with participation rates collected by RI for DR programs around the country, were used to calibrate DR market adoption curves for each technology and customer segment. The calibrated adoption rates were applied to the baseline load forecast to estimate the forecasted adoption estimates for cost-effective DR technologies.

Q. Please explain the methodology used by RI to develop adoption forecast estimates for the cost-effective DSRE measures.

A. RI did not produce estimates of adoption forecasts for DSRE measures as none of the measures passed the cost-effectiveness screening for either the RIM or TRC scenarios.

Q. After estimating measure adoption forecasts, what was the next major activity?

A. The next step in the study was to develop proposed DSM goals for a subset of the utilities.

VI. DSM GOAL DEVELOPMENT

Q. What additional support did RI provide in development of proposed DSM goals?

A. For JEA, OUC, and FPUC, RI assisted with the development of three scenarios: 1) potential DSM programs that contribute to proposed DSM goals (Proposed Goals Scenario), 2) potential DSM programs that pass the Participant and Rate Impact Measure Tests (RIM Scenario), and 3) potential DSM programs that pass the Participant and Total Resource Cost Tests (TRC Scenario). The proposed DSM goal development process and results for each scenario is described in more detail in Exhibit No. JH-14, No. JH-15, and No. JH-16, and consisted of the following steps:

Step 1: Program Review and Measure Bundling. For each scenario, Resource Innovations identified cost-effective measures from the economic analysis described above and reviewed existing utility program offerings to identify and align measures included in the TP study analysis with current programs. Measures included in existing programs but not part of the TRC Scenario or RIM Scenario determined in the economic analysis were identified. In addition, measures that were cost-effective for the TRC Scenario or RIM Scenario but were not currently offered in a utility program were also identified. Based on the program review and measure alignment, measures in each scenario were bundled into preliminary program concepts that might align with current programs or become new program offerings for the utility.

Step 2: Program Refinement and Modeling. Preliminary program concepts and measure bundles were refined into proposed program offerings and incentive and non-incentive budgets, participation estimates, and impacts were developed using RI's TEA-POT model. The modeling results were exported into RI's Program Planner workbook that aggregated the program and portfolio impacts for each scenario. For the TRC Scenario and RIM Scenario no further refinements to the programs were made. For the Proposed Goals scenario, RI continued to work collaboratively with each utility to identify the measures and program concepts that comprise the proposed DSM goals.

Q. Was the DSM program development process limited to measures passing the economic screening?

A. No. In addition to measures that passed the TRC Scenario or RIM Scenario screening, the measure bundling and program development process for the Proposed Goals Scenario included additional measures, such as measures that may be included in current programs or could be complementary additions to current programs.

Q. For measures currently offered by each utility, was the analysis limited to the continuation of current programs?

A. No. While continuity in program offerings is typically beneficial for customer and contractor awareness and education, RI and each utility (JEA, OUC, and FPUC) worked collaboratively to identify programs that are of interest to continue and those that may need refinement. RI also provided our expertise in utility program design from around the country to help guide the program development process.

VII. REASONABLENESS OF RI'S ANALYSES

Q. Are the methodology and models RI employed to develop TP estimates, economic analysis, measure adoption forecasts, and proposed DSM goals for the FEECA Utilities analytically sound?

A**.** Yes. RI's approach is aligned with industry-standard methods and has been applied and externally reviewed in numerous regulated jurisdictions. RI's

TEA-POT and SPIDER modeling tools have been specifically developed to accommodate and calibrate to individual utility load forecast data, and they enable the application of individual DSM measures and analysis of market potential at a high resolution—by segment, end-use, equipment type, measure, vintage, and year for each scenario analyzed.

The methodology and rigor of the measure development, technical potential, and economic analysis is also consistent with the analysis conducted for the 2019 energy conservation goals proceedings before this Commission.

Q. Have these methodologies and models been relied upon by other commissions or governmental agencies?

A. Yes. RI's methodology and the TEA-POT and SPIDER modeling tools have been used in numerous studies in the United States and Canada. RI's tools and results have undergone extensive regulatory review and have been used for the establishment of utility DSM targets in multiple jurisdictions, including North Carolina, South Carolina, Georgia, California, Pennsylvania, Texas, and Ontario.

Q. Are the estimates of the TP developed by RI analytically sound and reasonable?

A. Yes. The TP was performed under my direction and resulted in a thorough and wide-ranging analysis of DSM opportunities technically feasible in the FEECA Utilities' service areas. The TP process aligned with industry standards and included a greater level of analytic detail than that of comparable models and methodologies.

The process included extensive iterative analytical work and continuous collaboration with the FEECA Utilities to ensure that it was comprehensive and aligned with the characteristics of their service areas and forecasted loads.

Q. Is the economic analysis conducted by RI analytically sound and reasonable?

A. Yes. The economic analysis was based on applying defined economic screening metrics to each TP measure to determine cost-effectiveness. The analysis included utility-provided economic forecasts to ensure alignment with other aspects of utility resource planning and to determine an accurate assessment of cost-effective DSM measures for each utility.

Q. Are the proposed DSM goals that RI helped develop based on reasonable and appropriate analysis of DSM measures and programs?

A. Yes. RI's estimated measure adoption forecasts identified cost-effective DSM opportunities for FEECA Utilities, based on the test perspectives included in each scenario analyzed. These forecasts provided the foundation of the DSM planning process that included a robust analysis of current utility programs, bundling, and alignment of measures analyzed in the potential study as well as the development of cost-effective programs. These programs collectively sum to the sector-level and overall proposed DSM goals for each utility. This process represents a reasonable and appropriate approach to the development of utility DSM goals.

Q. Does this conclude your direct testimony?

A. Yes.

Jim Herndon

Vice President

Jim Herndon is a Vice President in the Advisory Services group, focusing on strategic planning and program design to more effectively implement demand-side management (DSM) programs. His work is informed by 22 years of experience performing market assessments, planning portfolios, managing program design and implementation, conducting technical project reviews and analyses, and delivering third-party program evaluations across a variety of sectors. Jim leads potential and market characterization studies, program portfolio development and cost-effectiveness analyses, and provides regulatory support and expert witness testimony for program filings and integrated resource planning (IRP) activities. In these capacities, he serves many electric and natural gas utilities, including Duke Energy, Dominion Energy, Georgia Power Company, Florida Power and Light, Santee Cooper, Columbia Gas of Virginia, and Washington Gas. In each consulting engagement, Jim strives to understand his client's objectives and tailor his team's analyses to leverage best practices, while providing strategic insights with the client's specific needs in mind.

EXPERIENCE

Vice President | Principal Consultant, Resource Innovations / Nexant (2013 - Present)

As an account executive and team leader in the Advisory Services Group, Jim ensures compliance with regulatory and energy program rules and coordinates staff workload and budgets. He works directly with clients, service providers, and customers to provide quality assurance on projects. Jim also manages regional and national client planning and benchmarking studies, as well as third-party impact and process evaluations.

Sr. Project Manager | Project Manager, Resource Innovations / Nexant (2007 - 2012)

As a Senior Project Manager and Southeast regional lead, Jim oversaw design and implementation of utility-sponsored DSM programs, including management of program design, administration, engineering, trade ally, and marketing program teams in NC and SC.

Sr. Project Engineer | Project Engineer, Resource Innovations / Nexant (2002 - 2006)

As a Project Engineer, Jim performed energy audits and analyses on facilities to identify, provide implementation support for, and verify the effectiveness of energy efficiency improvements. He was a Certified Home Energy Report (HERS) rater and supported the implementation of publicly funded energy efficiency and load management programs, including due diligence reviews of energy efficiency projects installed in California, New York, and Utah.

EDUCATION, CERTIFICATIONS, AND LICENSING

M.S. in Engineering Management – Duke University

B.S. in Civil and Environmental Engineering – Duke University

AFFILIATIONS

Southeast Energy Efficiency Alliance (SEEA) – Former Member of the Board of Directors (2014 - 2019)

AREAS OF EXPERTISE

Integrated Resource Planning (IRP) Support • Energy Analysis and Market Characterization • DSM & DER Market Potential Studies • Portfolio Planning, Program Design, and Evaluation • Regulatory Support and Expert Witness • Program Management

REPRESENTATIVE PROJECTS

Florida Power & Light Company – Florida Statewide DSM Technical Potential Study (2017 – 2019, and 2022 - Present)

Jim is leading the Resource Innovations team that was retained by Florida Power & Light in the state of Florida to complete technical potential studies of Demand Side Management (DSM) measures and renewable energy systems on behalf of six utilities. The six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA) include four Florida investor-owned utilities (IOUs): Florida Power & Light Company (FPL), Duke Energy Florida, LLC (DEF), Tampa Electric Company (TECO), and Florida Public Utilities Company (FPUC) that are regulated by the Florida Public Service Commission (FPSC) and two municipal utilities: JEA and Orlando Utilities Commission (OUC) that are not regulated by the FPSC. The FPSC establishes goals for the FEECA utilities to reduce the growth of Florida's peak electric demand and energy consumption and reviews the progress towards those goals frequently (every five years at a minimum). The scope of the studies includes Energy Efficiency (EE), Demand Response (DR), and Distributed Energy Resources (DER) opportunities across the residential, commercial, and industrial sectors, including interaction between these categories of DSM to account for overlapping impacts. In addition to the technical potential analysis, Jim and his team are assessing the economic and achievable opportunities for a subset of the six utilities. The results of this study will be used as the basis of the utilities' DSM goal-setting process for 2025-2034 in the 2024 Florida Goals Proceeding. Following the completion of the studies, Jim will provide regulatory support for these proceedings, including the preparation of direct written testimony, deposition, and support for the discovery process by preparing required responses to data requests and regulatory interrogatories.

Jim also led Resource Innovations' team that conducted the technical potential study and provided regulatory support for the 2019 FEECA goalsetting proceedings.

Duke Energy – Market Potential Studies (2015 - Present)

Jim has directed multiple DSM market potential studies for Duke Energy's North Carolina, South Carolina, Indiana, and Ohio service territories. The studies for each service territory integrated both energy efficiency and demand response opportunities across Duke Energy's residential, commercial, and industrial customer classes; and determined the technical, economic, and program potential. Resource Innovations conducts the studies in close coordination with Duke Energy's IRP team, as well as program design and delivery teams, to provide an accurate assessment of market potential that can be directly applied to Duke Energy's current and future DSM planning efforts.

Duke Energy – Program Evaluations (2014 - Present)

Jim currently serves as the Project Manager for the evaluation, measurement, and verification (EM&V) of six DSM program offerings, which include Duke Energy's Residential HVAC program, MyHER program, EE Education program, Save Energy & Water Kits program, Non-Residential Custom program, and Power Manager program. The evaluation activities include separate impact and process evaluations across Duke Energy's five service territories to assess program performance, adherence to best practices, and opportunities for program improvements. Jim provides daily project management oversight of project staff, coordination of resources, and quality control oversight of project deliverables.

Santee Cooper – Market Assessment, DSM Program Design, and Implementation (2009 - Present)

Jim provides strategic program design support activities for Santee Cooper's suite of energy efficiency programs across the residential and commercial market segments, as well as strategic program advisory services for Santee Cooper's long-term energy reduction goals. Jim also led the market assessment and market potential study that Resource Innovations conducted for Santee Cooper's service territory in 2019 and updated in 2023. The study included primary data collection to benchmark equipment efficiency and saturation in the service territory and incorporate this data into the development of future market potential. Previously, Jim managed the initial development, rollout, and management of Santee Cooper's commercial energy efficiency programs.

Columbia Gas of Virginia (CVA) – DSM Program Design, Cost-Benefit Analysis, and Implementation (2010 - Present)

Jim is the technical lead for the program design and regulatory support services team assisting CVA's WarmWise program offerings. This support includes portfolio planning and regulatory support for CVA's residential and commercial energy efficiency programs, as well as providing rebate processing and other support services to assist CVA in the implementation of their programs. Jim led portfolio planning efforts, including market characterization analysis, technical analysis of proposed programs and portfolio, development of annual program budgets and savings targets, and regulatory support of CVA's program filings with the Virginia State Corporation Commission, including providing written testimony supporting the analysis.

Dominion Energy – DSM Program Design and Implementation (2020 - Present)

Jim oversees DSM portfolio planning and program design projects for Dominion Energy's natural gas utilities in North Carolina, South Carolina, and Ohio. In each of these service territories, Jim and his team worked collaboratively with Dominion Energy to identify applicable DSM measures, quantify measure impacts, create logical program offerings, and analyze the cost-effectiveness of the offerings. Jim also supported the DSM regulatory process in each jurisdiction through the development of expert witness testimony and assistance with responses to regulatory data requests.

Virginia Natural Gas – DSM Program Design, Cost-Benefit Analysis, and Regulatory Support (2014 - Present)

On behalf of Virginia Natural Gas, Jim leads technical and regulatory support for the residential DSM portfolio. Support activities include program cost-effectiveness analysis and preparation of regulatory filings including annual status updates to the Virginia State Corporation Commission, and technical analysis and testimony for regulatory approval of program updates and modifications.

Georgia Power Company – DSM Program Analysis and IRP Support (2005 - 2019)

Jim provided technical and regulatory support for Georgia Power Company's DSM program analysis in the residential and commercial markets for their 2007, 2010, 2013, 2016, and 2019 IRP filings. The program analysis support included comprehensive compilation and assessment of applicable DSM measures and technologies across the residential, commercial, and industrial sectors, as well as the determination of the overall market potential through four separate technical potential studies (completed in 2007, 2012, 2015, and 2018). Jim also led the portfolio planning efforts that included developing preliminary program designs, savings targets, and budgets, along with supporting cost-effectiveness analysis to determine the feasibility of individual measures and program offerings for implementation.

Elizabethtown Gas – DSM Program Design and Regulatory Support (2016 - 2018)

In support of Elizabethtown Gas, Jim led technical and regulatory support to develop updated DSM program offerings for residential and commercial customers. He worked collaboratively with Elizabethtown Gas to develop cost-beneficial programs for eligible customers. Activities included program cost-effectiveness analysis and testimony preparation for regulatory program filing with the New Jersey Board of Public Utilities.

Dominion Virginia Power – Program Development and Regulatory Support (2014 - 2016)

Jim served as the program design lead and expert witness in support of Dominion Virginia Power's regulatory filing for three proposed DSM program offerings. He provided input on the delivery structure, eligibility criteria, and cost-effectiveness analysis in the development of program offerings.

Additionally, Jim provided written and oral testimony on behalf of Dominion Virginia Power in support of the technical analysis on the feasibility and cost-effectiveness of the programs to the Virginia State Corporation Commission.

Los Angeles Department of Water and Power (LADWP) – Energy Efficiency Potential Study (2013 - 2015)

Jim managed the development of an energy efficiency potential study for the LADWP. Under his direction, his team quantified the energy efficiency potential for LADWP's service territory, including collection of primary data through facility auditing to determine the energy efficiency potential of facilities owned by the City of Los Angeles. The study followed industry best practices to determine energy efficiency potential and undertook unique approaches to aggregate and bundle measures into program delivery channels to identify all possible achievable savings. The study informed LADWP's short-term program planning, as well as updates to their 10-year program planning targets.

CPS Energy – Market Potential Study, DSM Program Design, and M&V (2008 - 2014)

Jim provided technical expertise and support for DSM services to CPS Energy, which included: developing an energy efficiency market potential study, designing, and implementing DSM programs, and performing program measurement and verification (M&V). The comprehensive market potential study analyzed the economic and achievable energy and demand impacts of cost-effective DSM measures across CPS Energy's residential, commercial, and industrial customer segments. The program design utilized the identified market potential to enhance CPS Energy's existing DSM programs and provided recommendations on new programs that target CPS Energy's long-term energy efficiency goals. Jim and his team also provided annual M&V of CPS Energy's DSM programs.

Danville Utilities – Residential Program Design and Implementation (2011 - 2013)

Jim led the initial development of Danville Utilities' Home$ave program in Virginia. This residential program initiative included a suite of energy efficiency measures targeting Danville's residential customer base. Jim managed the rollout of the program offering that included rebate processing, trade ally outreach, marketing support, and verification of measure installation and achieved energy savings.

CONFERENCE PRESENTATIONS

Herndon, J. (2023). "Foundations of Energy Efficiency: Program Planning & Delivery", Southeast Energy Summit, October 2023, Atlanta, GA.

Herndon, J.; Jacot, D. (2015). "LADWP EE Potential Study: Innovative Approach to Achievable Potential," International Energy Program Evaluation Conference (IEPEC), August 2015, Long Beach, CA.

resource innovations

Technical Potential Study of Demand Side Management

Florida Power & Light Company

Date: 03.07.2024

Table of Contents

Executive Summary

In October 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems.

The main objective of the study was to assess the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of Florida Power & Light Company's (FPL) service area.

1.1 Methodology

Resource Innovations estimates DSM savings potential by applying an analytical framework that aligns baseline market conditions for energy consumption and demand with DSM opportunities. After describing the baseline condition, Resource Innovations applies estimated measure savings to disaggregated consumption and demand data. The approach varies slightly according to the type of DSM resources and available data; the specific approaches used for each type of DSM are described below.

1.1.1 EE Potential

This study utilized Resource Innovations' proprietary EE modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual program savings. The methodology for the EE potential assessment was based on a hybrid "top-down/bottom-up" approach, which started with the current utility load forecast, then disaggregated it into its constituent customer-class and end-use components. Our assessment examined the effect of the range of EE measures and practices on each end-use, taking into account current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the end-use, customer class, and system levels for FPL.

1.1.2 DR Potential

The assessment of DR potential in FPL's service area was an analysis of mass market direct load control programs for residential and small commercial and industrial (C&I) customers, and an analysis of DR programs for large C&I customers. The direct load control program assessment focused on the potential for demand reduction through heating, ventilation, and air conditioning (HVAC), water heater, managed electric vehicle charging, and pool pump load control. These end-uses were of particular interest because of their large contribution to peak period system load. For this analysis, a range of direct load control measures were examined for each customer segment to highlight the range of potential. The assessment further accounted for existing DR programs for FPL when calculating the total DR potential.

1.1.3 DSRE Potential

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from customers' PV systems, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

1.2 Savings Potential

Technical potential for EE, DR, and DSRE are as follows:

1.2.1 EE Potential

EE technical potential describes the savings potential when all technically feasible EE measures are fully implemented, ignoring all non-technical constraints on electricity savings, such as cost-effectiveness and customer willingness to adopt EE.

The estimated EE technical potential results are summarized in Table 1.

Table 1. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	5,257	3,983	22,839
Non-Residential[1]	2,831	2,493	15,299
Total	8,088	6,476	38,138

1.2.2 DR Potential

DR technical potential describes the magnitude of loads that can be managed during conditions when grid operators need peak capacity. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale such as heating, cooling, water heaters, managed electric vehicle charging, and pool pumps. For large C&I customers, this included their entire electric demand during a utility's system peak, as many of these types of customers will forego virtually all electric demand temporarily if the financial incentive is large enough.

The estimated DR technical potential results are summarized in Table 2.

Table 2. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	14,527	7,650
Non-Residential	8,741	8,460
Total	23,268	16,110

[1] Non-Residential results include all commercial and industrial customer segments.

1.2.3 DSRE Potential

DSRE technical potential estimates quantify all technically feasible distributed generation opportunities from PV systems, battery storage systems charged from PV, and CHP technologies based on the customer characteristics of FPL's customer base.

The estimated DSRE technical potential results are summarized in Table 3.

Table 3. DSRE Technical Potential[2]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	9,142	1,438	71,354
Non-Residential	2,699	196	18,926
Total	11,841	1,634	90,280
Battery Storage charged from PV Systems			
Residential	1,456	4,811	0
Non-Residential	379	1,013	0
Total	1,835	5,824	0
CHP Systems			
Total	1,857	979	8,171

[2] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

2 Introduction

In October, 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems. The main objective of the study was:

- Assessing the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of FPL's service territory.

The following deliverables were developed by Resource Innovations as part of the project and are addressed in this report:

- DSM measure list and detailed assumption workbooks
- Disaggregated baseline demand and energy use by year, sector, and end-use
- Baseline technology saturations, energy consumption, and demand
- Technical potential demand and energy savings
- Supporting calculation spreadsheets

2.1 Technical Potential Study Approach

Resource Innovations estimates technical potential according to the industry standard categorization, as follows:

> *Technical Potential is the theoretical maximum amount of energy and capacity that could be displaced by DSM, regardless of cost and other barriers that may prevent the installation or adoption of a DSM measure.*

For this study, technical potential included full application of commercially available DSM technologies to all residential, commercial, and industrial customers in the utility's service territory.

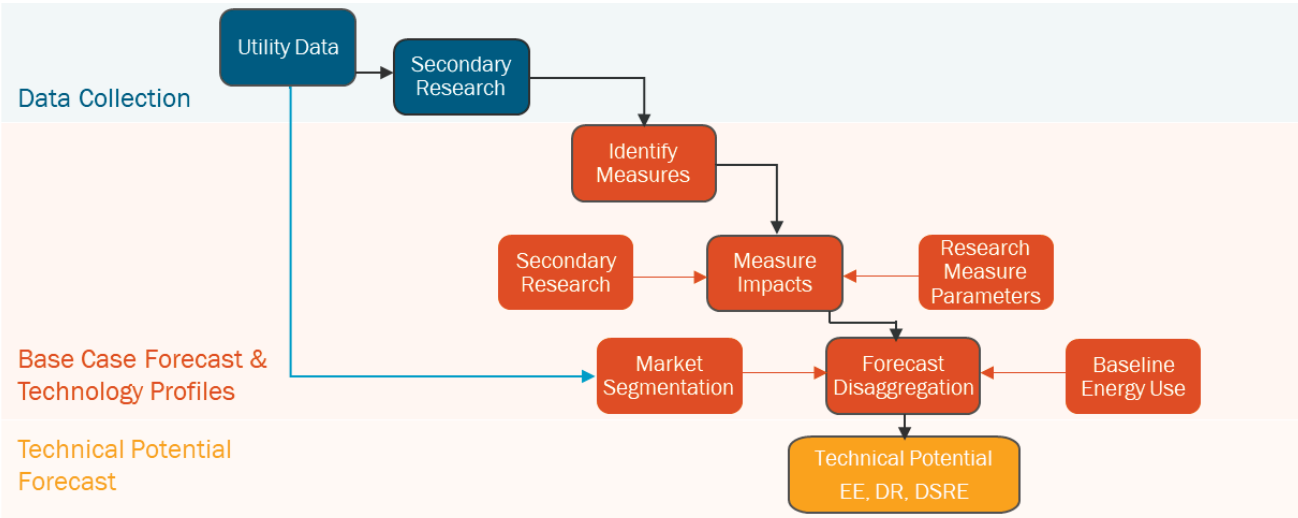
Quantifying DSM technical potential is the result of an analytical process that refines DSM opportunities that align with FPL's customers' electric consumption patterns. Resource Innovations' general methodology for estimating technical potential is a hybrid "top-

down/bottom-up" approach, which is described in detail in Sections 3 through 5 of this report and includes the following steps:

- Develop a baseline forecast: the study began with a disaggregation of the utility's official electric energy forecast to create a baseline electric energy forecast. This forecast does not include any utility-specific assumptions around DSM performance. Resource Innovations applied customer segmentation and consumption data from each utility and data from secondary sources to describe baseline customer-class and end-use components. Additional details on the forecast disaggregation are included in Section 3.
- Identify DSM opportunities: A comprehensive set of DSM opportunities applicable to FPL's climate and customers were analyzed to best depict DSM technical potential. Effects for a range of DSM technologies for each end-use could then be examined while accounting for current market saturations, technical feasibility, and impacts.
- Collect cost and impact data for measures: For those measures applicable to FPL's customers, Resource Innovations conducted primary and secondary research and estimated costs, energy savings, measure life, and demand savings. We differentiated between the type of cost (capital, installation labor, maintenance, etc.) to separately evaluate different implementation modes: retrofit (capital plus installation labor plus incremental maintenance); new construction (incremental capital and incremental maintenance); and burnout costs (incremental capital and incremental maintenance costs for replacement of appliances and equipment that has reached the end of its useful life). Additional details on measure development are included in Section 4.

Figure 1 provides an illustration of the technical potential modeling process conducted for FPL, with the assessment starting with the current utility load forecast, disaggregated into its constituent customer-class and end-use components, and calibrated to ensure consistency with the overall forecast. Resource Innovations considered the range of DSM measures and practices application to each end-use, accounting for current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the technology, end-use, customer class, and system levels.

Figure 1. Approach to Technical Potential Modeling



Resource Innovations estimated DSM technical potential based on a combination of market research, utility load forecasts and customer data, and measure impact analysis, all in coordination with FPL. Resource Innovations examined the technical potential for EE, DR, and DSRE opportunities; this report is organized to offer detail on each DSM category, with additional details on technical potential methodology presented in Section 5.

2.2 EE Potential Overview

To estimate EE potential, this study utilized Resource Innovations' modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual utility program savings, as described in Section 5.1.1 below. While the analysis estimates the impacts of individual EE measures, the model accounts for interactions and overlap of individual measure impacts within an end-use or equipment type. The model provides transparency into the assumptions and calculations for estimating EE potential.

2.3 DR Potential Overview

To estimate DR market potential, Resource Innovations considered customer demand during utility peaking conditions and projected customer response to DR measures. Customer demand was determined by looking at account-level interval data for a sample of customers within each segment. For each segment, Resource Innovations determined the portion of a customer's load that could be curtailed during the system peak.

2.4 DSRE Potential Overview

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from PV, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

3 Baseline Forecast Development

3.1 Market Characterization

The FPL base year energy use and sales forecast provided the reference point to determine potential savings. The end-use market characterization of the base year energy use and reference case forecast included customer segmentation and load forecast disaggregation. The characterization is described in this section, while the subsequent section addresses the measures and market potential energy and demand savings scenarios.

3.1.1 Customer Segmentation

In order to estimate EE, DR, and DSRE potential, the sales forecast and peak load forecasts were segmented by customer characteristics. As electricity consumption patterns vary by customer type, Resource Innovations segmented customers into homogenous groups to identify which customer groups are eligible to adopt specific DSM technologies, have similar building characteristics and load profiles, or are able to provide DSM grid services.

Resource Innovations segmented customers according to the following:

1) By Sector – how much of FPL's energy sales, summer and winter peak demand forecast is attributable to the residential, commercial, and industrial sectors?
2) By Customer – how much electricity does each customer typically consume annually and during system peaking conditions?
3) By End-Use – within a home or business, what equipment is using electricity during the system peak? How much energy does this end-use consume over the course of a year?

Table 4 summarizes the segmentation within each sector. In addition to the segmentation described here for the EE and DSRE analyses, the residential customer segments were further segmented by heating type (electric heat, gas heat, or unknown) and by annual consumption bins within each sub-segment for the DR analysis.

Table 4. Customer Segmentation

Residential	Commercial		Industrial	
Single Family	Assembly	Miscellaneous	Agriculture and Assembly	Primary Resources Industries
Multi-Family	College and University	Offices	Chemicals and Plastics	Stone/Glass/ Clay/Concrete
Manufactured Homes	Grocery	Restaurant	Construction	Textiles and Leather
	Healthcare	Retail	Electrical and Electronic Equipment	Transportation Equipment
	Hospitals	Schools K-12	Lumber/Furniture/ Pulp/Paper	Water and Wastewater
	Institutional	Warehouse	Metal Products and Machinery	Other
	Lodging/ Hospitality		Miscellaneous Manufacturing	

From an equipment and energy use perspective, each segment has variation within each building type or sub-sector. For example, the energy consuming equipment in a convenience store will vary significantly from the equipment found in a supermarket. To account for this variation, the selected end-uses describe energy consumption patterns that are consistent with those typically studied in national or regional surveys, such as the U.S. Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS), Commercial Building Energy Consumption Survey (CBECS) and Manufacturing Energy Consumption Survey (MECS), among others. The end-uses selected for this study are listed in Table 5.

Table 5. End-Uses

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Space heating[3]	Space heating[3]	Process heating
Space cooling[3]	Space cooling[3]	Process cooling
Domestic hot water	Domestic hot water	Compressed air
Ventilation and circulation	Ventilation and circulation	Motors/pumps

[3] Includes the contribution of building envelope measures and efficiencies.

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Lighting	Interior lighting	Fan, blower motors
Cooking	Exterior lighting	Process-specific
Appliances	Cooking	Industrial lighting
Electronics	Refrigeration	Exterior lighting
Miscellaneous	Office equipment	HVAC[3]
	Miscellaneous	Other

For DR, the end-uses targeted were those with controllable load for residential customers (*i.e.*, HVAC, water heaters, pool pumps, and electric vehicles) and small C&I customers (HVAC and electric vehicles). For large C&I customers, all load during peak hours was included assuming these customers would potentially be willing to reduce electricity consumption for a limited time if offered a large enough incentive during temporary system peak demand conditions.

3.1.2 Forecast Disaggregation

A common understanding of the assumptions and granularity in the baseline load forecast was developed with input from FPL. Key discussion topics reviewed included:

- How current DSM offerings are reflected in the energy and demand forecast.
- Assumed weather conditions and hour(s) of the day when the system is projected to peak.
- Are there portions of the load forecast attributable to customers or equipment not eligible for DSM programs?
- How are projections of population increase, changes in appliance efficiency, and evolving distribution of end-use load shares accounted for in the peak demand forecast?

3.1.2.1 Electricity Consumption (kWh) Forecast

Resource Innovations segmented FPL's electricity consumption forecast into electricity consumption load shares by customer class and end-use. The baseline customer segmentation represents the electricity market by describing how electricity was consumed within the service territory. Resource Innovations developed the forecast for the year 2025, and based it on data provided by FPL, primarily their 2023 Ten-Year Site Plan, which was the most recent plan available at the time the studies were initiated. The data addressed current baseline consumption, system load, and sales forecasts.

3.1.2.2 Peak Demand (kW) Forecast

A fundamental component of DR potential was establishing a baseline forecast of what loads or operational requirements would be absent due to existing dispatchable DR or time varying rates. This baseline was necessary to assess how DR can assist in meeting specific planning and operational requirements. We utilized FPL's summer and winter peak demand forecast, which was developed for system planning purposes.

3.1.2.3 Estimating Consumption by End-Use Technology

As part of the forecast disaggregation, Resource Innovations developed a list of electricity end-uses by sector (Table 5). To develop this list, Resource Innovations began with FPL's estimates of average end-use consumption by customer and sector. Resource Innovations combined these data with other information, such as utility residential appliance saturation surveys, as available, to develop estimates of customers' baseline consumption. Resource Innovations calibrated the utility-provided data with data available from public sources, such as the EIA's recurring data-collection efforts that describe energy end-use consumption for the residential, commercial, and manufacturing sectors.

To develop estimates of end-use electricity consumption by customer segment and end-use, Resource Innovations applied estimates of end-use and equipment-type saturation to the average energy consumption for each sector. The following data sources and adjustments were used in developing the base year 2025 sales by end-use:

Residential Sector:

- The disaggregation was based on FPL's rate class load shares and intensities.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - FPL rate class load share is based on average per customer.
    - Resource Innovations made conversions to usage estimates generated by applying EIA RECS data, residential end-use study data received from other FEECA utilities, and EIA's Annual Energy Outlook (AEO) 2023.

Commercial Sector:

- The disaggregation was based on FPL's rate class load shares, intensities, and EIA CBECS data.
- Segment data from EIA and FPL.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:

- Rate class load share based on EIA CBECS and end-use forecasts from FPL.

Industrial Sector:

- The disaggregation was based on rate class load shares, intensities, and EIA MECS data.
- Segment data from EIA and FPL.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
  - Rate class load share based on EIA MECS and end-use forecasts from FPL.

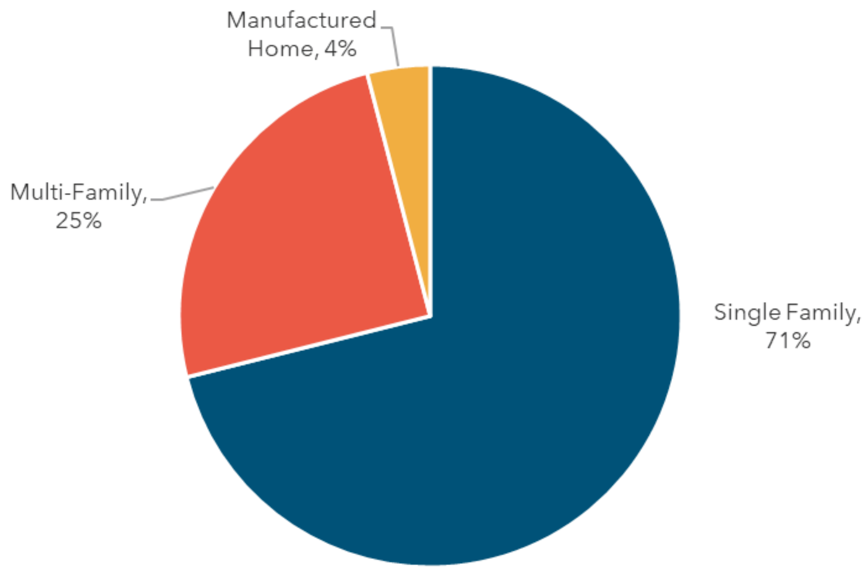
3.2 Analysis of Customer Segmentation

Customer segmentation is important to ensuring that a MPS examines DSM measure savings potential in a manner that reflects the diversity of energy savings opportunities existing across the utility's customer base. FPL provided Resource Innovations with data concerning the premise type and loads characteristics for all customers for the MPS analysis. Resource Innovations examined the provided data from multiple perspectives to identify customer segments. Resource Innovations' approach to segmentation varied slightly for non-residential and residential accounts, but the overall logic was consistent with the concept of expressing the accounts in terms that were relevant to DSM opportunities.

3.2.1 Residential Customers (EE, DR, and DSRE Analysis)

Segmentation of residential customer accounts enabled Resource Innovations to align DSM opportunities with appropriate DSM measures. Resource Innovations used utility customer data, supplemented with EIA data, to segment the residential sector by customer dwelling type (single family, multi-family, or manufactured home). The resulting distribution of customers according to dwelling unit type is presented in Figure 2.

Figure 2. Residential Customer Segmentation



3.2.2 Non-Residential (Commercial and Industrial) Customers (EE and DSRE Analysis)

For the EE and DSRE analysis, Resource Innovations segmented C&I accounts using the utility's North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes, supplemented by data produced by the EIA's CBECS and MECS. Resource Innovations classified the customers in this group as either commercial or industrial, on the basis of DSM measure information available and applicable to each. For example, agriculture and forestry DSM measures are commonly considered industrial savings opportunities. Resource Innovations based this classification on the types of DSM measures applicable by segment, rather than on the annual energy consumption or maximum instantaneous demand from the segment as a whole. The estimated energy sales distributions Resource Innovations applied are shown below in Figure 3 and Figure 4.

Figure 3. Commercial Customer Segmentation

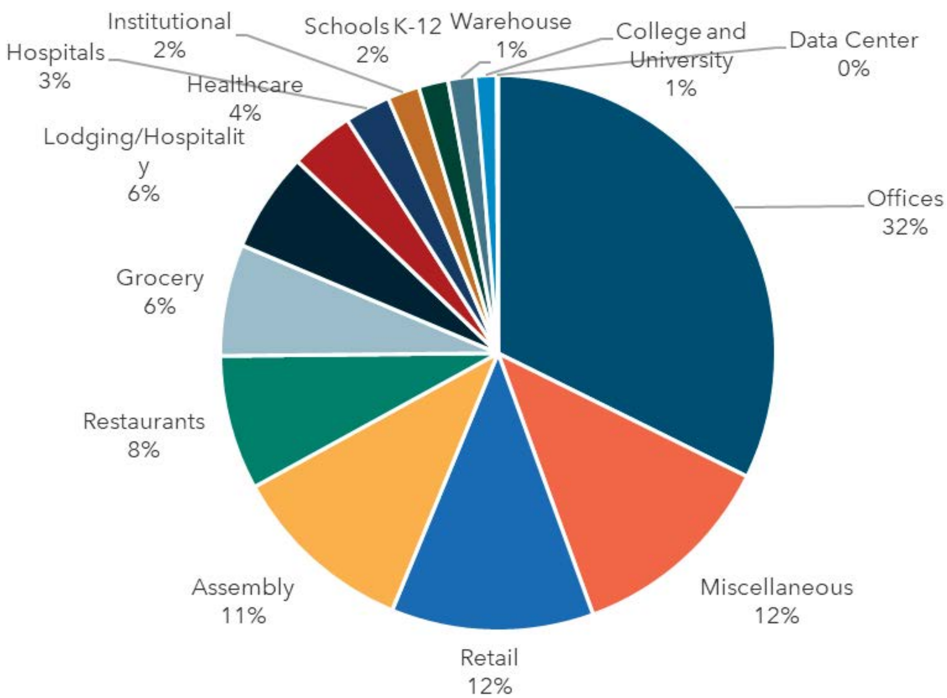
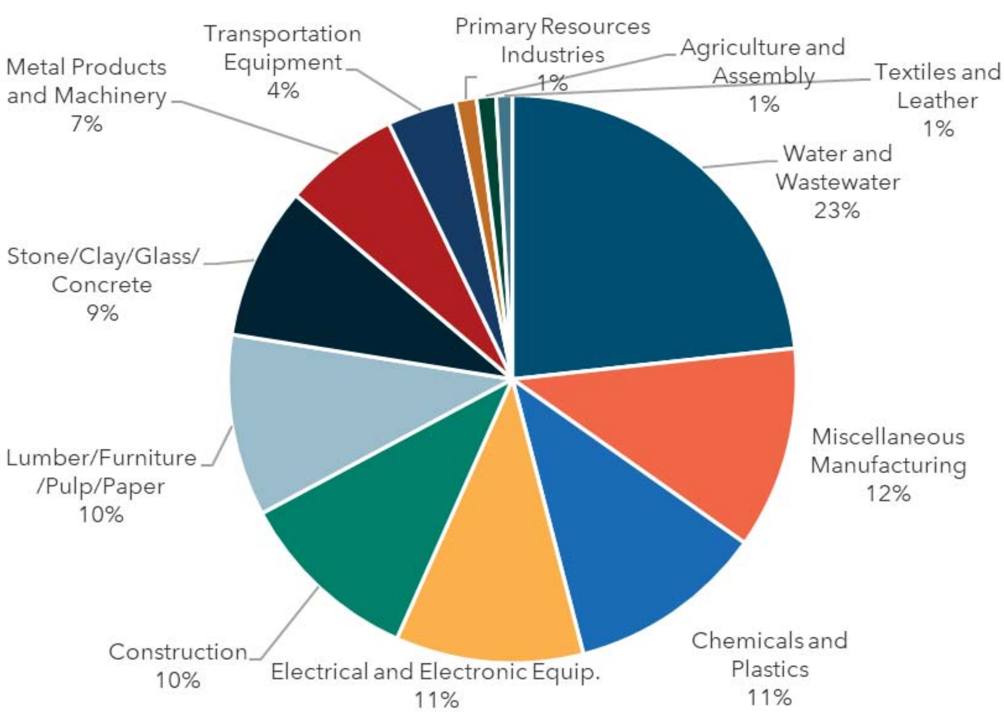


Figure 4. Industrial Customer Segmentation



3.2.3 Commercial and Industrial Accounts (DR Analysis)

For the DR analysis, Resource Innovations divided the non-residential customers into the two customer classes of small C&I and large C&I using rate class and annual consumption. For the purposes of this analysis, small C&I customers are those on the General Service (GS) tariff. Large C&I customers are all customers on the General Service Demand (GSD) tariff or on the General Service Large Demand (GSLD) tariff. Resource Innovations further segmented these two groups based on customer size. For small C&I, segmentation was determined using annual customer consumption and for large C&I the customer's maximum demand was used. Both customer maximum demand and customer annual consumption were calculated using billing data provided by FPL.

Table 6 shows the account breakout between small C&I and large C&I.

Table 6. Summary of Customer Classes for DR Analysis

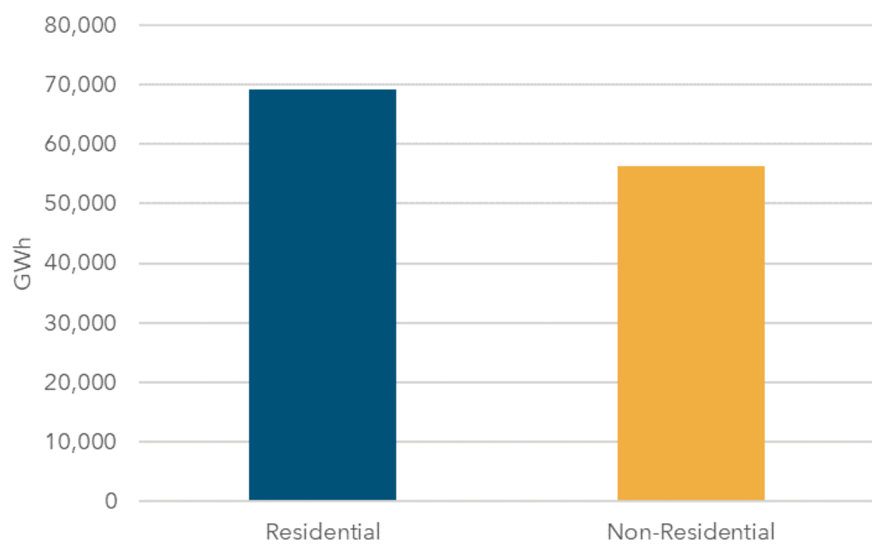
Customer Class	Annual kWh	Estimated Number of Accounts
Small C&I	0-15,000 kWh	360,182
	15,001-25,000 kWh	81,685
	25,001-50,000 kWh	78,842
	50,001 kWh +	36,567
	Total	557,276
Large C&I	0-50 kW	64,699
	51-300 kW	49,692
	301-500 kW	5,141
	501 kW +	4,332
	Total	123,864

3.3 Analysis of System Load

3.3.1 System Energy Sales

Technical potential is based on FPL's load forecast for the year 2025 from their 2023 Ten Year Site Plan, which is illustrated in Figure 5.

Figure 5. 2025 Electricity Sales Forecast by Sector



3.3.2 System Demand

To determine the technical potential for DR, Resource Innovations first established peaking conditions for each utility by looking at when each utility historically experienced its maximum demand. The primary data source used to determine when maximum DR impact was the historical system load for FPL. The data provided contained the system loads for all 8,760 hours of the most recent five years leading up to the study (2016-2021). The utility summer and winter peaks were then identified within the utility-defined peaking conditions. For FPL the summer peaking conditions were defined as August from 4:00-5:00 PM and the winter peaking conditions were defined as January from 7:00-8:00 AM. The seasonal peaks were then selected as the maximum demand during utility peaking conditions.

3.3.3 Load Disaggregation

The disaggregated annual electric loads[4] for the base year 2025 by sector and end-use are summarized in Figure 6, Figure 7, and Figure 8.

[4] Full disaggregation of system demand by end-use was not conducted, as DR potential for residential and small C&I customers focused on specific end-uses of particular interest because of their large contribution to peak period system load, and was not end-use specific for large C&I customers. A description of the end-use analysis for residential and small C&I customers is included in Section 5.1.2

Figure 6. Residential Baseline (2025) Energy Sales by End-Use

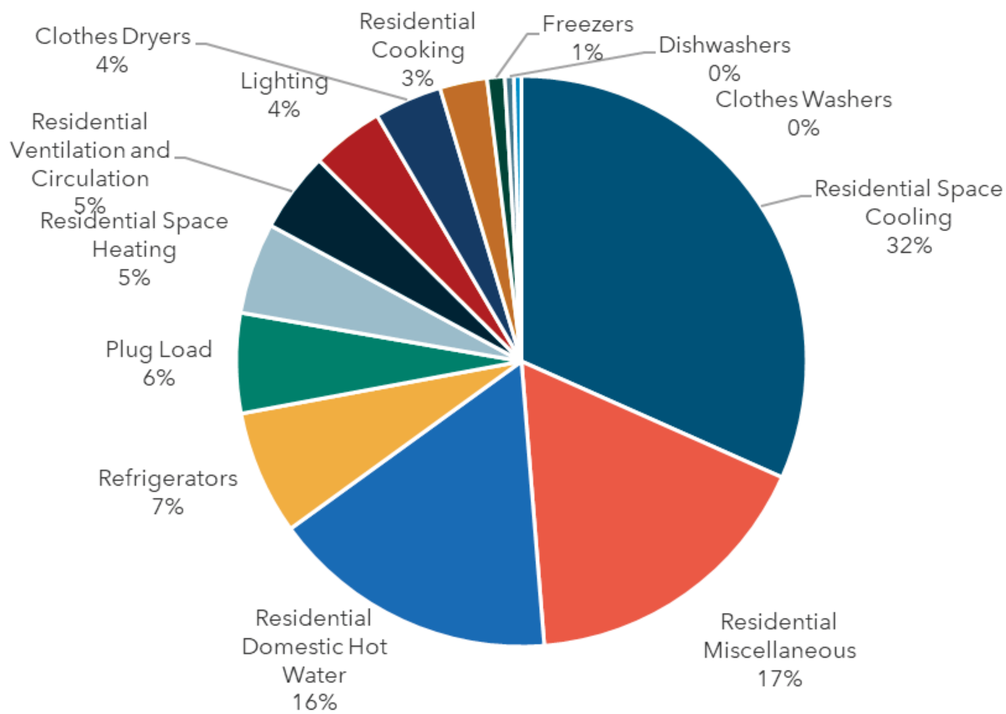


Figure 7. Commercial Baseline (2025) Energy Sales by End-Use

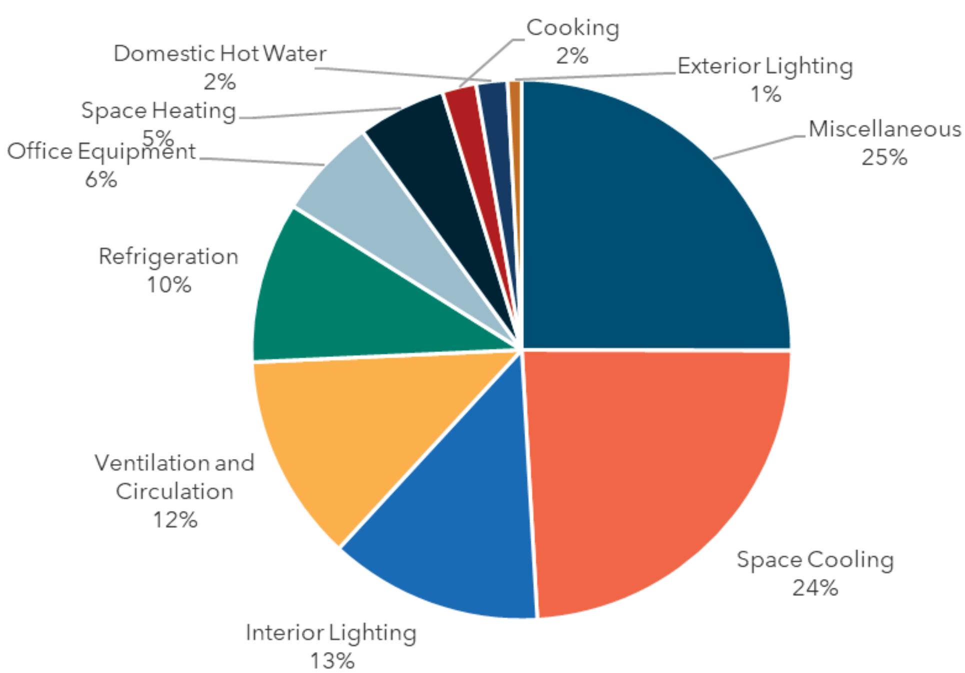
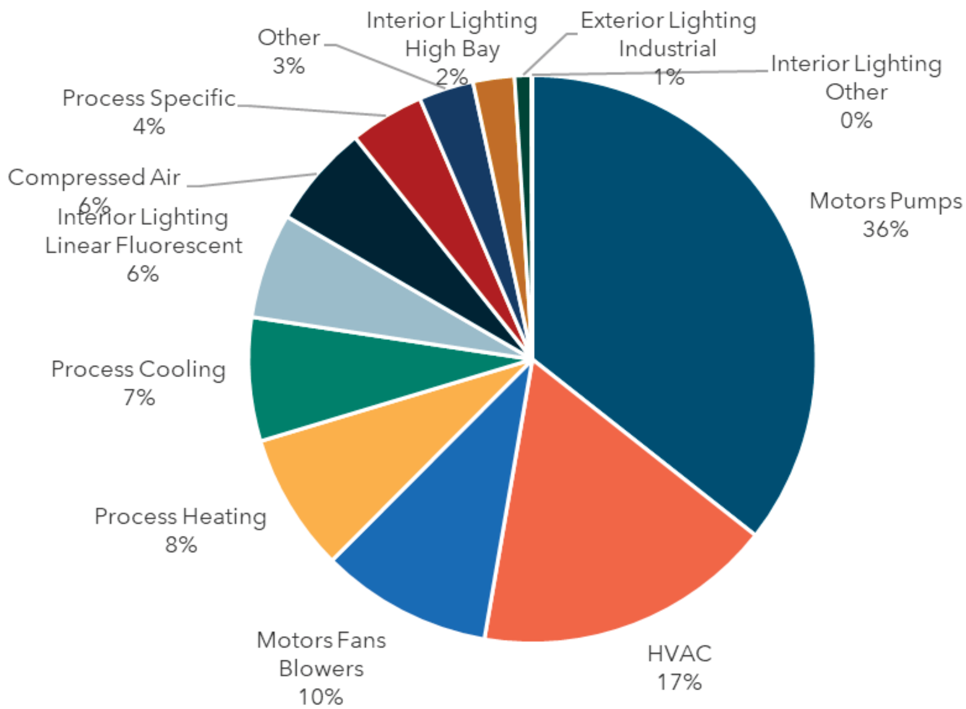


Figure 8. Industrial Baseline (2025) Energy Sales by End-Use



4 DSM Measure Development

DSM potential is described by comparing baseline market consumption with opportunities for savings. Describing these individual savings opportunities results in a list of DSM measures to analyze. This section presents the methodology to develop the EE, DR, and DSRE measure lists.

4.1 Methodology

Resource Innovations identified a comprehensive catalog of DSM measures for the study. The measure list is the same for all FEECA Utilities. The iterative vetting process with the utilities to develop the measure list began by initially examining the list of measures included in the 2019 Goals docket. This list was then adjusted based on proposed measure additions and revisions provided by the FEECA Utilities. Resource Innovations further refined the measure list based on reviews of Resource Innovations' DSM measure library, compiled from similar market potential studies conducted in recent years throughout the United States, as well as measures included in other utility programs where Resource Innovations is involved with program design, implementation, or evaluation. The FEECA Utilities also reached out to interested parties and received input with recommendations on measure additions to the 2019 measure list. Their measure suggestions were reviewed and incorporated into the study as appropriate. External measure suggestions and actions are summarized in Appendix D. The extensive, iterative review process involving multiple parties has ensured that the study included a robust and comprehensive set of DSM measures.

See Appendix A for the list of EE measures, Appendix B for the list of DR measures, and Appendix C for the list of DSRE measures analyzed in the study.

4.2 EE Measures

EE measures represent technologies applicable to the residential, commercial, and industrial customers in the FEECA Utilities' service territories. The development of EE measures included consideration of:

- EE technologies that are applicable to Florida and commercially available: Measures that are not applicable due to climate or customer characteristics were excluded, as were "emerging" technologies that are not currently commercially available to FEECA utility customers.
- Current and planned Florida Building Codes and Federal equipment standards (Codes & Standards) for baseline equipment: Measures included from prior studies

were adjusted to reflect current Codes & Standards as well as updated efficiency tiers, as appropriate.
- Eligibility for utility DSM offerings in Florida: For example, behavioral measures were excluded from consideration, as they historically have not been allowed to count towards utility DSM goals. Behavioral measures are intended to motivate customers to operate in a more energy-efficient manner (*e.g.*, setting an air-conditioner thermostat to a higher temperature) without accompanying: a) physical changes to more efficient end-use equipment or to their building envelope, b) utility-provided products and tools to facilitate the efficiency improvements, or c) permanent operational changes that improve efficiency which are not easily revertible to prior conditions. These types of behavioral measures were excluded because of the variability in forecasting the magnitude and persistence of energy and demand savings from the utility's perspective. Additionally, decoupling behavioral measure savings from the installation of certain EE technologies like smart thermostats can be challenging and could result in overlapping potential with other EE measures included in the study.

Upon development of the final EE measure list, utility-specific measure details were developed. RI maintains a proprietary online database of energy efficiency measures for MPS studies, which was used as a starting point for measure development for this study. Measures are added or updated at the request of project stakeholders or because of changes to the EE marketplace (for example, new codes and standards, or current practice in the market). Measure data are refined as new data or algorithms are developed for estimating measure impacts, and updated for each study to incorporate inputs parameters specific to the service territory being analyzed. The database contains the following information for each of the measures:

- Measure description: measure classification by type, end-use, and subsector, and description of the base-case and the efficient-case scenarios.
- kWh savings: Energy savings associated with each measure were developed through engineering algorithms or building simulation modeling, taking climate data and customer segments into consideration as appropriate. Reference sources used for developing residential, commercial, and industrial measure savings included a variety of Florida-specific, as well as regional and national sources, such as utility-specific measurement & verification (M&V) data, technical reference manuals (TRM) from other jurisdictions, ENERGY STAR calculators, and manufacturer or retailer specifications for particular products.
- Energy savings were applied in RI's TEA-POT model as a percentage of total baseline consumption. Peak demand savings were determined using utility-specific load shapes or coincidence factors.

- Measure Expected Useful Lifetime: Sources included the Database for Energy Efficient Resources (DEER), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, TRMs, and other regional and national measure databases and EE program evaluations.
- Measure Costs: Per-unit costs (full or incremental, depending on the application) associated with measure installations. Sources included: TRMs, ENERGY STAR calculator, online market research, FEECA utility program data, and other secondary sources.

The measure details from the online measure library are exported for use in RI's TEA-POT model, accompanied by utility-specific estimates of measure applicability. Measure applicability is a general term encompassing an array of factors, including technical feasibility of installation, and the measure's current saturation as well as factors to allocate savings associated with competing measures. Information used was primarily derived from data in current regional and national databases, as well as FPL's program tracking data. These factors are described in Table 7.

Table 7. Measure Applicability Factors

Measure Impact	Explanation	Sources
Technical Feasibility	The percentage of buildings that can have the measure physically installed. Various factors may affect this, including, but not limited to, whether the building already has the baseline measure (*e.g.*, dishwasher), and limitations on installation (*e.g.*, size of unit and space available to install the unit).	Various secondary sources and engineering experience.
Measure Incomplete Factor	The percentage of buildings without the specific measure currently installed.	Utility RASS; EIA RECS, CBECS; MECS; ENERGY STAR sales figures; and engineering experience.
Measure Share	Used to distribute the percentage of market shares for competing measures (*e.g.*, only blown-in ceiling insulation or spray foam insulation, not both would be installed in an attic).	Utility customer data, Various secondary sources and engineering experience.

As shown in Table 8, the measure list includes 400 unique energy-efficiency measures. Expanding the measures to account for all appropriate installation scenarios resulted in

9,683 measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (*i.e.*, a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed).

Table 8. EE Measure Counts by Sector

Sector	Unique Measures	Permutations
Residential	122	1,209
Commercial	166	5,910
Industrial	112	2,564

4.3 DR Measures

The DR measures included in the measure list utilize the following DR strategies:

- **Direct Load Control.** Utility control of selected equipment at the customer's home or business, such as HVAC or water heaters.
- **Critical Peak Pricing (CPP) with Technology.** Electricity rate structures that vary based on time of day. Includes CPP when the rate is substantially higher for a limited number of hours or days per year (customers receive advance notification of CPP event) coupled with technology that enables customer to lower their usage in a specific end-use in response to the event (e.g., HVAC via smart thermostat).
- **Contractual DR.** Customers receive incentive payments or a rate discount for committing to reduce load by a pre-determined amount or to a pre-determined firm service level upon utility request.
- **Automated DR.** Utility dispatched control of specific end-uses at a customer facility.

DR initiatives that do not rely on the installation of a specific device or technology to implement (such as a voluntary curtailment program or time of use rates) were not included.

A workbook was developed for each measure which included the same measure inputs as previously described for the EE measures. In addition, the DR workbook included expected load reduction from the measure, based on utility technical potential, existing utility DR programs, and other nationwide DR programs if needed.

For technical potential, Resource Innovations did not break out results by specific measure or control technology because all of the developed measures target the end-uses estimated

for technical potential (*i.e.*, potential is reported for space cooling end-use and not allocated to switches, smart thermostats, etc.).

4.4 DSRE Measures

The DSRE measure list includes rooftop PV systems, battery storage systems charged from PV systems, and CHP systems.

PV Systems

PV systems utilize solar panels (a packaged collection of PV cells) to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter, a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted systems that face south-west, south, and/or, south-east. The potential associated with roof-mounted systems installed on residential and commercial buildings was analyzed.

Battery Storage Systems Charged from PV Systems

Distributed battery storage systems included in this study consist of behind-the-meter battery systems installed in conjunction with an appropriately-sized PV system at residential and commercial customer facilities. These battery systems typically consist of a DC-charged battery, a DC/AC inverter, and electrical system interconnections to a PV system. On their own battery storage systems do not generate or conserve energy, but can collect and store excess PV generation to provide power during particular time periods, which for DSM purposes would be to offset customer demand during the utility's system peak.

CHP Systems

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide other on-site needs. Common prime mover technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Internal combustion engines

A workbook was developed for each measure which included the inputs previously described for EE measures and prime mover operating parameters.

5 Technical Potential

In the previous sections, the approach for DSM measure development was summarized, and the 2025 base year load shares and reference-case load forecast were described. The outputs from these tasks provided the input for estimating the technical potential scenario, which is discussed in this section.

The technical potential scenario estimates the potential energy and demand savings when all technically feasible and commercially available DSM measures are implemented without regard for cost-effectiveness and customer willingness to adopt the most impactful EE, DR, or DSRE technologies. Since the technical potential does not consider the costs or time required to achieve these savings, the estimates provide a theoretical upper limit on electricity savings potential. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. For this study, technical potential included full application of the commercially available DSM measures to all residential, commercial, and industrial customers in the utility's service territory.

5.1 Methodology

5.1.1 EE Technical Potential

EE technical potential refers to delivering less electricity to the same end-uses. In other words, technical potential might be summarized as "doing the same thing with less energy, regardless of the cost."

DSM measures were applied to the disaggregated utility electricity sales forecasts to estimate technical potential. This involved applying estimated energy savings from equipment and non-equipment measures to all electricity end-uses and customers. Technical potential consists of the total energy and demand that can be saved in the market which Resource Innovations reported as single numerical values for each utility's service territory.

The core equation used in the residential sector EE technical potential analysis for each individual efficiency measure is shown in Equation 1 below, while the core equation used in the nonresidential sector technical potential analysis for each individual efficiency measure is shown in Equation 2.

Equation 1: Core Equation for Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Number of Households × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Baseline Equipment Energy Use Intensity** = the electricity used per customer per year by each baseline technology in each market segment. In other words, the baseline equipment energy-use intensity is the consumption of the electrical energy using equipment that the efficient technology replaces or affects.
- **Saturation Share** = the fraction of the end-use electrical energy that is applicable for the efficient technology in a given market segment. For example, for residential cooling, the saturation share would be the fraction of all residential electric customers that have central air conditioners in their household.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of central air conditioners that is not already energy efficient.
- **Feasibility Factor** = the fraction of units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (*i.e.*, it may not be possible to install LEDs in all light sockets in a home because the available styles may not fit in every socket).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

Equation 2: Core Equation for Non-Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Stock Sq. Footage by Building Type by EDC × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Total Stock Square Footage by Segment** = the forecasted square footage level for a given building type (*e.g.*, square feet of office buildings).
- **Baseline Equipment Energy Use Intensity** = the electricity used per square foot per year by each baseline equipment type in each market segment.

- **Saturation Shares** = the fraction of total end-use energy consumption associated with the efficient technology in a given market segment. For example, for packaged terminal air-conditioner (PTAC), the saturation share would be the fraction of all space cooling kWh in a given market segment that is associated with PTAC equipment.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient.
- **Feasibility Factor** = the fraction of the equipment or practice that is technically feasible for conversion to the efficient technology from an engineering perspective (*i.e.*, it may not be possible to install Variable Frequency Drives (VFD) on all motors in a given market segment).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

It is important to note that the technical potential estimate represents electricity savings potential at a specific point in time. In other words, the technical potential estimate is based on data describing status quo customer electricity use and technologies known to exist today. As technology and electricity consumption patterns evolve over time, the baseline electricity consumption will also change accordingly. For this reason, technical potential is a discrete estimate of a dynamic market. Resource Innovations reported the technical potential for 2025, based on currently known DSM measures and observed electricity consumption patterns.

Measure Interaction and Competition (Overlap)

While the technical potential equations listed above focus on the technical potential of a single measure or technology, Resource Innovations' modeling approach does recognize the overlap of individual measure impacts within an end-use or equipment type, and accounts for the following interactive effects:

- Measure interaction: Installing high-efficiency equipment could reduce energy savings in absolute terms (kWh) associated with non-equipment measures that impact the same end-use. For example, installing a high-efficiency heat pump will reduce heating and cooling consumption which will reduce the baseline against which attic insulation would be applied, thus reducing savings associated with installing insulation. To account for this interaction, Resource Innovations' TEA-POT model ranks measures that interact with one another and reduces the baseline consumption for the subsequent measure based on the savings achieved by the preceding measure. For technical potential, interactive measures are ranked based on total end-use energy savings percentage.
- Measure competition (overlap): The "measure share"—as defined above—accounted for competing measures, ensuring savings were not double-counted. This interaction

occurred when two or more measures "competed" for the same end-use. For example, a T-12 lamp could be replaced with a T-8 or linear LED lamp.

Addressing Naturally-Occurring EE

Naturally occurring energy efficiency includes actions taken by customers to improve the efficiency of their homes and businesses in the absence of utility program intervention. For the analysis of technical potential, Resource Innovations verified with FPL's forecasting group that the baseline sales forecasts incorporated two known sources of naturally-occurring efficiency:

- Codes and Standards: The sales forecasts already incorporated the impacts of known Code & standards changes.
- Baseline Measure Adoption: The sales forecast excluded the projected impacts of future DSM efforts but included already implemented DSM penetration.

By properly accounting for these factors, the technical potential analysis estimated the additional EE opportunities beyond what is already included in the utility sales forecast.

5.1.2 DR Technical Potential

The concept of technical potential applies differently to DR than for EE. Technical potential for DR is effectively the magnitude of loads that can be curtailed during conditions when utilities need peak capacity reductions. In evaluating this potential at peak capacity, the following were considered: which customers are consuming electricity at those times? What end-uses are in play? Can those end-use loads be managed? Large C&I accounts generally do not provide the utility with direct control over particular end-uses. Instead, many of these customers will forego electric demand temporarily if the financial incentive is large enough. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale.

This framework makes end-use disaggregation an important element for understanding DR potential, particularly in the residential and small C&I sectors. When done properly, end-use disaggregation not only provides insights into which loads are on and off when specific grid services are needed, it also provides insight concerning how key loads and end-uses, such as air conditioning use, vary across customers. Resource Innovations' approach used for load disaggregation is more advanced than what is used for most potential studies. Instead of disaggregating annual consumption or peak demand, Resource Innovations produced end-use load disaggregation for all 8,760 hours. This was needed because the loads available at times when different grid applications are needed can vary substantially. Instead

of producing disaggregated loads for the average customer, the study was produced for several customer segments. For FPL, Resource Innovations examined three residential segments based on customer housing type, four different small C&I segments based on customer size, and four different large C&I segments based on customer size, for a total of 11 different customer segments.

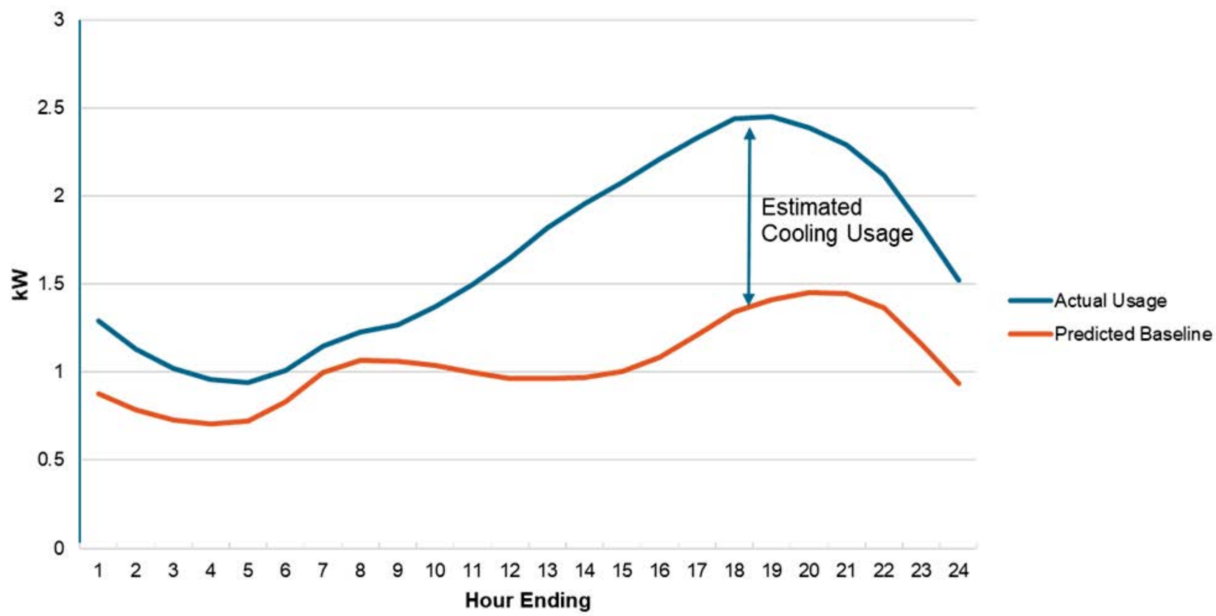
Technical potential, in the context of DR, is defined as the total amount of load available for reduction that is coincident with the period of interest; in this case, the system peak hour for the summer and winter seasons. Thus, two sets of capacity values are estimated: a summer capacity and a winter capacity.

As previously mentioned, for technical potential purposes, all coincident large C&I load is considered dispatchable, while residential and small C&I DR capacity is based on specific end-uses. Summer DR capacity for residential customers was comprised of air-conditioning (AC), pool pumps, water heaters, and managed electric vehicle charging. For small C&I customers, summer capacity was based on AC load. For winter DR capacity, residential was based on electric heating, pool pumps, and water heaters. For small C&I customers, winter capacity was based on electric heating.

AC and heating load profiles were generated for residential and small C&I customers using a sample of customer interval data provided by FPL. This sample included a customer breakout based on housing type for residential customers and size for small C&I customers. Resource Innovations then used the interval data from these customers to create an average load profile for each customer segment.

The average load profile for each customer segment was combined with historical weather data, and used to estimate hourly load as a function of weather conditions. AC and heating loads were estimated by first calculating the baseline load on days when cooling degree days (CDD) and heating degree days (HDD) were equal to zero, and then subtracting this baseline load. This methodology is illustrated by Figure 9 (a similar methodology was used to predict heating loads).

Figure 9: Methodology for Estimating Cooling Loads



This method was able to produce estimates for average AC/heating load profiles for the seven different customer segments within the residential and small C&I sectors.

Profiles for residential water heater and pool pump loads were estimated by utilizing end-use load data from NREL's residential end-use load profile database.

For all eligible loads, the technical potential was defined as the amount that was coincident with system peak hours for each season, which are August from 4:00-5:00 PM for summer, and January from 7:00-8:00 AM for winter. As mentioned in Section 4, for technical potential there was also no measure breakout needed, because all measures will target the end-uses' estimated total loads.

5.1.3 DSRE Technical Potential

5.1.3.1 PV Systems

To determine technical potential for PV systems, RI estimated the percentage of rooftop square footage in Florida that is suitable for hosting PV technology. Our estimate of technical potential for PV systems in this report is based in part on the available roof area and consisted of the following steps:

- Step 1: Outcomes from the forecast disaggregation analysis were used to characterize the existing and new residential, commercial, and industrial building stocks.
    - To calculate the total roof area for residential buildings, the average roof area per household is multiplied by the number of households.
    - For commercial and industrial buildings, RI calculated the total roof area by first dividing the load forecast by the energy usage intensity, which provides an estimate of the total building square footage. This result is then divided by the average number of floors to derive the total roof area.
- Step 2: The total available roof area feasible for installing PV systems was calculated. Relevant parameters included unusable area due to other rooftop equipment and setback requirements, in addition to possible shading from trees and limitations of roof orientation (factored into a "technical suitability" multiplier).
- Step 3: Estimated the expected power density (kW per square foot of roof area).
- Step 4: Estimated the hourly PV generation profile using NREL's PV Watts Calculator
- Step 5: Calculated total energy and coincident peak demand potential by applying RI's Spatial Penetration and Integration of Distributed Energy Resources (SPIDER) Model.

The methodology presented in this report uses the following formula to estimate overall technical potential of PVs:

Equation 3: Core Equation for Solar DSRE Technical Energy Potential

PV Technical Energy Potential = Suitable Rooftop PV Area (Sq Ft) × PV Power Density (kW-DC/Sq Ft) × Generation Factor (kWh/kW-DC)

Where:

- **Suitable Rooftop PV Area for Residential [Square Feet]:** Number of Residential Buildings x Average Roof Area Per Building x Technical Suitability Factor
- **Suitable Rooftop PV Area for Commercial [Square Feet] :** Energy Consumption [kWh] / Energy Intensity [kWh / Square Feet] / Average No. of Stories Per Building x Technical Suitability Factor
- **PV Power Density [kW-DC/Square Feet]:** Maximum power generated in Watts per square foot of solar panel.
- **Generation Factor:** Annual Energy Generation Factor for PV, from PV Watts (dependent on local solar irradiance)

5.1.3.2 Battery Storage Systems Charged from PV Systems

Battery storage systems on their own do not generate power or create efficiency improvements, but store power for use at different times. Therefore, in analyzing the technical potential for battery storage systems, the source of the stored power and overlap with technical potential identified in other categories was considered.

Battery storage systems that are powered directly from the grid do not produce annual energy savings but may be used to shift or curtail load during particular time periods. As the DR technical potential analyzes curtailment opportunities for the summer and winter peak period, and battery storage systems can be used as a DR technology, the study concluded that no additional technical potential should be claimed for grid-powered battery systems beyond that already attributed to DR.

Battery storage systems that are connected to on-site PV systems also do not produce additional energy savings beyond the energy produced from the PV system[5]. However, PV-connected battery systems do create the opportunity to store energy during period when the PV system is generating more than the home or business is consuming and use that stored power during utility system peak periods.

To determine the additional technical potential peak demand savings for "solar plus storage" systems, our methodology consisted of the following steps:

- Assume that every PV system included in PV Technical Potential is installed with a paired storage system.
- Size the storage system assuming peak storage power is equal to peak PV generation and energy storage duration is three hours.
- Apply RI's hourly dispatch optimization module in SPIDER to create an hourly storage dispatch profile that flattens the individual customer's load profile to the greatest extent possible accounting for a) customer hourly load profile, b) hourly PV generation profile, and c) battery peak demand, energy capacity, and roundtrip charge/discharge efficiency.
- Calculate the effective hourly impact for the utility using the above storage dispatch profile, aligned with the utility's peak hour (calculated separately for summer and winter)
- Report the output storage kW impact on utility coincident peak demand in summer and winter.

[5] PV-connected battery systems experience some efficiency loss due to storage, charging, and discharging. However, for this study, these losses were not quantified.

5.1.3.3 CHP Systems

The CHP analysis created a series of unique distributed generation potential models for each primary market sector (commercial and industrial).

Only non-residential customer segments whose electric and thermal load profiles allow for the application of CHP were considered. The technical potential analysis followed a three-step process. First, minimum facilities size thresholds were determined for each non-residential customer segment. Next, the full population of non-residential customers were segmented and screened based on the size threshold established for that segment. Finally, the facilities that were of sufficient size were matched with the appropriately sized CHP technology.

To determine the minimum threshold for CHP suitability, a thermal factor was applied to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load in order to achieve improved efficiencies.

The study collected electric and thermal intensity data from other recent CHP studies. For industrial customers, Resource Innovations assumed that the thermal load would primarily be used for process operations and was not modified from the secondary data sources for Florida climate conditions. For commercial customers, the thermal load is more commonly made up of water heating, space heating, and space cooling (through the use of an absorption chiller). Therefore, to account for the hot and humid climate in Florida, which traditionally limits weather-dependent internal heating loads, commercial customers' thermal loads were adjusted to incorporate a higher proportion of space cooling to space heating as available opportunities for waste heat recovery.

After determination of minimum kWh thresholds by segment, Resource Innovations used the utility-provided customer data with NAICS or SIC codes as well as annual consumption data. Non-residential customers were then categorized by segment and size. Customers with annual loads below the kWh thresholds are not expected to have the consistent electric and thermal loads necessary to support CHP and were eliminated from consideration.

In general, internal combustion engines are the prime mover for systems under 500kW with gas turbines becoming progressively more popular as system size increases above that. Based on the available load by customer, adjusted by the estimated thermal factor for each segment, CHP technologies were assigned to utility customers in a top-down fashion (*i.e.*, starting with the largest CHP generators).

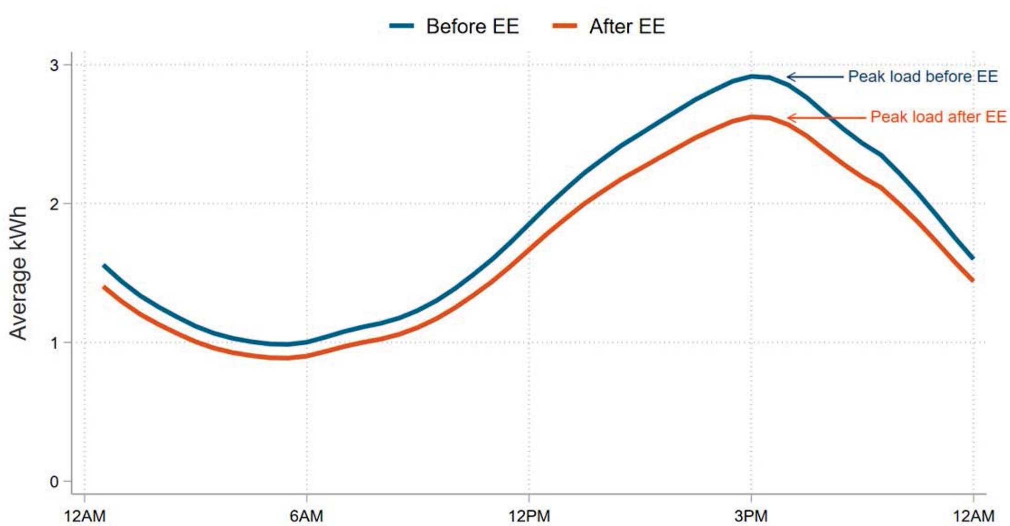
Measure Interaction

PV systems and battery storage charged from PV systems were analyzed collectively due to their common power generation source; and therefore, the identified technical potential for these systems is additive. However, CHP systems were independently analyzed for technical potential without consideration of the competition between DSRE technologies or customer preference for a particular DSRE system. Therefore, results for CHP technical potential should not be combined with PV systems or battery storage systems for overall DSRE potential but used as independent estimates.

5.1.4 Interaction of Technical Potential Impacts

As described above, the technical potential was estimated using separate models for EE, DR, and DSRE systems. However, there is interaction between these technologies; for example, a more efficient HVAC system would result in a reduced peak demand available for DR curtailment, as illustrated in Figure 10.

Figure 10: Illustration of EE Impacts on HVAC System Load Shape



Therefore, after development of the independent models, the interaction between EE, DR, and DSRE was incorporated as follows:

- The EE technical potential was assumed to be implemented first, followed by DR technical potential and DSRE technical potential.

- To account for the impact of EE technical potential on DR, the baseline load forecast for the applicable end-uses was adjusted by the EE technical potential, resulting in a reduction in baseline load available for curtailment.
- For DSRE systems, the EE and DR technical potential was incorporated in a similar fashion, adjusting the baseline load used to estimate DSRE potential.
  - For the PV analysis, this did not impact the results as the EE and DR technical potential did not affect the amount of PV that could be installed on available rooftops.
  - For the battery storage charged from PV systems, the reduced baseline load from EE resulted in additional PV-generated energy being available for the battery systems and for use during peak periods. The impact of DR events during the assumed curtailment hours was incorporated into the modeling of available battery storage and discharge loads.
- For CHP systems, the reduced baseline load from EE resulted in a reduction in the number of facilities that met the annual energy threshold needed for CHP installations. Installed DR capacity was assumed to not impact CHP potential as the CHP system feasibility was determined based on energy and thermal consumption at the facility. It should be noted that CHP systems not connected to the grid could impact the amount of load available for curtailment with utility-sponsored DR. Therefore, CHP technical potential should not be combined with DR potential but used as independent estimates.

5.2 EE Technical Potential

5.2.1 Summary

Table 9 summarizes the EE technical potential by sector:

Table 9. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	5,257	3,983	22,839
Non-Residential[6]	2,831	2,493	15,299
Total	8,088	6,476	38,138

[6] Non-Residential results include all commercial and industrial customer segments.

5.2.2 Residential

Figure 11, Figure 12, and Figure 13 summarize the residential sector EE technical potential by end-use.

Figure 11: Residential EE Technical Potential by End-Use (Summer Peak Savings)

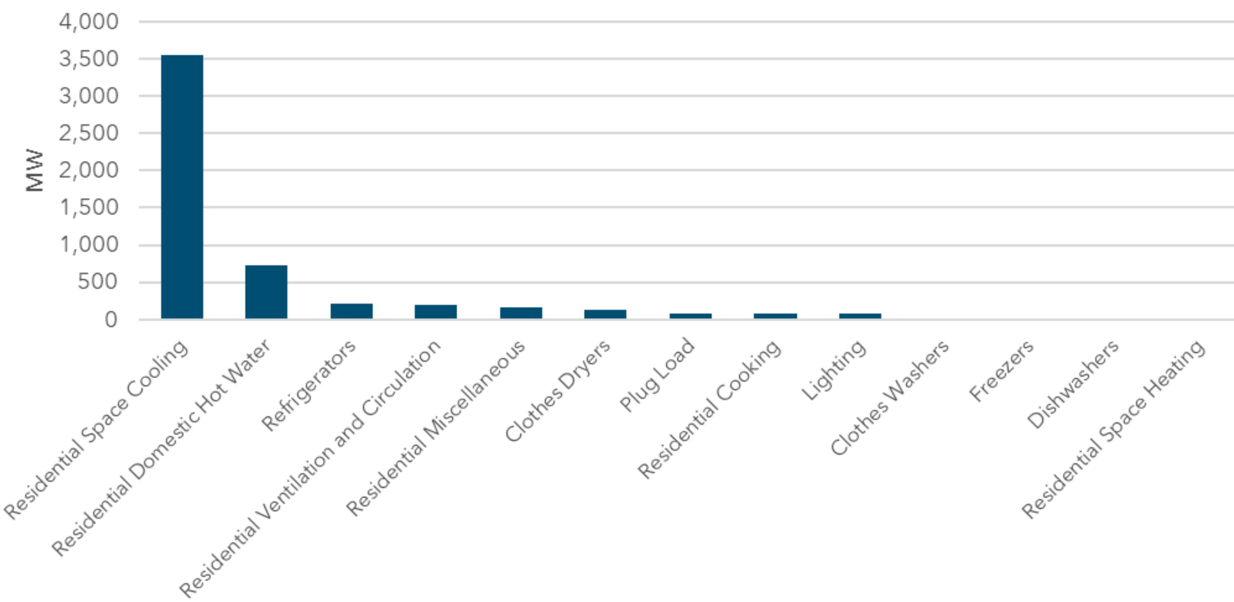


Figure 12: Residential EE Technical Potential by End-Use (Winter Peak Savings)

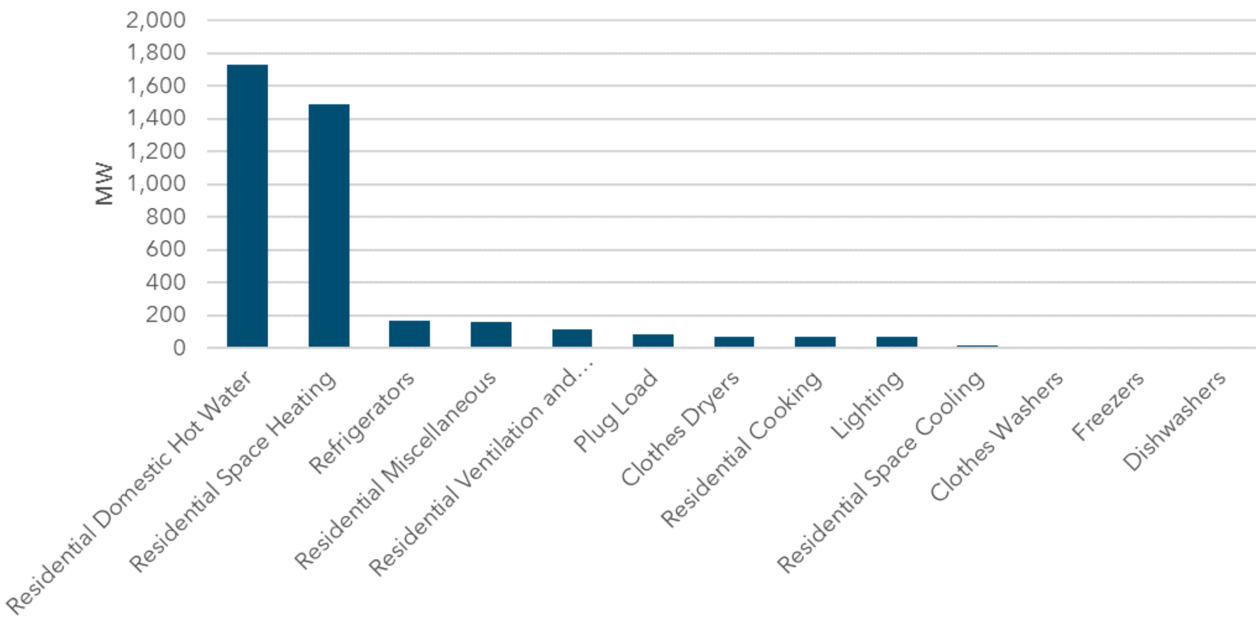
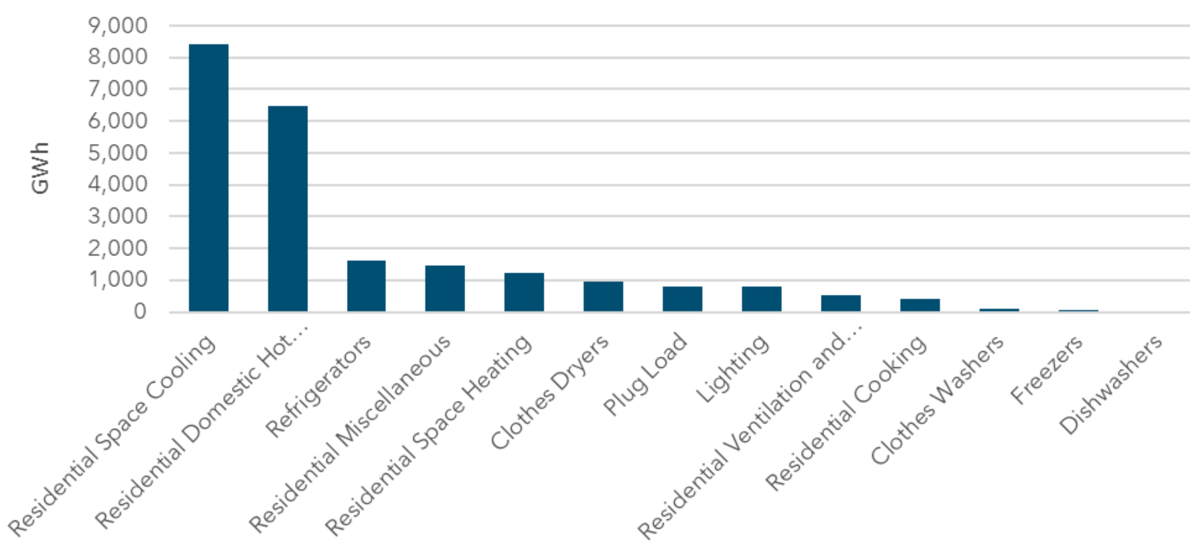


Figure 13: Residential EE Technical Potential by End-Use (Energy Savings)



5.2.3 Non-Residential

5.2.3.1 Commercial Segments

Figure 14, Figure 15, and Figure 16 summarize the commercial sector EE technical potential by end-use.

Figure 14: Commercial EE Technical Potential by End-Use (Summer Peak Savings)

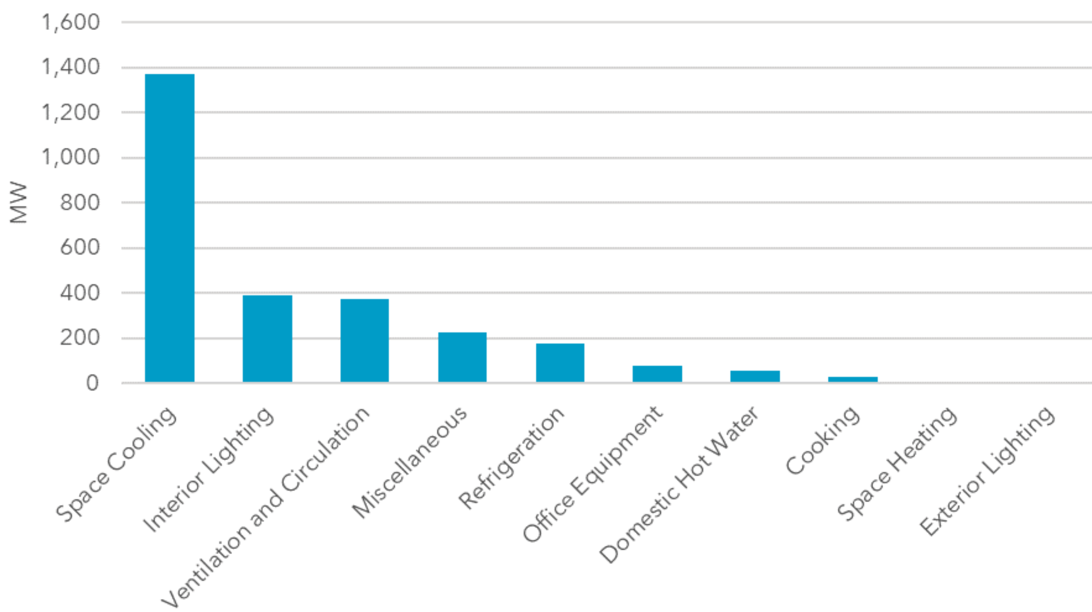


Figure 15: Commercial EE Technical Potential by End-Use (Winter Peak Savings)

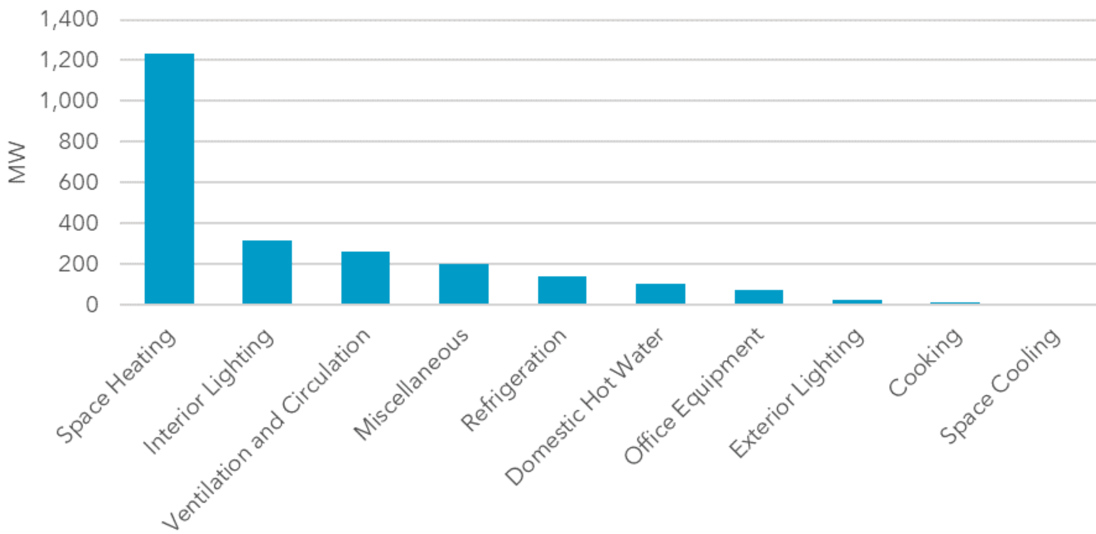
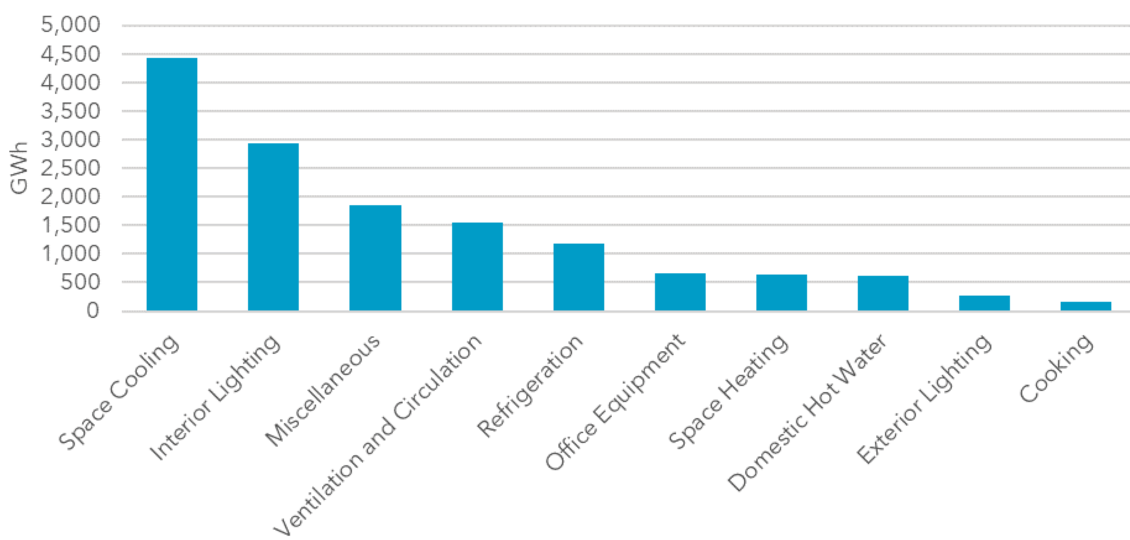


Figure 16: Commercial EE Technical Potential by End-Use (Energy Savings)



5.2.3.2 Industrial Segments

Figure 17, Figure 18, and Figure 19 summarize the industrial sector EE technical potential by end-use.

Figure 17: Industrial EE Technical Potential by End-Use (Summer Peak Savings)

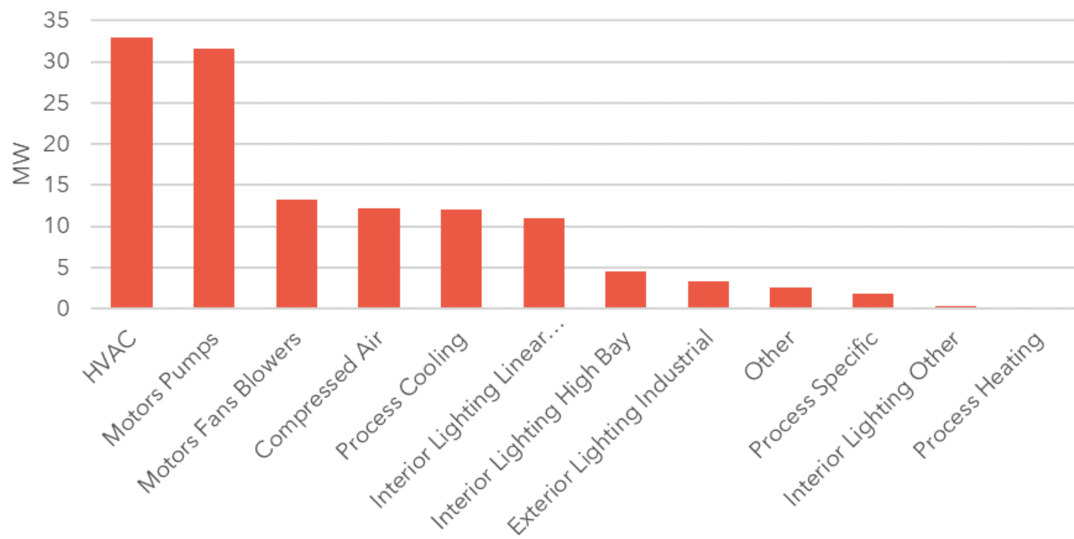


Figure 18: Industrial EE Technical Potential by End-Use (Winter Peak Savings)

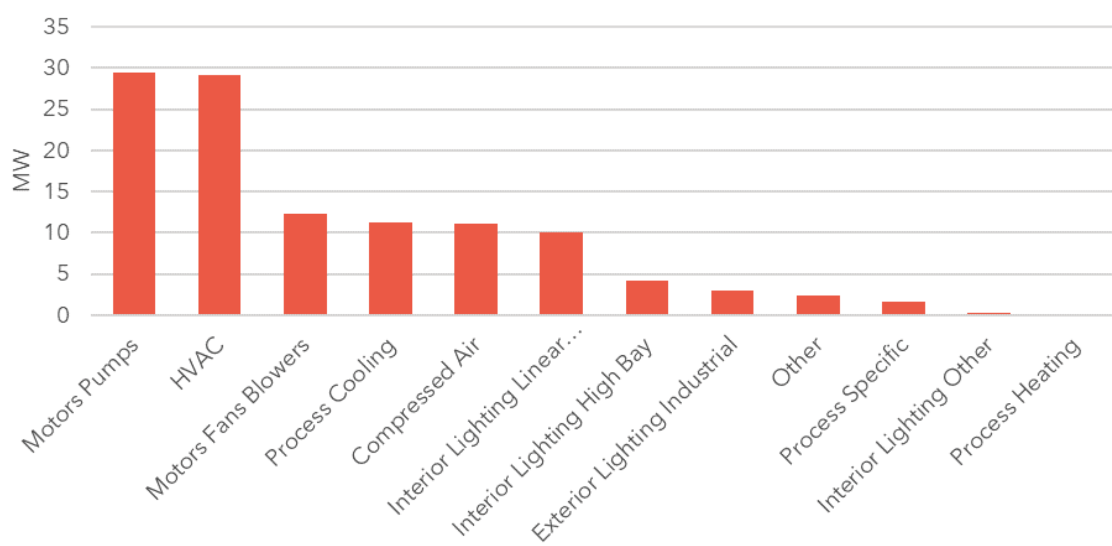
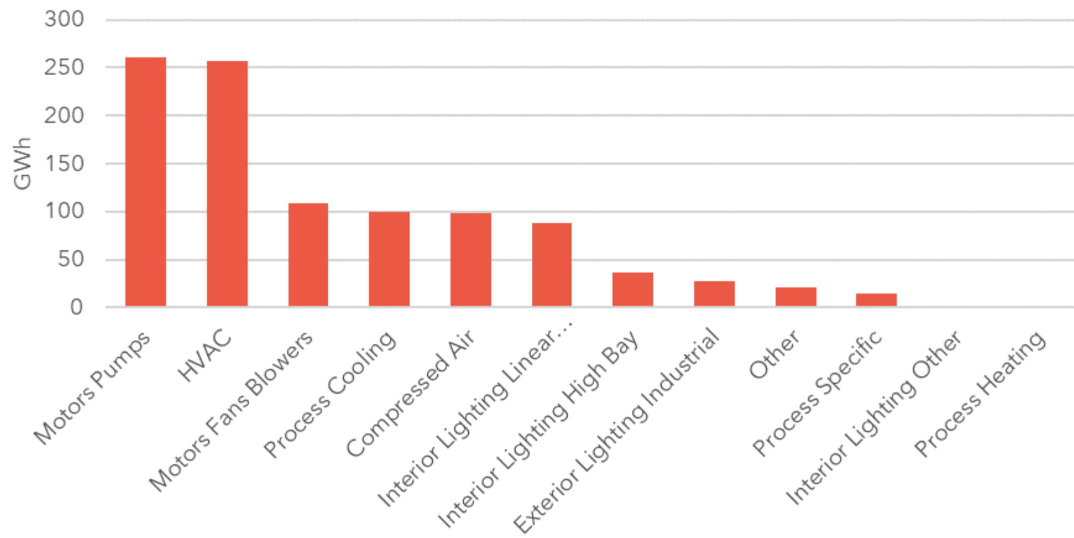


Figure 19: Industrial EE Technical Potential by End-Use (Energy Savings)



5.3 DR Technical Potential

Technical potential for DR is defined for each class of customers as follows:

- Residential & Small C&I customers – Technical potential is equal to the aggregate load for all end-uses that can participate in FPL's current programs plus DR measures not currently offered in which the utility uses specialized devices to control loads (*i.e.,* direct load control programs). This includes cooling and heating loads for residential and small C&I customers and water heater and pool pump loads for residential customers. Not all demand reductions are delivered via direct load control of end-uses. The magnitude of demand reductions from non-direct load control such as time varying pricing, peak time rebates and targeted notifications is linked to cooling and heating loads.
- Large C&I customers – Technical potential is equal to the total amount of load for each customer segment (*i.e.*, that customers reduce their total load to zero when called upon).

Table 10 summarizes the seasonal DR technical potential by sector:

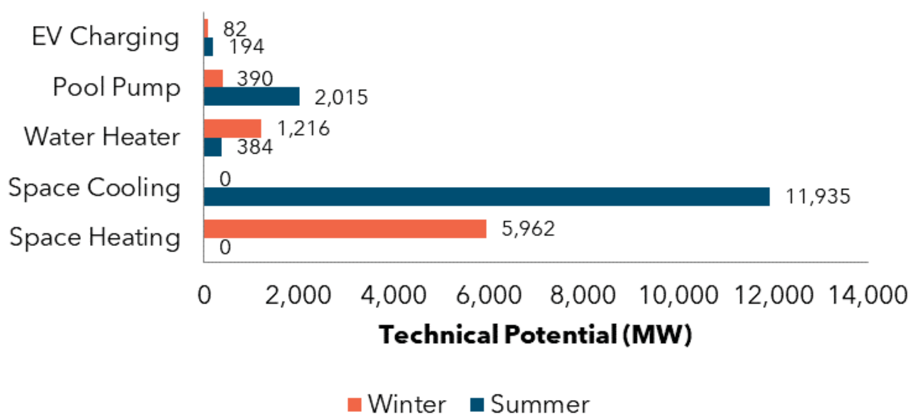
Table 10. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	14,527	7,650
Non-Residential	8,741	8,460
Total	23,268	16,110

5.3.1 Residential

Residential technical potential is summarized in Figure 20.

Figure 20: Residential DR Technical Potential by End-Use

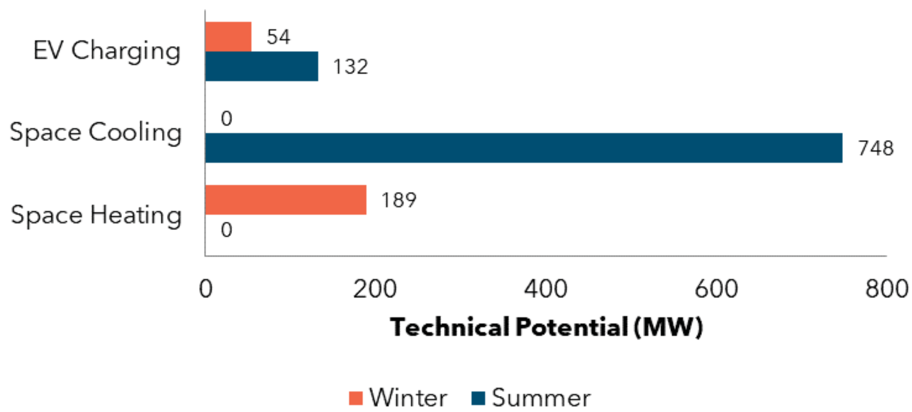


5.3.2 Non-Residential

5.3.2.1 Small C&I Customers

For small C&I technical potential, Resource Innovations looked at cooling and heating loads only. Small C&I technical potential is provided in Figure 21.

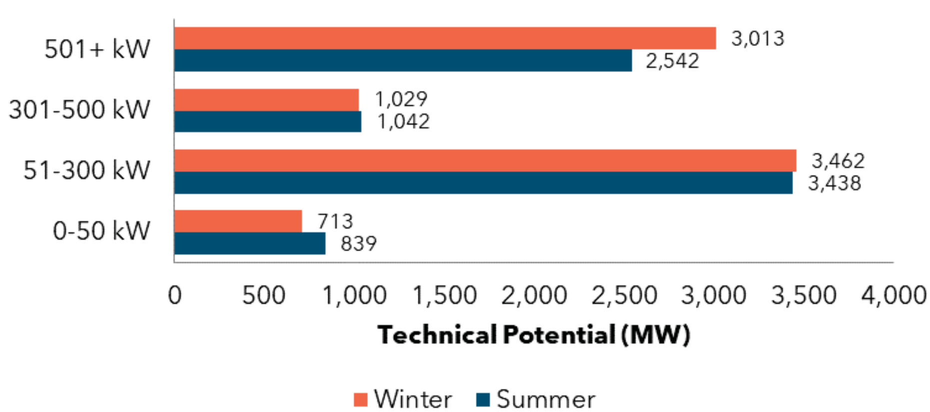
Figure 21: Small C&I DR Technical Potential by End-Use



5.3.2.2 Large C&I Customers

Figure 22 provides the technical potential for large C&I customers, broken down by customer size.

Figure 22: Large C&I DR Technical Potential by Segment



5.4 DSRE Technical Potential

Table 11 provides the results of the DSRE technical potential for each customer segment:

Table 11. DSRE Technical Potential[7]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	9,142	1,438	71,354
Non-Residential	2,699	196	18,926
Total	11,841	1,634	90,280
Battery Storage charged from PV Systems			
Residential	1,456	4,811	0
Non-Residential	379	1,013	0
Total	1,835	5,824	0
CHP Systems			
Total	1,857	979	8,171

[7] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

Appendix A EE Measure List

For information on how Resource Innovations developed this list, please see Section 4.

Table 12: Residential EE Measures

Measure	End-Use	Description	Baseline
120v Heat Pump Water Heater 50 Gallons	Residential Domestic Hot Water	120v Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Air Sealing-Infiltration Control	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Improved Infiltration Control	Standard Heating and Cooling System with Standard Infiltration Control
Air-to-Water Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star Air-to-Water Heat Pump, 25 SEER, 13 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - 15 SEER/14.3 SEER2 from base electric resistance	Residential Space Cooling, Residential Space Heating	ASHP 15 SEER from base electric resistance	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2 (from elec resistance)	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2, 10.5 HSPF	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling,	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating

Measure	End-Use	Description	Baseline
(from elec resistance)	Residential Space Heating		
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2 (from elect resistance)	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
Basement or Crawlspace Wall Insulation R-15	Residential Space Cooling, Residential Space Heating	Increased Basement or Crawlspace Wall Insulation (R-15)	Code-Compliant Exterior Below-Grade Wall Insulation (R-10)
Bathroom Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
CEE Advanced Tier Clothes Dryer	Clothes Dryers	CEE Advanced Tier Clothes Dryer	One Clothes Dryer meeting Federal Standard
CEE Advanced Tier Clothes Washer	Clothes Washers	Tier 3 CEE Clothes washer	One Clothes Washer meeting Federal Standard
CEE Tier 3 Refrigerator	Refrigerators	Residential Tier 3 Refrigerator	One Refrigerator meeting Federal Standard
Ceiling Insulation (R11 to R30)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes, bring to current code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R30)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes, bring to current code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R49)	Residential Space Cooling,	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
	Residential Space Heating		
Ceiling Insulation (R2 to R30)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes, bring to current code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R38 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Residential Space Cooling	Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - 24 SEER/22.9 SEER2	Residential Space Cooling	Central AC - 24 SEER/22.9 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Residential Space Cooling	Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling	Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC Tune Up	Residential Space Cooling	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Existing Typical Central AC without Regular Maintenance/tune-up
Dehumidifier Recycling	Plug Load	No dehumidifier	One Dehumidifier meeting Federal Standard

Measure	End-Use	Description	Baseline
Drain Water Heat Recovery	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Duct Insulation	Residential Space Cooling, Residential Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork	Standard Electric Heating and Central AC with Uninsulated Ductwork
Duct Repair	Residential Space Cooling, Residential Space Heating	Duct Repair to eliminate/minimize leaks, includes testing and sealing	Standard Electric Heating and Central AC with typical duct leakage
ECM Circulator Pump	Residential Miscellaneous	Install ECM Circulator Pump	Install Standard Circulator Pump
Energy Star Air Purifier	Plug Load	One Air Purifier meeting ENERGY STAR 2.0 Standards	One Standard Conventional Air Purifier
Energy Star Audio-Video Equipment	Plug Load	One DVD/Blu-Ray Player meeting current ENERGY STAR Standards	One Market Average DVD/Blu-Ray Player
Energy Star Bathroom Ventilating Fan	Residential Ventilation and Circulation	Bathroom Exhaust Fan meeting current ENERGY STAR Standards	Bathroom Exhaust Fan meeting Federal Standard
Energy Star Ceiling Fan	Residential Miscellaneous	60" Ceiling Fan Meeting ENERGY STAR 3.1 Standards	Standard 60" Ceiling Fan
Energy Star Clothes Dryer	Clothes Dryers	One Electric Resistance Clothes Dryer meeting ENERGY STAR 1.1 Standards	One Clothes Dryer meeting Federal Standard
Energy Star Clothes Washer	Clothes Washers	One Clothes Washer meeting ENERGY STAR 8.1 Standards	One Clothes Washer meeting Federal Standard
Energy Star Dehumidifier	Plug Load	One Dehumidifier meeting ENERGY STAR 5.0 Standards	One Dehumidifier meeting Federal Standard
Energy Star Dishwasher	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements (effective on July 19, 2023), electric water heating	One Dishwasher meeting Federal Standard
Energy Star Dishwasher (Gas Water Heating)	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements, gas water heating	One Dishwasher meeting Federal Standard; gas water heating
Energy Star Door	Residential Space Cooling, Residential Space Heating	100ft2 of Opaque Door meeting Energy Star Version 6.0 Requirements (U-Value: 0.17)	100ft2 of Opaque Door meeting current FL Code Requirements
ENERGY STAR EV supply equipment (level 2 charger)	Residential Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)

Measure	End-Use	Description	Baseline
Energy Star Freezer	Freezers	One Freezer meeting current ENERGY STAR 5.1 Standards	One Freezer meeting Federal Standard
Energy Star Ground Source Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star GSHP, 17.1 SEER, 12 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Energy Star Imaging Equipment	Plug Load	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star Monitor	Plug Load	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star Personal Computer	Plug Load	One Personal Computer meeting ENERGY STAR 8.0 Standards	One Personal Computer meeting ENERGY STARÂ® 3.0 Standards
Energy Star Refrigerator	Refrigerators	One Refrigerator/Freezer meeting ENERGY STAR 5.1 Standards	One Refrigerator/Freezer meeting Federal Standard
Energy Star Room AC	Residential Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star Set-Top Receiver	Plug Load	One Set-top Box meeting ENERGY STAR 4.1 Standards	One Market Average Set-top Box
Energy Star TV	Plug Load	One Television meeting ENERGY STAR 9.0 Standards	One non-ENERGY STAR Television
Energy Star Windows	Residential Space Cooling, Residential Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window current FL energy code requirements
Exterior Wall Insulation	Residential Space Cooling, Residential Space Heating	Increased Exterior Above-Grade Wall Insulation (R-13)	Market Average Existing Exterior Above-Grade Wall Insulation
Filter Whistle	Residential Ventilation and Circulation	Install the Furnace Filter Alarm	No Furnace Filter Alarm on a Central Forced-Air Furnace
Floor Insulation	Residential Space Heating	Increased Floor Insulation (R-30)	Code-Compliant Floor Insulation
Freezer Recycling	Freezers	No Freezer	Current Market Freezer
Green Roof	Residential Space Cooling	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
Heat Pump Clothes Dryer	Clothes Dryers	One Heat Pump Clothes Dryer	One Clothes Dryer meeting Federal Standard
Heat Pump Pool Heater	Residential Miscellaneous	Heat Pump Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Heat Pump Tune Up	Residential Space Cooling, Residential Space Heating	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Standard Heating and Cooling System without Regular Maintenance/tune-up

Measure	End-Use	Description	Baseline
Heat Pump Water Heater 50 Gallons-CEE Advanced Tier	Residential Domestic Hot Water	CEE Advanced Tier Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 50 Gallons-ENERGY STAR	Residential Domestic Hot Water	Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 80 Gallons-ENERGY STAR	Residential Domestic Hot Water	Energy Star Heat Pump Water Heater 80 Gallons	Code-Compliant 80 Gallon Electric Resistance Water Heater
Heat Trap	Residential Domestic Hot Water	Heat Trap	Existing Water Heater without heat trap
High Efficiency Convection Oven	Residential Cooking	One Full-Size Convection Oven meeting ENERGY STAR 3.0 Standards	One Standard Economy-Grade Full-Size Oven
High Efficiency Induction Cooktop	Residential Cooking	One residential induction cooktop	One standard residential electric cooktop
Home Energy Management System	Lighting, Plug Load, Residential Space Cooling, Residential Space Heating	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Hot Water Pipe Insulation	Residential Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-5	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
HVAC ECM Motor	Residential Ventilation and Circulation	A brushless permanent magnet (ECM) blower motor for electric furnace	Permanent Split Capacitor Motor for Electric Furnace
HVAC Economizer	Residential Space Cooling	Install residential economizer	No economizer
HVAC Zoning System	Residential Space Cooling, Residential Space Heating	Install dampers in the ducts, dividing home into multiple zones, each controlled by its own thermostat	Single zone HVAC system
Indoor Daylight Sensor	Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Range	Residential Cooking	Residential induction range	Electric range
Instantaneous Hot Water System	Residential Domestic Hot Water	Instantaneous Hot Water System	Standard Efficiency Storage Tank Water Heater
Kitchen Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
LED - 9W_CFL Baseline	Lighting	LED (assume 9W) replacing CFL baseline lamp	14W CFL (60W equivalent)

Measure	End-Use	Description	Baseline
LED - 9W_Halogen Baseline	Lighting	LED (assume 9W) replacing EISA-2020 compliant baseline lamp	EISA-2020 compliant baseline lamp (60W equivalent)
LED Specialty Lamps-5W Chandelier	Lighting	5 W Chandelier LED	Standard incandescent chandelier lamp
Linear LED	Lighting	Linear LED Lamps in Linear Fluorescent Fixture	Standard (32w) T8 lamps in Linear Fluorescent Fixture
Low Flow Showerhead	Residential Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
New Construction - Whole Home Improvements - Tier 1	Whole Home	Performance-based improvements in new homes - 20% savings	Residential New Construction (Baseline Efficiency)
New Construction - Whole Home Improvements - Tier 2	Whole Home	Performance-based improvements in new homes - 35% savings	Residential New Construction (Baseline Efficiency)
Occupancy Sensors Switch Mounted	Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Timer	Lighting	Timer on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Outdoor Motion Sensor	Lighting	Motion Sensor on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Ozone Laundry	Clothes Washers	Add a New, Single-Unit Ozone Laundry System to the Clothes Washer	One Clothes Washer meeting Federal Standard
Programmable Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Properly Sized CAC	Residential Space Cooling	Properly Sized Central Air Conditioning	Standard Central Air Conditioning, Oversized
Radiant Barrier	Residential Space Cooling	Radiant Barrier	No radiant barrier
Reflective Roof	Residential Space Cooling	Reflective Roof Treatment	Standard dark shingle
Refrigerator Coil Cleaning	Refrigerators	Refrigerator Coil Cleaning	
Refrigerator Recycling	Refrigerators	No Refrigerator	Current Market Average Refrigerator
Residential Whole House Fan	Residential Space Cooling	Standard Central Air Conditioning with Whole House Fan	Standard Central Air Conditioning, No Whole House Fan

Measure	End-Use	Description	Baseline
Sealed crawlspace	Residential Space Cooling, Residential Space Heating	Encapsulated and semi-conditioned crawlspace	Naturally vented, unconditioned crawlspace
Smart Breaker	Whole Home	Smart Breaker	standard electric breakers
Smart Panel	Whole Home	Multi-channel device that attaches to customer's circuit breaker to enable monitoring and control of major end-use appliances by customer	standard electric panel
Smart Power Strip	Plug Load	Smart plug strips for entertainment centers and home office	Standard entertainment center or home office usage, no smart strip controls
Smart Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Solar Attic Fan	Residential Space Cooling	Standard Central Air Conditioning with Solar Attic Fan	Standard Central Air Conditioning, No Solar Attic Fan
Solar Pool Heater	Residential Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pumps	Residential Miscellaneous	Solar Powered Pool Pump	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System	Residential Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Spray Foam Insulation (Base R11)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R19)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R2)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R30)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Thermostatic Shower Restriction Valve	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Thermostatic Shower Valves	50 Gallon Electric Resistance Heater and Standard Shower Valves

Measure	End-Use	Description	Baseline
Variable Refrigerant Flow (VRF) HVAC Systems	Residential Space Cooling, Residential Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Water Heater Blanket	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Insulated Tank Wrap	Code-Compliant 50 Gallon Electric Resistance Water Heater, No Tank Wrap
Water Heater Thermostat Setback	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Temperature Setpoint of 119°F	Code-Compliant 50 Gallon Electric Resistance Water Heater (Temp. Setpoint = 130Â°F)
Water Heater Timeclock	Residential Domestic Hot Water	Water Heater Timeclock	Existing Water Heater without time clock
Weather stripping	Residential Space Cooling, Residential Space Heating	Specific quantity of weather stripping to seal	
Window Caulking	Residential Space Cooling, Residential Space Heating	Window caulking	
Window Sun Protection	Residential Space Cooling	Window Film Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

Table 13: Commercial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
Advanced Rooftop Controller	Ventilation and Circulation	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Miscellaneous	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor

Measure	End-Use	Description	Baseline
Air Curtains	Space Cooling, Space Heating	Air Curtain across door opening	Door opening with no air curtain
Airside Economizer	Space Cooling	Airside Economizer	No economizer
Anti-Sweat Controls	Refrigeration	One Medium Temperature Reach-In Case with Anti-Sweat Heater Controls	One Medium Temperature Reach-In Case without Anti-Sweat Heater Controls
Auto Off Time Switch	Interior Lighting	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Automatic Door Closer for Walk-in Coolers and Freezers	Refrigeration	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Beverage Vending Machine Controls	Refrigeration	One non-ENERGY STAR beverage vending machine equipped with infrared occupancy sensing controls	One non-ENERGY STAR beverage vending machine, no controls
Bi-Level Lighting Control (Exterior)	Exterior Lighting	Bi-Level Controls on Exterior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Interior)	Interior Lighting	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ceiling Insulation (R19 to R30)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R30)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Chilled Water Reset	Space Cooling	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature

Measure	End-Use	Description	Baseline
Chiller maintenance	Space Cooling	O&M improvements to restore chiller performance	
CO Sensors for Parking Garage Exhaust	Miscellaneous	Enclosed Parking Garage Exhaust with CO Control	Constant Volume Enclosed Parking Garage Exhaust
Commercial Duct Sealing	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Commercial Strategic Energy Management	Whole Building	Commercial Strategic Energy Management	No active energy management
Custom measure - Non-lighting	Space Cooling, Space Heating	Custom Improvement to Facility's Operations	Baseline Technology/Process
Data Center Hot Cold Aisle	Office Equipment	Equipment configuration that saves HVAC	No hot, cold aisle containment
Dedicated Outside Air System (DOAS)	Space Cooling, Space Heating	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Circulating Systems	Domestic Hot Water	Recirculation Pump with Demand Control Mechanism	Uncontrolled Recirculation Pump
Demand Controlled Ventilation	Ventilation and Circulation	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Refrigeration	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Destratification Fans	Space Heating	Destratification Fans improve temperature distribution by circulating warmer air from the ceiling back down to the floor level	No destratification fan
Door Gasket (Cooler)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Door Gasket (Freezer)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Drain water heat recovery	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Dual Enthalpy Economizer	Ventilation and Circulation	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
Duct Insulation	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork (R-8)	Standard Electric Heating and Central AC with Uninsulated Ductwork (R-4)

Measure	End-Use	Description	Baseline
Ductless Mini-Split AC	Space Cooling	Ductless Mini-Split AC, 4 Ton, 16 SEER	Code-Compliant AC Unit, 4 Ton, 15 SEER
Ductless Mini-Split HP	Space Cooling, Space Heating	Ductless Mini-Split HP, 17 SEER, 9.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
DX Coil Cleaning	Space Cooling	DX Coil Cleaning	DX Coil Not Cleaned
ECM Motors on Furnaces	Space Heating	Variable Speed Electronically Commutated Motor for an Electric Furnace	Permanent Split Capacitor Motor for Electric Furnace
Efficient Battery Charger	Miscellaneous	Efficient Battery Charger	FR or SCR charging stations with power conversion efficiency < 89% or > 10 W
Efficient Exhaust Hood	Cooking	Kitchen ventilation with automatically adjusting fan controls	Kitchen ventilation with constant speed ventilation motor
Efficient Motor Belts	Miscellaneous	Synchronous belt, 98% efficiency	Standard V-belt drive
Efficient New Construction Lighting	Interior Lighting	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Energy Recovery Ventilation System (ERV)	Space Cooling	Unitary Cooling Equipment that Incorporates Energy Recovery	Current Market Packaged or Split DX Unit
Energy Star Combination Oven	Cooking	Energy Star Combination Oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade 10-Pan Combination Oven
Energy Star Commercial Clothes Washer	Miscellaneous	One Commercial Clothes Washer meeting current ENERGY STAR Version 8.1 Standards	One Commercial Clothes Washer meeting Federal Standard
Energy Star Commercial Dishwasher	Domestic Hot Water	One Commercial Dishwasher meeting ENERGY STAR Version 3.0 Standards	One Dishwasher meeting Federal Standard
Energy Star Commercial Glass Door Freezer	Refrigeration	One Glass Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Glass Door Freezer meeting Federal Standards
Energy Star Commercial Glass Door Refrigerator	Refrigeration	One Glass Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Glass Door Refrigerator meeting Federal Standards
Energy Star Commercial Solid Door Freezer	Refrigeration	One Solid Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Solid Door Freezer meeting Federal Standards
Energy Star Commercial Solid Door Refrigerator	Refrigeration	One Solid Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Solid Door Refrigerator meeting Federal Standards
Energy Star convection oven	Cooking	Energy Star convection oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Full-Size Convection Oven

Measure	End-Use	Description	Baseline
Energy Star EV Chargers	Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Fryer	Cooking	One Standard Vat Electric Fryer meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Standard Vat Electric Fryer
Energy Star Griddle	Cooking	One Griddle meeting current ENERGY STAR Version 1.2 Standards	One Conventional Griddle
Energy Star Hot Food Holding Cabinet	Cooking	One Hot Food Holding Cabinet meeting current ENERGY STAR Version 2.0 Standards	One Standard Hot Food Holding Cabinet
Energy Star Ice Maker	Refrigeration	One Continuous Self-Contained Ice Maker meeting ENERGY STAR Version 3.0 Standards	One Continuous Self-Contained Ice Maker meeting Federal Standard
ENERGY STAR Imaging Equipment	Office Equipment	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star LED Directional Lamp	Interior Lighting	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star Monitors	Office Equipment	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star PCs	Office Equipment	One Personal Computer (desktop or laptop) meeting current ENERGY STARÂ® Standards	One non-ENERGY STARÂ® Personal Computer
Energy Star room AC	Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC, 1 Ton, 10.9 CEER
Energy Star Servers	Office Equipment	One Server meeting ENERGY STAR 2.0 Standards	One Standard Server
Energy Star Steamer	Cooking	One 4-Pan Electric Steamer meeting ENERGY STARÂ® 2.0 Standards	One Standard Economy-Grade 4-Pan Steamer
Energy Star Uninterruptable Power Supply	Office Equipment	Standard Desktop Plugged into Energy Star Uninterruptable Power Supply at 25% Load	Standard Desktop Plugged into Average Rotary Uninterruptable Power Supply at 25% Load
Energy Star Vending Machine	Refrigeration	One Refrigerated Vending Machine meeting ENERGY STAR Version 4.0 Standards	One Refrigerated Vending Machine meeting ENERGY STARÂ® 1.0 Standards
ENERGY STAR Water Cooler	Miscellaneous	One Storage Type Hot/Cold Water Cooler Unit meeting ENERGY STAR Version 3.0 Standards	One Standard Storage Type Hot/Cold Water Cooler Unit
Energy Star windows	Space Cooling, Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)

Measure	End-Use	Description	Baseline
Engine Block Timer	Miscellaneous	Plug-in timer that activates engine block timer to reduce unnecessary run time	Engine block heater (typically used for backup generators) running continuously
Escalator Motor Efficiency Controller	Miscellaneous	Install Escalator Motor Efficiency Controller	Escalator without Motor Efficiency Controller
Facility Commissioning	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility commissioning to optimize building operations in new facilities	Standard new construction facility with no commissioning
Facility Energy Management System	Space Cooling, Space Heating, Ventilation and Circulation	Typical HVAC by Building Type Controlled by Energy Management System	Standard/manual facility equipment controls
Faucet Aerator	Domestic Hot Water	Low-flow lavatory faucet aerator, flow rate: 1.0 gpm	Federal lavatory flow rate standard, 1994, flow rate: 2.2 gpm
Floating Head Pressure Controls	Refrigeration	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Floor Insulation	Space Cooling, Space Heating	Increased Floor Insulation (R-19)	Market Average Existing Floor Insulation
Geothermal Heat Pump	Space Cooling, Space Heating	Geothermal Heat Pump	Code-Compliant Air Source Heat Pump
Green roof	Space Cooling, Space Heating	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
HE Air Cooled Chiller - All Compressor Types - 100 Tons	Space Cooling	HE Air Cooled Chiller - Air Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE DX 11.25-20.0 Tons Elec Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER

Measure	End-Use	Description	Baseline
HE DX Less than 5.4 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
Heat Pump Pool Heater Commercial	Miscellaneous	High Efficiency Pool Heater Eff. >=84%	Standard Efficiency Pool Heater 78% Eff.
Heat Pump Water Heater	Domestic Hot Water	Efficient 50 Gallon Electric Heat Pump Water Heater	Code-Compliant 50 Gallon Electric Heat Pump Water Heater
High Efficiency Air Compressor	Miscellaneous	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Data Center Cooling	Space Cooling	High Efficiency CRAC (computer room air conditioner)	Standard Efficiency CRAC
High Efficiency PTAC	Space Cooling	High Efficiency PTAC	Code-Compliant PTAC
High Efficiency PTHP	Space Cooling, Space Heating	High Efficiency PTHP	Code-Compliant PTHP
High Efficiency Refrigeration Compressor_Discus	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor_Scroll	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Speed Fans	Ventilation and Circulation	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
Hot water pipe insulation	Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-4	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
Hotel Card Energy Control Systems	Space Cooling, Space Heating	Guest Room HVAC Unit Controlled by Hotel-Key-Card	Guest Room HVAC Unit, Manually Controlled by Guest

Measure	End-Use	Description	Baseline
		Activated Energy Control System	
Indoor daylight sensor	Interior Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Cooktops	Cooking	Efficient Induction Cooktop	One Standard Electric Cooktop
Infiltration Reduction - Air Sealing	Space Cooling, Space Heating	Reduced leakage through caulking, weather-stripping	Standard Heating and Cooling System with Moderate Infiltration
Instantaneous Hot Water System Commercial	Domestic Hot Water	Instantaneous Hot Water System	Code-Compliant Electric Storage Water Heater
LED - 14W_CFL Baseline	Interior Lighting	LED (assume 14W) replacing CFL	100W equivalent CFL
LED - 9W Flood_CFL Baseline	Exterior Lighting	LED (assume 9W) replacing CFL	14W CFL
LED Canopy Lighting (Exterior)	Exterior Lighting	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Exit Sign	Interior Lighting	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting	2x4 LED Troffer	Lumen-Equivalent 32-Watt T8 Lamp
LED Linear - Lamp Replacement	Interior Lighting	Linear LED (16W)	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	Space Cooling, Space Heating	LEED New Construction Whole Building	Comparable facility, code-compliance construction
Light Tube	Interior Lighting	One 14" Light Tube, Delivering light to 250 S.F. of Commercial Space	250 S.F. of Commercial Space Lit by Typical Lighting Strategies

Measure	End-Use	Description	Baseline
Low Flow Shower Head	Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.50 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
Low-Flow Pre-Rinse Sprayers	Domestic Hot Water	Low-Flow Pre-Rinse Sprayer with Flow Rate of 1.6 gpm	Pre-Rinse Sprayer with Federal Standard Flow Rate of 2.25 gpm
Network PC Power Management	Office Equipment	One computer and monitor attached to centralized energy management system that controls when desktop computers and monitors plugged into a n	One computer and monitor, manually controlled
Networked Lighting Controls	Interior Lighting	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Night Covers for Display Cases	Refrigeration	One Open Vertical Case with Night Covers	One Existing Open Vertical Case, No Night Covers
Occupancy Sensors, Ceiling Mounted	Interior Lighting	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy Sensors, Switch Mounted	Interior Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ozone Laundry Commercial	Miscellaneous	Add a new ozone laundry system onto a commercial clothes washer	One commercial clothes washer without ozone laundry system
Programmable thermostat	Space Cooling, Space Heating	Pre-set programmable thermostat that replaces manual thermostat	Standard Heating and Cooling System with Manual Thermostat
PSC to ECM Evaporator Fan Motor (Reach-In)	Refrigeration	Medium Temperature Reach-In Case with equivalent size Electronically Commutated Evaporator Fan Motor	Medium Temperature Reach-In Case with Permanent Split Capacitor Evaporator Fan Motor
PSC to ECM Evaporator Fan Motor (Walk-In, Refrigerator)	Refrigeration	Medium Temperature Walk-In Case with Electronically Commutated Evaporator Fan Motor	Medium Temperature Walk-In Case with Permanent Split Capacitor Evaporator Fan Motor
Q-Sync Evaporator Fan Motor	Refrigeration	Medium Temperature Reach-In Case with equivalent size Q-Sync Evaporator Fan Motor	Medium Temperature Reach-In Case with 20W Permanent Split Capacitor Fan Motor

Measure	End-Use	Description	Baseline
Reflective Roof Treatment	Space Cooling	Reflective Roof Treatment	Standard Black Roof
Refrigerated Display Case LED Lighting	Refrigeration	60" Refrigerated Case LED Strip	Lumen-Equivalent 32-Watt T8 Fixture
Refrigerated Display Case Lighting Controls	Refrigeration	Occupancy Sensors for Refrigerated Case Lighting to reduce run time	Market-Share Weighted Existing Linear Fluorescent Fixture
Refrigeration Commissioning	Refrigeration	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Refrigeration Economizer	Refrigeration	Walk-in refrigerator with economizer	Walk-in refrigerator without economizer
Regenerative Drive Elevator Motor	Miscellaneous	Regenerative drive produced energy when motor in overhaul condition	Standard motor
Retro-Commissioning (Existing Construction)	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	
Roof Insulation	Space Cooling, Space Heating	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Server Virtualization	Office Equipment	2 Virtual Host Server	20 Single Application Servers
Smart Strip Plug Outlet	Office Equipment	One Smart Strip Plug Outlet	One Standard plug strip/outlet
Smart thermostat	Space Cooling, Space Heating	Thermostats that include "smart" features such as occupancy sensors, geo-fencing, multi-zone sensors	Standard Heating and Cooling System with Manual Thermostat
Solar Pool Heater Commercial	Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pump	Miscellaneous	Solar Powered Pool Pump Motor	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System Commercial	Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Strip Curtains - Freezers	Refrigeration	Walk-in freezer with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in freezer without strip curtains
Strip Curtains - Refrigerators	Refrigeration	Walk-in cooler with strip curtains at least 0.06 inches	Walk-in cooler without strip curtains

Measure	End-Use	Description	Baseline
		thick covering the entire area of the doorway	
Suction Pipe Insulation - Freezers	Refrigeration	Suction Pipe Insulation - Freezers	Uninsulated freezer suction lines
Suction Pipe Insulation - Refrigerators	Refrigeration	Suction Pipe Insulation - Refrigerators	Uninsulated refrigeration suction lines
Thermal Energy Storage	Space Cooling	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Thermostatic Shower Restriction Valve Commercial	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Pressure Balance Shower Valves	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater and Standard Shower Valves
Time Clock Control	Interior Lighting	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Variable Refrigerant Flow (VRF) HVAC Systems	Space Cooling, Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant PTHP
VAV System	Ventilation and Circulation	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Cooling Tower Fans	Space Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Pump	Space Cooling, Space Heating	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VSD Controlled Compressor	Refrigeration	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Wall Insulation	Space Cooling, Space Heating	Increased Exterior Above-Grade Wall Insulation	Market Average Existing Exterior Above-Grade Wall Insulation
Warehouse Loading Dock Seals	Space Cooling, Space Heating	Seals to reduce infiltration losses at loading dock	Loading dock with no seals
Water Cooled Refrigeration Heat Recovery	Domestic Hot Water	The heat reclaim system transfers waste heat from refrigeration system to space heating or hot water	No heat recovery
Water Heater Setback	Domestic Hot Water	A 50 gallon electric hot water tank with a thermostat setting reduced to no lower than 120 degrees.	A 50 gallon electric hot water tank with a thermostat setting that is higher than 120 degrees, typically hot water tanks with settings of 130 degrees or higher.
Water source heat pump	Space Cooling, Space Heating	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP

Measure	End-Use	Description	Baseline
Waterside Economizer	Space Cooling	Waterside Economizer	No economizer
Window shade film	Space Cooling	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC
Zero Energy Doors	Refrigeration	Install zero energy doors for a reach-in refrigerated cooler or freezer	Standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors

Table 14: Industrial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
3-phase High Frequency Battery Charger - 1 shift	Other	3-phase High Frequency Battery Charger	Standard Charger
Advanced Rooftop Controller	HVAC	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Compressed Air	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air curtains	HVAC	Air Curtain across door opening	Door opening with no air curtain
Airside economizer	HVAC	Airside Economizer	No economizer
Auto Closer on Refrigerator Door	Process Cooling	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Auto Off Time Switch	Interior Lighting High Bay	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled

Measure	End-Use	Description	Baseline
Bi-Level Lighting Control (Exterior)	Exterior Lighting Industrial	Install Exterior Bi-Level Lighting Control, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Bi-Level Lighting Control (Interior)	Interior Lighting High Bay	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Chilled Water Reset	HVAC	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Cogged Belt on 15hp ODP Motor	Motors Pumps	15HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	15HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Cogged Belt on 40hp ODP Motor	Motors Pumps	40HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	40HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Compressed Air Desiccant Dryer	Process Specific	heated regenerative desiccant dryer without dew point demand controls	heatless regenerative desiccant dryer without dew point demand controls
Compressed Air No-Loss Condensate Drains	Process Specific	Install no-loss condensate drains	Install standard condensate drains
Compressed Air Storage Tank	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Receiver Tank	20 HP Inlet Modulation Fixed-Speed Compressor, No Receiver Tank
Custom Measure - Non-Lighting	HVAC	Custom Improvement to Facility's Operations	Baseline Technology/Process
Dairy Refrigeration Heat Recovery	Other	refrigeration equipment with refrigeration heat recovery tank installed	existing dairy farm with refrigeration equipment and a water heater unit without an RHR unit
Dedicated Outside Air System (DOAS)	HVAC	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Ventilation	HVAC	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Process Cooling	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Dew Point Sensor Control for Dessicant CA Dryer	Compressed Air	1000 CFM Heated Desicant Air Dryer with Dew Point Controls	1000 CFM Modulating Heated Desicant Air Dryer
Drip Irrigation Nozzles	Other	Flow Control Nozzles	Standard Irrigation Nozzles

Measure	End-Use	Description	Baseline
Dual Enthalpy Economizer	Process Cooling	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
DX Coil Cleaning	HVAC	DX Coil Cleaning	DX Coil Not Cleaned
Efficient Compressed Air Nozzles	Compressed Air	1/4" Engineered Air Nozzle	1/4" Open-End Air Nozzle
Efficient New Construction Lighting	Interior Lighting High Bay	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Electric Actuators	Other	Electric Actuator	Pneumatic Actuator
Energy Efficient Laboratory Fume Hood	HVAC	Variable Air Volume High Performance Fume Hood	Constant Volume Conventional Bypass Fume Hood
Energy Efficient Transformers	Other	Energy Efficient Dry Type Transformer (CSL-3)	Standard Transformer (TP-1)
Energy Recovery Ventilation System	HVAC	Unitary Cooling Equipment that Incorporates Energy Recovery	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11.2 EER
Energy Star LED Directional Lamp	Interior Lighting Other	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star room ac	HVAC	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star windows	HVAC	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Other	An engine block heater operated by an outdoor plug-in timer	An engine block heater that is manually plugged in
Facility Commissioning	HVAC	Perform facility commissioning	Comparable facility, no commissioning
Facility Energy Management System	HVAC	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Fan Thermostat Controller	HVAC	Typical HVAC by Building Type with Fan Thermostat Controller Installed	Typical HVAC by Building Type with Programmable Thermostat
Floating Head Pressure Controller	Process Cooling	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Grain Bin Aeration Control System	Process Specific	Grain Storage Fan System with Automatic Controls	Grain Storage Fan System with Manual Controls

Measure	End-Use	Description	Baseline
HE Air Cooled Chiller - All Compressor Types - 100 Tons	HVAC	HE Air Cooled Chiller - All Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE Air Cooled Chiller - All Compressor Types - 300 Tons	HVAC	Air Cooled Positive Displacement Chiller with Integral VFD, 300 Tons, 13.7 EER	Code-Compliant Air Cooled Positive Displacement Chiller, 300 Tons, 12.5 EER
HE DX 11.25-20.0 Tons Elec Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
High Bay Occupancy	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 800 Watts Controlled	800 Watts of Lighting, Manually Controlled

Measure	End-Use	Description	Baseline
Sensors, Ceiling Mounted			
High Efficiency Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Refrigeration Compressor - Discus	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor - Scroll	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Welder	Process Specific	High Efficiency Welder	Standard Welding Practices
High Speed Fans	HVAC	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
High Volume Low Speed Fan (HVLS)	Motors Fans Blowers	20' High Volume Low Speed Fan	Conventional Circulating Fan
Indoor Agriculture - LED Grow Lights	Interior Lighting High Bay	LED grow light	1000W High Pressure Sodium
Indoor daylight sensor	Interior Lighting High Bay	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Industrial Duct Sealing	HVAC	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Injection Mold and Extruder Barrel Wraps	Other	2' Diameter, 20' Long Machine Barrel with 1" Insulation	2' Diameter, 20' Long Machine Barrel with no Insulation
Insulated Pellet Dryer Tanks and Ducts	Process Heating	Insulation for Pellet Tank and Duct	Uninsulated Pellet Tank and Duct
LED - 14W_CFL Baseline	Interior Lighting Other	LED (assume 14W) replacing CFL	100W equivalent CFL
LED Canopy Lighting (Exterior)	Exterior Lighting Industrial	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting Industrial	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting Other	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED exit sign	Interior Lighting Other	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting Industrial	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting

Measure	End-Use	Description	Baseline
LED High Bay_HID Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting Linear Fluorescent	2x4 LED Troffer Fixture	Lumen-Equivalent 32-Watt T8 Fixture
LED Linear - Lamp Replacement	Interior Lighting Linear Fluorescent	Linear LED	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting Industrial	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	HVAC	LEED Qualifying New Construction	Comparable facility, code-compliance construction
Light Tube	Interior Lighting Other	One 14" Light Tube, Delivering light to 250 S.F. of Industrial Space	250 S.F. of Industrial Space Lit by Typical Lighting Strategies
Low Energy Livestock Waterer	Motors Pumps	Install Thermostatically Controlled Livestock Watering System	Standard Livestock Watering System
Low Pressure Sprinkler Nozzles	Motors Pumps	Low Pressure Irrigation Nozzles operate at 35 psi or lower	Standard high pressure irrigation nozzles that operate at 50 psi or greater
Low Pressure-drop Filters	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Low Pressure Drop Filter	20 HP Inlet Modulation Fixed-Speed Compressor, No Particulate Removal
Milk Pre-Cooler	Other	Installed pre-cooler heat exchanger	no pre-cooler heat exchanger installed
Networked Lighting Controls	Interior Lighting Linear Fluorescent	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy sensors, switch mounted	Interior Lighting Linear Fluorescent	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting Industrial	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting Industrial	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Packaged Terminal AC	HVAC	High Efficiency Packaged Terminal AC	Code-Compliant PTAC, 10.9 EER

Measure	End-Use	Description	Baseline
Process Cooling Ventilation Reduction	Process Cooling	Standard Process Cooling with Reduced Ventilation	Standard Process Cooling
Programmable thermostat	HVAC	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Reflective Roof Treatment	HVAC	Reflective Roof Treatment	Standard Black Roof
Refrigeration Commissioning	Process Cooling	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Retro-Commissioning (Existing Construction)	HVAC	Perform Facility Retro-commissioning	
Roof insulation	HVAC	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Smart thermostat	HVAC	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Strategic Energy Management	HVAC	SEM goal setting and tracking	No active energy management
Synchronous Belt on 15hp ODP Motor	Motors Pumps	15 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	15 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 5hp ODP Motor	Motors Pumps	5 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	5 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 75hp ODP Motor	Motors Pumps	75 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	75 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Thermal energy storage	HVAC	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Time Clock Control	Interior Lighting High Bay	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
VAV System	HVAC	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
VFD on Cooling Tower Fans	Process Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control

Measure	End-Use	Description	Baseline
VFD on HVAC Fan	Motors Fans Blowers	5 HP HVAC Fan Motor, with VFD Control	5 HP HVAC Fan Motor, no VFD Control
VFD on HVAC Pump	Motors Pumps	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VFD on process pump	Motors Pumps	20 HP Process Pump Equipped with VFD Control	20 HP Process Pump, Constant Speed
VSD Controlled Compressor	Process Cooling	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Water source heat pump	HVAC	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside economizer	HVAC	Waterside Economizer	No economizer
Window shade film	HVAC	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

The following EE measures from the 2019 Technical Potential Study were eliminated from the current study[8]:

Table 15: 2019 EE Measures Eliminated from Current Study

Sector	Measure	End-Use	Reason for Removal
Residential	CFL – 15W Flood	Lighting	Better technology (LED) available
Residential	CFL – 15W Flood (Exterior)	Lighting	Better technology (LED) available
Residential	CFL – 13W	Lighting	Better technology (LED) available
Residential	CFL – 23W	Lighting	Better technology (LED) available
Residential	Low Wattage T8 Fixture	Lighting	Better technology (LED) available
Residential	15 SEER Central AC	Space Cooling	Updated Federal Standard
Residential	15 SEER Air Source Heat Pump	Space Cooling, Space Heating	Updated Federal Standard
Residential	14 SEER ASHP from base electric resistance heating	Space Cooling, Space Heating	Updated Federal Standard

[8] Additional measures from the 2019 study were updated to reflect current vintage/technology for the current study.

Sector	Measure	End-Use	Reason for Removal
Residential	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Storm Door	Space Cooling, Space Heating	Minimal/uncertain energy savings
Commercial	CFL – 15W Flood	Exterior Lighting	Better technology (LED) available
Commercial	High Efficiency HID Lighting	Exterior Lighting	Better technology (LED) available
Commercial	LED Street Lights	Exterior Lighting	Market standard
Commercial	LED Traffic and Crosswalk Lighting	Exterior Lighting	Market standard
Commercial	CFL-23W	Interior Lighting	Better technology (LED) available
Commercial	High Bay Fluorescent (T5)	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Fixture Replacement	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Lamp Replacement	Interior Lighting	Better technology (LED) available
Commercial	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Tank Wrap on Water Heater	Domestic Hot Water	Limited applicability
Commercial	Ceiling Insulation (R12 to R38)	Space Cooling, Space Heating	Consolidated measure baseline assumptions
Commercial	Ceiling Insulation (R30 to R38)	Miscellaneous	Consolidated measure baseline assumptions

Appendix B DR Measure List

Table 16: Residential DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Water heater control	Direct load control	Summer and Winter	Load control installed on a water heater (integrated or external switch)
Pool pump switches	Direct load control	Summer and Winter	Load control program with switch installed on pool pump
Room AC	Direct load control	Summer	Load control program that is focused on room AC units rather than central AC
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 17: Small C&I DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 18: Large C&I DR Measures

Measure	Type	Season	Description
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of

Measure	Type	Season	Description
			CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Auto DR	Utility-controlled loads	Summer and Winter	Custom load control of specific end-uses/processes that is triggered by utility signal to building management system; customer can sometimes opt-out of specific events
Firm Service Level	Contractual	Summer and Winter	Customer commits to a maximum usage level during peak periods and, when notified by the utility, agrees to cut usage to that level.
Guaranteed Load Drop	Contractual	Summer and Winter	Customer agrees to reduce usage by an agreed upon amount when notified

No DR measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix C DSRE Measure List

Table 19: Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation

Table 20: Non-Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation
CHP – Fuel Cell	An electrochemical cell-based generator that reacts hydrogen fuel with oxygen
CHP – Micro Turbine	Small combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Gas Turbine	A combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Reciprocating Engine	An engine that uses one or more pistons to convert pressure into rotational motion
CHP - Steam Turbine	A turbine that extracts thermal energy from pressured steam to drive a generator

No DSRE measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix D External Measure Suggestions

Table 21: External Measure Suggestions and Actions

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Efficient Electrification Measures	All measures that can produce substantial site energy savings by converting from natural gas or other fossil fuels should be included in the Florida electric utilities' next efficiency potential study. Key examples include efficient heat pumps to displace gas furnaces and efficient heat pump water heaters to displace gas water heaters. It is important to note that these electrification measures provide not only heating energy savings and water heating energy savings, but can also potentially provide cooling efficiency benefits as well. In the case of heat pumps, that can occur because efficient heat pumps can operate in cooling mode more efficiently than standard central air conditioners. In the case of heat pump water heaters, cooling and dehumidification benefits can occur when/if the water heater is in conditioned space because they transfer heat (particularly latent heat) from the air around them to the water they are heating. A growing number of jurisdictions – including Illinois, Minnesota and some northeastern states – have begun to include efficient electrification measures in their efficiency programs portfolios.	Fuel-switching and electrification are outside the scope of this study
Networked Lighting Controls	LED lighting technology has become increasingly accepted and installed in commercial buildings. The next big efficiency opportunity in commercial lighting efficiency is in sophisticated controls integrated into the light fixtures themselves – both luminaire level lighting controls and networked lighting controls. For example, a 2017 report for both the Northwest Energy Efficiency Alliance and the Design Lights Consortium, a non-profit that works with utilities and manufacturers of lighting products (and which many utilities across the country reference for determination of eligibility of lighting products for efficiency program rebates), found that networked lighting controls can provide on the order of 50% additional savings after LED conversion. Other studies have also found the national savings potential from such products to be enormous. Moreover, these products can be designed to provide not only lighting energy savings but also a number of other non-energy benefits (e.g., asset tracking, such as the ability of hospitals to know the location of all wheel chairs). Numerous utilities across the country now actively promote this technology through their efficiency programs. For example, Commonwealth Edison, the utility serving Chicago and other parts of northern Illinois, is currently getting a significant portion of its commercial lighting savings from promotion of networked lighting controls	Added to measure list for 2024 study

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Ductless mini-split heat pumps to displace inefficient electric baseboard heating	While most Florida residential buildings with electric heat provide that heat with heat pumps, at least some (perhaps most likely being older multi-family rental buildings) still use inefficient electric resistance heat. Ductless mini- split heat pump retrofits can very efficiently displace such inefficient electric heat and should be added to the residential measure list.	Added to measure list for 2024 study
Air Source Heat Pump baseline assumptions	There are seven air source heat pump (ASHP) measures included in the residential measure list. Two of them – one at SEER 14 and a second at SEER 21 – are listed as relative to an electric resistance baseline. Five of them – SEER 15, SEER 16, SEER 17, SEER 18 and SEER 21 – appear to be relative to a baseline of a standard new ASHP. Are we interpreting this correctly? If so, we have a couple of comments/questions/suggestions: • The efficiency standards assessed need to be modified to be consistent with new federal standards, including new testing procedures. • For cases where the baseline is "electric resistance", why only assessing two efficiency tiers (i.e., fewer than for standard ASHP baselines)? The same number of efficiency tiers should be assessed for both baselines.	Incorporated suggestions into 2024 study, including updated baseline standard and assessing same efficiency tiers for both baselines
Heat Pump Water Heater Efficiency	The Res EE tab of the utilities draft measure list suggests that the efficiency of a heat pump water heater is an EF of 2.50. That is unrealistically low. In fact, of the 222 products listed on the Energy Star website, none had UEFs less than 2.80 and only 29 (13%) had UEFs that were less than 3.4; the average was 3.57. Indeed, the first product listed on a search of heat pump water heaters on Home Depot's website is a 50 gallon, Rheem (Pro Terra) product with a UEF of 3.75 and a cost of $1699.	Incorporated suggestion into 2024 study
New Construction Measure Packages	The measures lists did not appear to include packages of measures for building new residential and/or new commercial buildings to levels of efficiency beyond those required by code. Utilities in many jurisdictions run new construction efficiency programs supporting such measure packages. In the residential sector, many base their programs on the long-standing Federal Energy Star standard. However, increasingly utility programs are promoting additional efficiency tiers – often as part of all-electric new construction program offerings – that go well beyond the Energy Star standard. For example, Consumers Energy (Michigan) offers $1000 rebates to builders who construct Energy Star single family homes	Incorporated suggestion into 2024 study with 2 tiers of residential new construction whole-home improvement measures.

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
	with a Home Energy Rating (HERS) score of 57 or less, but offer higher rebates for more efficient buildings – up to $4000 for all electric homes with a HERS score of 40 or less. The Florida utilities potential study should assess savings potential for both the Energy Star level and a tier or two of additional efficiency beyond that level. Similar assessments of new commercial building savings potential should also be assessed.	
Custom Industrial Measures	The utilities' list of industrial efficiency measures addresses common industrial efficiency opportunities. However, it does not address efficiency opportunities that may be unique to individual industries or even to individual industrial facilities. That can include such things as changes in types of materials used in manufacturing, reductions in waste streams, improved use of water delivered by agricultural irrigation systems, and/or other things that are not directly related to energy using equipment or controls of such equipment. It is obviously not possible to list all such measures. However, a potential study will understate savings potential if it does not include a way of capturing such potential in its estimates. One potential way to get a sense of such potential is to review results of comprehensive industrial efficiency programs run by other utilities to identify the portion of actual program savings from such unique custom measures – and then assume that portion of custom savings could be added to the savings estimated in the study for named measures.	Added to measure list for 2024 study
Electric Vehicle measures	Some EV chargers are more efficient than others. The Federal Energy Star program has a standard for them. Savings potential may not be huge, but should be considered in the study. With a growing number of EV sales, the study should also consider the potential savings from promoting the most efficient EVs within different size/style categories	Added to measure list for 2024 study
Removing screw-based LEDs	The screw-based LEDs on both the Residential and Commercial measure lists should now be considered baseline due to federal efficiency standards adopted earlier this year. Utility load forecasts for IRPs should reflect resulting improvements in end use efficiency.	Screw-based LEDs were included in the study but with limited applicability to reflect current market
Removing Commercial fluorescent lighting	LED technology – for both fixtures and lamps – has advanced significantly in recent years, to the point where it should be the only technology considered for commercial lighting. Measures such as high performance T-8 fluorescent fixtures and high bay T-5 fluorescent fixtures should be replaced with LED alternatives in the study.	Updated measure list for 2024 study to only include LED-based lamps for linear fluorescent replacements

Docket Nos. 20240012-EG to 20240017-EG
TPS For Florida Power & Light
Exhibit JH-2, Page 83 of 85

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Removing fossil-gas fueled CHP	Fossil-fuel fired CHP systems should not be considered "renewable" and have questionable benefits if electric generation is expected to get increasingly more renewable and clean. Biogas-fueled CHP – such as systems installed in wastewater treatment facilities that use methane byproducts of processing waste – should be included in the study.	2024 study will continue to assess all CHP options
Adding livestock methane power generation to renewables list	For example, see the "cow power" program currently being run by Green Mountain Power, Vermont's largest electric utility	2024 study will continue to assess DSRE options consistent with prior study, including customer-sited solar, solar plus storage, and CHP
Adding EV managed charging to DR list	With national market shares for EVs growing, it is important that utilities consider programs for managing when charging occurs. Numerous utilities are currently running managed charging programs. This does not currently appear to be on the measure list and should be added to the Florida utilities' potential study.	Added to measure list for 2024 study
Residential "smart thermostat" measure can provide both efficiency savings and demand response potential	This is recognized in the inclusion of smart thermostats in both the Res EE and DR tabs of the measure list spreadsheet. We simply want to flag that it is important when assessing cost-effectiveness of this measure that these two potential benefits are considered together. In other words, the cost should be considered compared to the combined efficiency and DR potential rather than separately considered relative to just EE savings and then separately again compared to just DR potential	2024 study will include interactive impacts of EE and DR opportunities
Emerging Technologies	The efficiency potential study measure list appears to be somewhat outdated. It does not include a number of new and emerging technologies. The potential list of such technologies is long. We suggest reviewing the attached list of emerging technologies developed almost two years ago by Consumers Energy (Michigan) and including them in the study.	Consumers Energy study was reviewed and commercially available measures were added to measure list for 2024 study, including heat pump water heaters - CEE advanced tier, heat pump clothes dryers, ozone laundry systems, and 21+ SEER HVAC units

Technical Potential Study of Demand Side Management

Duke Energy Florida

Date: 03.07.2024

Table of Contents

Executive Summary

In October 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems.

The main objective of the study was to assess the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of Duke Energy Florida's (DEF) service territory.

1.1 Methodology

Resource Innovations estimates DSM savings potential by applying an analytical framework that aligns baseline market conditions for energy consumption and demand with DSM opportunities. After describing the baseline condition, Resource Innovations applies estimated measure savings to disaggregated consumption and demand data. The approach varies slightly according to the type of DSM resources and available data; the specific approaches used for each type of DSM are described below.

1.1.1 EE Potential

This study utilized Resource Innovations' proprietary EE modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual program savings. The methodology for the EE potential assessment was based on a hybrid "top-down/bottom-up" approach, which started with the current utility load forecast, then disaggregated it into its constituent customer-class and end-use components. Our assessment examined the effect of the range of EE measures and practices on each end-use, taking into account current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the end-use, customer class, and system levels for DEF.

1.1.2 DR Potential

The assessment of DR potential in DEF's service territory was an analysis of mass market direct load control programs for residential and small commercial and industrial (C&I) customers, and an analysis of DR programs for large C&I customers. The direct load control program assessment focused on the potential for demand reduction through heating, ventilation, and air conditioning (HVAC), water heater, managed electric vehicle charging, and pool pump load control. These end-uses were of particular interest because of their large contribution to peak period system load. For this analysis, a range of direct load control measures were examined for each customer segment to highlight the range of potential. The assessment further accounted for existing DR programs for DEF when calculating the total DR potential.

1.1.3 DSRE Potential

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from customers' PV systems, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

1.2 Savings Potential

Technical potential for EE, DR, and DSRE are as follows:

1.2.1 EE Potential

EE technical potential describes the savings potential when all technically feasible EE measures are fully implemented, ignoring all non-technical constraints on electricity savings, such as cost-effectiveness and customer willingness to adopt EE.

The estimated EE technical potential results are summarized in Table 1.

Table 1. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	2,217	2,423	7,599
Non-Residential[1]	669	450	3,591
Total	2,886	2,873	11,190

1.2.2 DR Potential

DR technical potential describes the magnitude of loads that can be managed during conditions when grid operators need peak capacity. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale such as heating, cooling, water heaters, managed electric vehicle charging, and pool pumps. For large C&I customers, this included their entire electric demand during a utility's system peak, as many of these types of customers will forego virtually all electric demand temporarily if the financial incentive is large enough.

The estimated DR technical potential results are summarized in Table 2.

Table 2. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	3,147	3,218
Non-Residential	2,631	2,391
Total	5,778	5,609

[1] Non-Residential results include all commercial and industrial customer segments.

1.2.3 DSRE Potential

DSRE technical potential estimates quantify all technically feasible distributed generation opportunities from PV systems, battery storage systems charged from PV, and CHP technologies based on the customer characteristics of DEF's customer base.

The estimated DSRE technical potential results are summarized in Table 3.

Table 3. DSRE Technical Potential[2]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	1,761	152	17,637
Non-Residential	444	15	4,164
Total	2,205	167	21,801
Battery Storage charged from PV Systems			
Residential	2,016	2,176	0
Non-Residential	240	315	0
Total	2,256	2,491	0
CHP Systems			
Total	773	811	3,553

[2] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

2 Introduction

In October, 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems. The main objective of the study was:

- Assessing the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of DEF's service territory.

The following deliverables were developed by Resource Innovations as part of the project and are addressed in this report:

- DSM measure list and detailed assumption workbooks
- Disaggregated baseline demand and energy use by year, sector, and end-use
- Baseline technology saturations, energy consumption, and demand
- Technical potential demand and energy savings
- Supporting calculation spreadsheets

2.1 Technical Potential Study Approach

Resource Innovations estimates technical potential according to the industry standard categorization, as follows:

> *Technical Potential is the theoretical maximum amount of energy and capacity that could be displaced by DSM, regardless of cost and other barriers that may prevent the installation or adoption of a DSM measure.*

For this study, technical potential included full application of commercially available DSM technologies to all residential, commercial, and industrial customers in the utility's service territory.

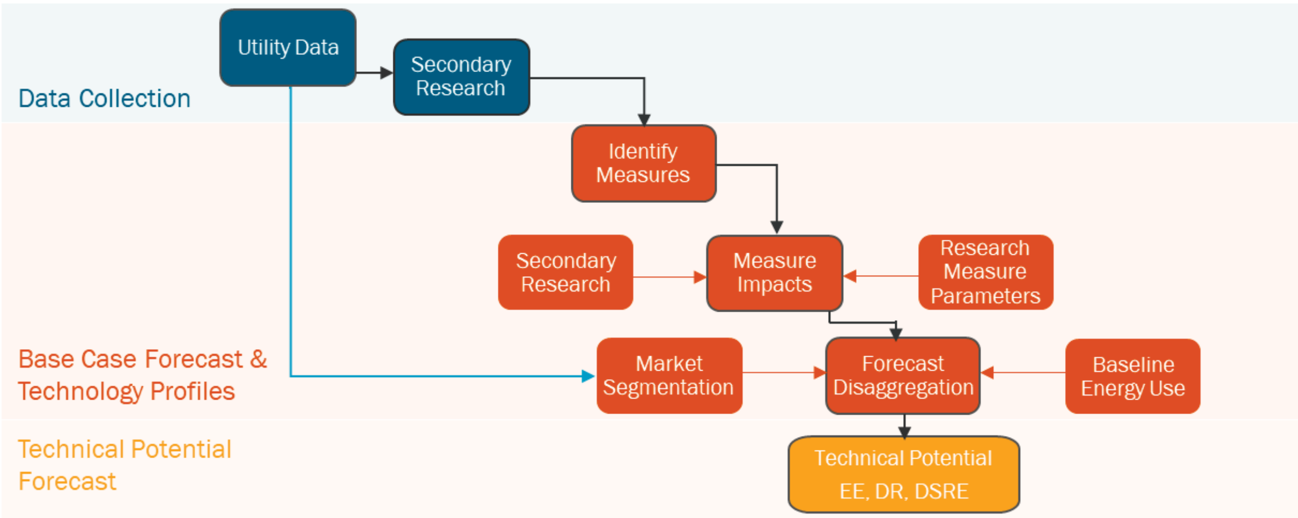
Quantifying DSM technical potential is the result of an analytical process that refines DSM opportunities that align with DEF's customers' electric consumption patterns. Resource Innovations' general methodology for estimating technical potential is a hybrid "top-

down/bottom-up" approach, which is described in detail in Sections 3 through 5 of this report and includes the following steps:

- Develop a baseline forecast: the study began with a disaggregation of the utility's official electric energy forecast to create a baseline electric energy forecast. This forecast does not include any utility-specific assumptions around DSM performance. Resource Innovations applied customer segmentation and consumption data from each utility and data from secondary sources to describe baseline customer-class and end-use components. Additional details on the forecast disaggregation are included in Section 3.
- Identify DSM opportunities: A comprehensive set of DSM opportunities applicable to DEF's climate and customers were analyzed to best depict DSM technical potential. Effects for a range of DSM technologies for each end-use could then be examined while accounting for current market saturations, technical feasibility, and impacts.
- Collect cost and impact data for measures: For those measures applicable to DEF's customers, Resource Innovations conducted primary and secondary research and estimated costs, energy savings, measure life, and demand savings. We differentiated between the type of cost (capital, installation labor, maintenance, etc.) to separately evaluate different implementation modes: retrofit (capital plus installation labor plus incremental maintenance); new construction (incremental capital and incremental maintenance); and burnout costs (incremental capital and incremental maintenance costs for replacement of appliances and equipment that has reached the end of its useful life). Additional details on measure development are included in Section 4.

Figure 1 provides an illustration of the technical potential modeling process conducted for DEF, with the assessment starting with the current utility load forecast, disaggregated into its constituent customer-class and end-use components, and calibrated to ensure consistency with the overall forecast. Resource Innovations considered the range of DSM measures and practices application to each end-use, accounting for current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the technology, end-use, customer class, and system levels.

Figure 1. Approach to Technical Potential Modeling



Resource Innovations estimated DSM technical potential based on a combination of market research, utility load forecasts and customer data, and measure impact analysis, all in coordination with DEF. Resource Innovations examined the technical potential for EE, DR, and DSRE opportunities; this report is organized to offer detail on each DSM category, with additional details on technical potential methodology presented in Section 5.

2.2 EE Potential Overview

To estimate EE potential, this study utilized Resource Innovations' modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual utility program savings, as described in Section 5.1.1 below. While the analysis estimates the impacts of individual EE measures, the model accounts for interactions and overlap of individual measure impacts within an end-use or equipment type. The model provides transparency into the assumptions and calculations for estimating EE potential.

2.3 DR Potential Overview

To estimate DR market potential, Resource Innovations considered customer demand during utility peaking conditions and projected customer response to DR measures. Customer demand was determined by looking at account-level interval data for a sample of customers within each segment. For each segment, Resource Innovations determined the portion of a customer's load that could be curtailed during the system peak.

2.4 DSRE Potential Overview

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from PV, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

3 Baseline Forecast Development

3.1 Market Characterization

The DEF base year energy use and sales forecast provided the reference point to determine potential savings. The end-use market characterization of the base year energy use and reference case forecast included customer segmentation and load forecast disaggregation. The characterization is described in this section, while the subsequent section addresses the measures and market potential energy and demand savings scenarios.

3.1.1 Customer Segmentation

In order to estimate EE, DR, and DSRE potential, the sales forecast and peak load forecasts were segmented by customer characteristics. As electricity consumption patterns vary by customer type, Resource Innovations segmented customers into homogenous groups to identify which customer groups are eligible to adopt specific DSM technologies, have similar building characteristics and load profiles, or are able to provide DSM grid services.

Resource Innovations segmented customers according to the following:

1) By Sector – how much of DEF's energy sales, summer and winter peak demand forecast is attributable to the residential, commercial, and industrial sectors?
2) By Customer – how much electricity does each customer typically consume annually and during system peaking conditions?
3) By End-Use – within a home or business, what equipment is using electricity during the system peak? How much energy does this end-use consume over the course of a year?

Table 4 summarizes the segmentation within each sector. In addition to the segmentation described here for the EE and DSRE analyses, the residential customer segments were further segmented by heating type (electric heat, gas heat, or unknown) and by annual consumption bins within each sub-segment for the DR analysis.

Table 4. Customer Segmentation

Residential	Commercial		Industrial	
Single Family	Assembly	Miscellaneous	Agriculture and Assembly	Primary Resources Industries
Multi-Family	College and University	Offices	Chemicals and Plastics	Stone/Glass/ Clay/Concrete
Manufactured Homes	Grocery	Restaurant	Construction	Textiles and Leather
	Healthcare	Retail	Electrical and Electronic Equipment	Transportation Equipment
	Hospitals	Schools K-12	Lumber/Furniture/ Pulp/Paper	Water and Wastewater
	Institutional	Warehouse	Metal Products and Machinery	Other
	Lodging/ Hospitality		Miscellaneous Manufacturing	

From an equipment and energy use perspective, each segment has variation within each building type or sub-sector. For example, the energy consuming equipment in a convenience store will vary significantly from the equipment found in a supermarket. To account for this variation, the selected end-uses describe energy consumption patterns that are consistent with those typically studied in national or regional surveys, such as the U.S. Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS), Commercial Building Energy Consumption Survey (CBECS) and Manufacturing Energy Consumption Survey (MECS), among others. The end-uses selected for this study are listed in Table 5.

Table 5. End-Uses

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Space heating[3]	Space heating[3]	Process heating
Space cooling[3]	Space cooling[3]	Process cooling
Domestic hot water	Domestic hot water	Compressed air
Ventilation and circulation	Ventilation and circulation	Motors/pumps

[3] Includes the contribution of building envelope measures and efficiencies.

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Lighting	Interior lighting	Fan, blower motors
Cooking	Exterior lighting	Process-specific
Appliances	Cooking	Industrial lighting
Electronics	Refrigeration	Exterior lighting
Miscellaneous	Office equipment	HVAC[3]
	Miscellaneous	Other

For DR, the end-uses targeted were those with controllable load for residential customers (*i.e.*, HVAC, water heaters, pool pumps, and electric vehicles) and small C&I customers (HVAC and electric vehicles). For large C&I customers, all load during peak hours was included assuming these customers would potentially be willing to reduce electricity consumption for a limited time if offered a large enough incentive during temporary system peak demand conditions.

3.1.2 Forecast Disaggregation

A common understanding of the assumptions and granularity in the baseline load forecast was developed with input from DEF. Key discussion topics reviewed included:

- How current DSM offerings are reflected in the energy and demand forecast.
- Assumed weather conditions and hour(s) of the day when the system is projected to peak.
- Are there portions of the load forecast attributable to customers or equipment not eligible for DSM programs?
- How are projections of population increase, changes in appliance efficiency, and evolving distribution of end-use load shares accounted for in the peak demand forecast?

3.1.2.1 Electricity Consumption (kWh) Forecast

Resource Innovations segmented DEF's electricity consumption forecast into electricity consumption load shares by customer class and end-use. The baseline customer segmentation represents the electricity market by describing how electricity was consumed within the service territory. Resource Innovations developed the forecast for the year 2025, and based it on data provided by DEF, primarily their 2023 Ten-Year Site Plan, which was the most recent plan available at the time the studies were initiated. The data addressed current baseline consumption, system load, and sales forecasts.

3.1.2.2 Peak Demand (kW) Forecast

A fundamental component of DR potential was establishing a baseline forecast of what loads or operational requirements would be absent due to existing dispatchable DR or time varying rates. This baseline was necessary to assess how DR can assist in meeting specific planning and operational requirements. We utilized DEF's summer and winter peak demand forecast, which was developed for system planning purposes.

3.1.2.3 Estimating Consumption by End-Use Technology

As part of the forecast disaggregation, Resource Innovations developed a list of electricity end-uses by sector (Table 5). To develop this list, Resource Innovations began with DEF's estimates of average end-use consumption by customer and sector. Resource Innovations combined these data with other information, such as utility residential appliance saturation surveys, as available, to develop estimates of customers' baseline consumption. Resource Innovations calibrated the utility-provided data with data available from public sources, such as the EIA's recurring data-collection efforts that describe energy end-use consumption for the residential, commercial, and manufacturing sectors.

To develop estimates of end-use electricity consumption by customer segment and end-use, Resource Innovations applied estimates of end-use and equipment-type saturation to the average energy consumption for each sector. The following data sources and adjustments were used in developing the base year 2025 sales by end-use:

Residential Sector:

- The disaggregation was based on DEF's rate class load shares and intensities.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - DEF rate class load share is based on average per customer.
    - Resource Innovations made conversions to usage estimates generated by applying Duke Energy's 2022 Residential End-Use Appliance Study, EIA RECS data, and EIA's Annual Energy Outlook (AEO) 2023.

Commercial Sector:

- The disaggregation was based on DEF's rate class load shares, intensities, and EIA CBECS data.
- Segment data from EIA and DEF.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:

- Rate class load share based on EIA CBECS and end-use forecasts from DEF.

Industrial Sector:

- The disaggregation was based on rate class load shares, intensities, and EIA MECS data.
- Segment data from EIA and DEF.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
  - Rate class load share based on EIA MECS and end-use forecasts from DEF.

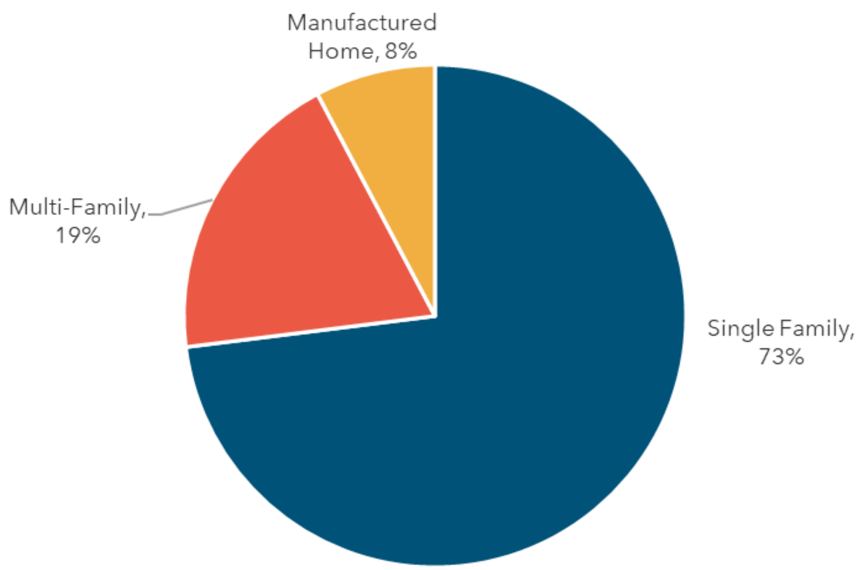
3.2 Analysis of Customer Segmentation

Customer segmentation is important to ensuring that a MPS examines DSM measure savings potential in a manner that reflects the diversity of energy savings opportunities existing across the utility's customer base. DEF provided Resource Innovations with data concerning the premise type and loads characteristics for all customers for the MPS analysis. Resource Innovations examined the provided data from multiple perspectives to identify customer segments. Resource Innovations' approach to segmentation varied slightly for non-residential and residential accounts, but the overall logic was consistent with the concept of expressing the accounts in terms that were relevant to DSM opportunities.

3.2.1 Residential Customers (EE, DR, and DSRE Analysis)

Segmentation of residential customer accounts enabled Resource Innovations to align DSM opportunities with appropriate DSM measures. Resource Innovations used utility customer data, supplemented with EIA data, to segment the residential sector by customer dwelling type (single family, multi-family, or manufactured home). The resulting distribution of customers according to dwelling unit type is presented in Figure 2.

Figure 2. Residential Customer Segmentation



3.2.2 Non-Residential (Commercial and Industrial) Customers (EE and DSRE Analysis)

For the EE and DSRE analysis, Resource Innovations segmented C&I accounts using the utility's North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes, supplemented by data produced by the EIA's CBECS and MECS. Resource Innovations classified the customers in this group as either commercial or industrial, on the basis of DSM measure information available and applicable to each. For example, agriculture and forestry DSM measures are commonly considered industrial savings opportunities. Resource Innovations based this classification on the types of DSM measures applicable by segment, rather than on the annual energy consumption or maximum instantaneous demand from the segment as a whole. The estimated energy sales distributions Resource Innovations applied are shown below in Figure 3 and Figure 4.

Figure 3. Commercial Customer Segmentation

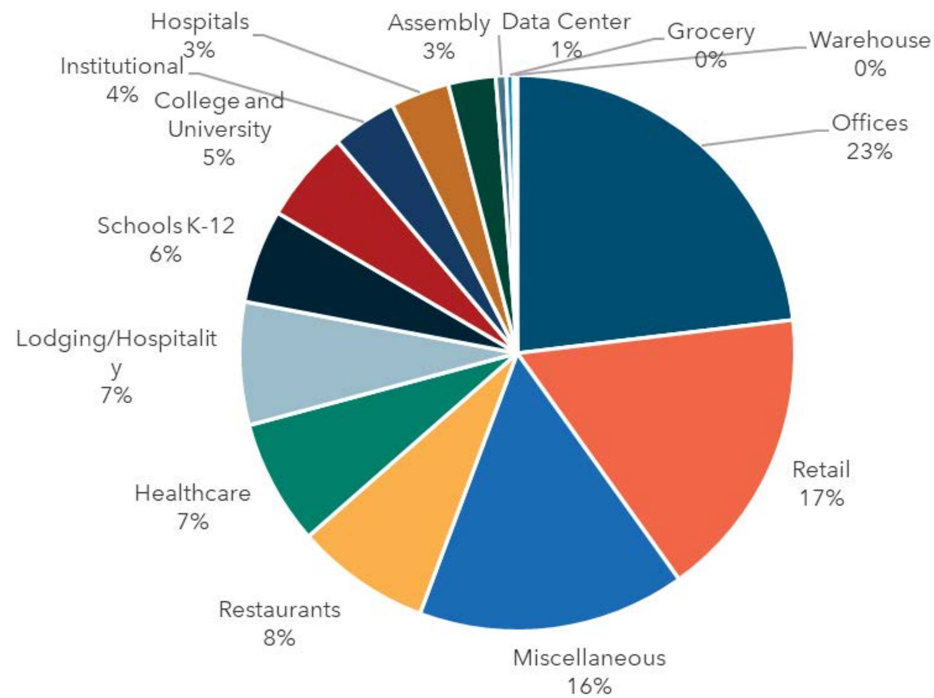
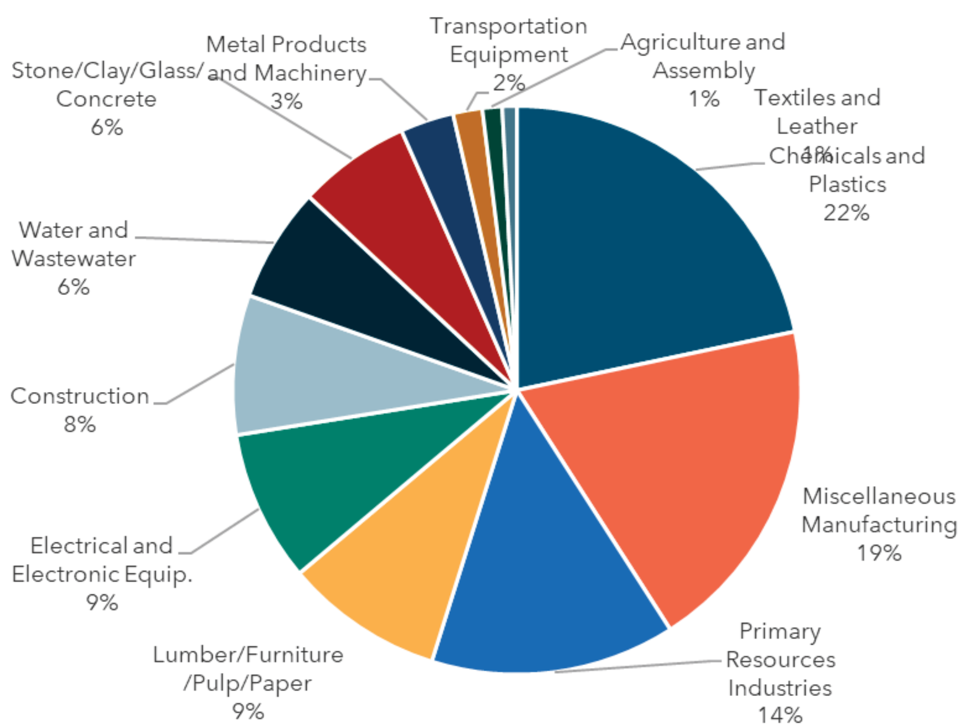


Figure 4. Industrial Customer Segmentation



3.2.3 Commercial and Industrial Accounts (DR Analysis)

For the DR analysis, Resource Innovations divided the non-residential customers into the two customer classes of small C&I and large C&I using rate class and annual consumption. For the purposes of this analysis, small C&I customers are those on the General Service (GS) tariff. Large C&I customers are all customers on the General Service Demand (GSD) tariff or on the General Service Large Demand (GSLD) tariff. Resource Innovations further segmented these two groups based on customer size. For small C&I, segmentation was determined using annual customer consumption and for large C&I the customer's maximum demand was used. Both customer maximum demand and customer annual consumption were calculated using billing data provided by DEF.

Table 6 shows the account breakout between small C&I and large C&I.

Table 6. Summary of Customer Classes for DR Analysis

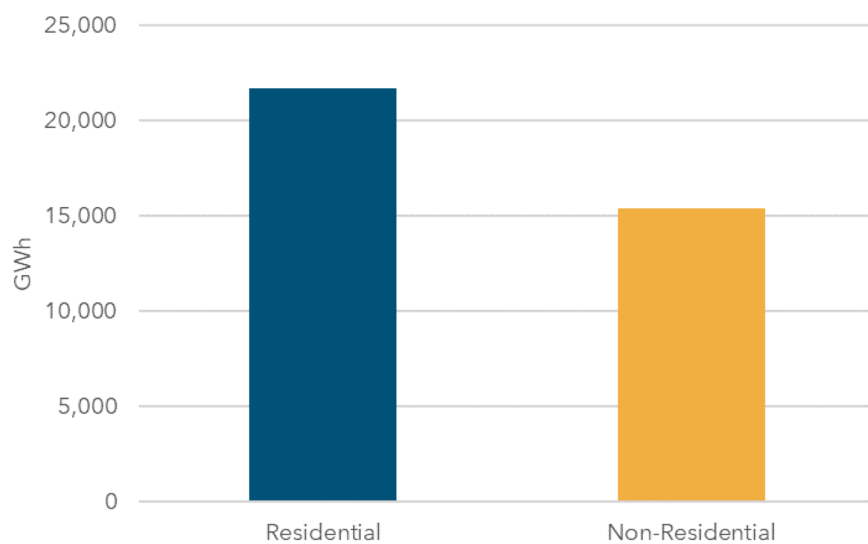
Customer Class	Annual kWh	Estimated Number of Accounts
Small C&I	0-15,000 kWh	113,449
	15,001-25,000 kWh	15,600
	25,001-50,000 kWh	10,446
	50,001 kWh +	7,403
	Total	146,898
Large C&I	0-50 kW	35,795
	51-300 kW	8,700
	301-500 kW	850
	501 kW +	924
	Total	46,269

3.3 Analysis of System Load

3.3.1 System Energy Sales

Technical potential is based on DEF's load forecast for the year 2025 from their 2023 Ten Year Site Plan, which is illustrated in Figure 5.

Figure 5. 2025 Electricity Sales Forecast by Sector



3.3.2 System Demand

To determine the technical potential for DR, Resource Innovations first established peaking conditions for each utility by looking at when each utility historically experienced its maximum demand. The primary data source used to determine when maximum DR impact was the historical system load for DEF. The data provided contained the system loads for all 8,760 hours of the most recent five years leading up to the study (2016-2021). The utility summer and winter peaks were then identified within the utility-defined peaking conditions. For DEF the summer peaking conditions were defined as August from 4:00-5:00 PM and the winter peaking conditions were defined as January from 7:00-8:00 AM. The seasonal peaks were then selected as the maximum demand during utility peaking conditions.

3.3.3 Load Disaggregation

The disaggregated annual electric loads[4] for the base year 2025 by sector and end-use are summarized in Figure 6, Figure 7, and Figure 8.

[4] Full disaggregation of system demand by end-use was not conducted, as DR potential for residential and small C&I customers focused on specific end-uses of particular interest because of their large contribution to peak period system load, and was not end-use specific for large C&I customers. A description of the end-use analysis for residential and small C&I customers is included in Section 5.1.2

Figure 6. Residential Baseline (2025) Energy Sales by End-Use

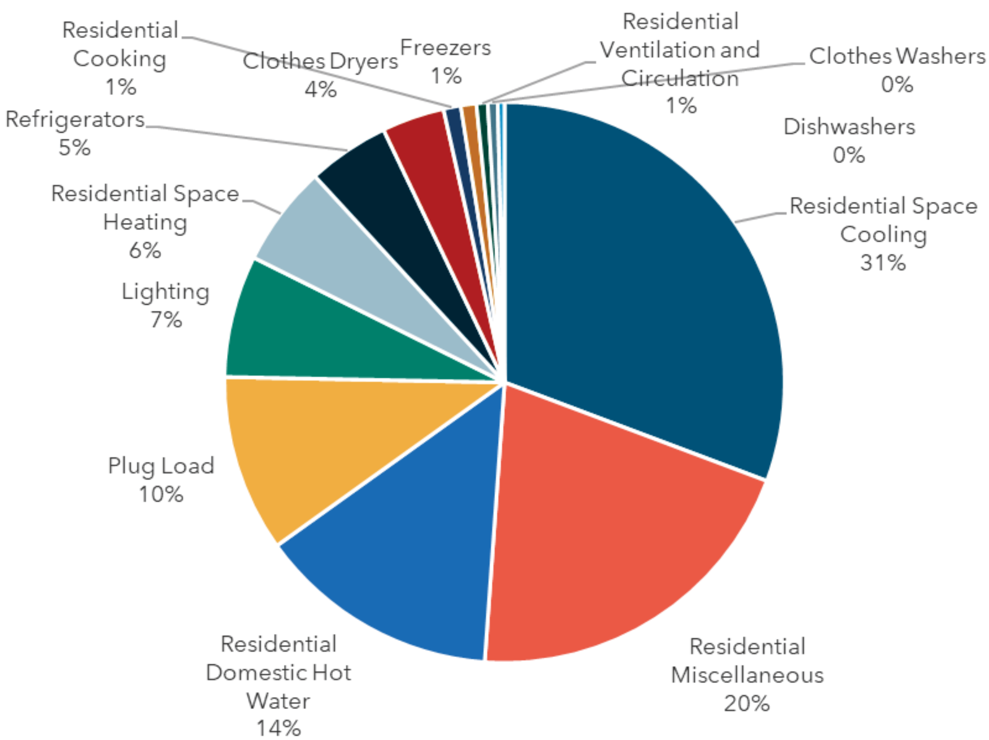


Figure 7. Commercial Baseline (2025) Energy Sales by End-Use

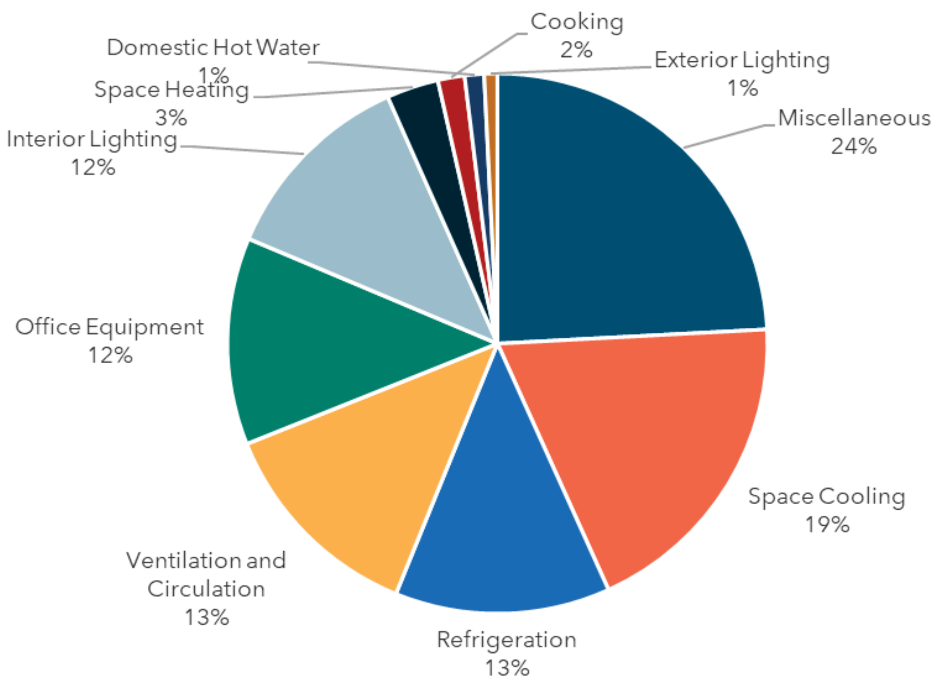
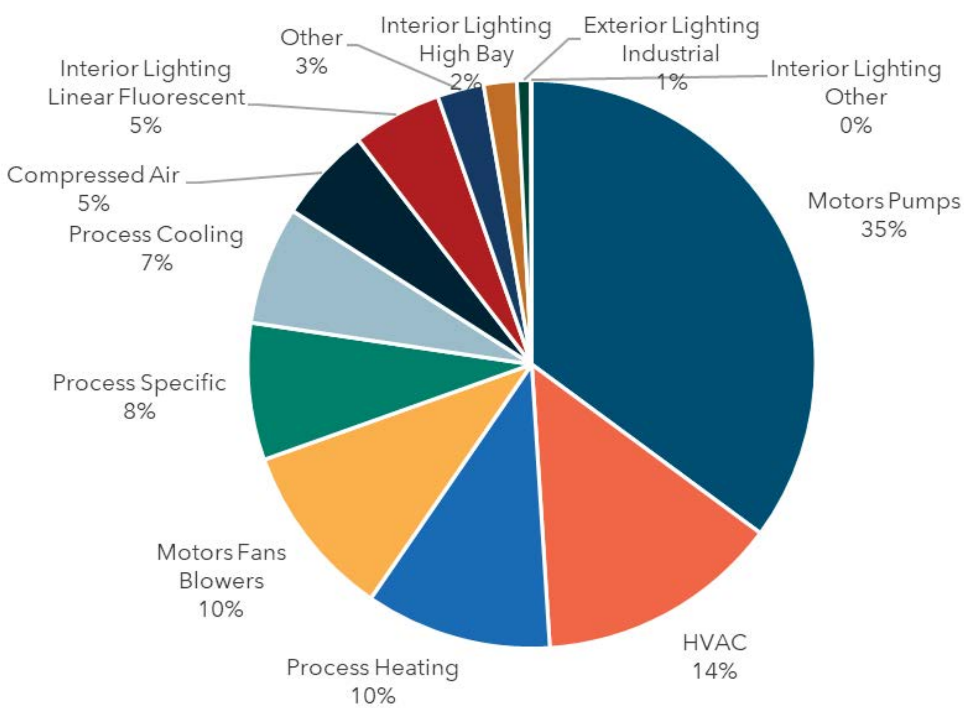


Figure 8. Industrial Baseline (2025) Energy Sales by End-Use



4 DSM Measure Development

DSM potential is described by comparing baseline market consumption with opportunities for savings. Describing these individual savings opportunities results in a list of DSM measures to analyze. This section presents the methodology to develop the EE, DR, and DSRE measure lists.

4.1 Methodology

Resource Innovations identified a comprehensive catalog of DSM measures for the study. The measure list is the same for all FEECA Utilities. The iterative vetting process with the utilities to develop the measure list began by initially examining the list of measures included in the 2019 Goals docket. This list was then adjusted based on proposed measure additions and revisions provided by the FEECA Utilities. Resource Innovations further refined the measure list based on reviews of Resource Innovations' DSM measure library, compiled from similar market potential studies conducted in recent years throughout the United States, as well as measures included in other utility programs where Resource Innovations is involved with program design, implementation, or evaluation. The FEECA Utilities also reached out to interested parties and received input with recommendations on measure additions to the 2019 measure list. Their measure suggestions were reviewed and incorporated into the study as appropriate. External measure suggestions and actions are summarized in Appendix D. The extensive, iterative review process involving multiple parties has ensured that the study included a robust and comprehensive set of DSM measures.

See Appendix A for the list of EE measures, Appendix B for the list of DR measures, and Appendix C for the list of DSRE measures analyzed in the study.

4.2 EE Measures

EE measures represent technologies applicable to the residential, commercial, and industrial customers in the FEECA Utilities' service territories. The development of EE measures included consideration of:

- EE technologies that are applicable to Florida and commercially available: Measures that are not applicable due to climate or customer characteristics were excluded, as were "emerging" technologies that are not currently commercially available to FEECA utility customers.
- Current and planned Florida Building Codes and Federal equipment standards (Codes & Standards) for baseline equipment: Measures included from prior studies

were adjusted to reflect current Codes & Standards as well as updated efficiency tiers, as appropriate.

- Eligibility for utility DSM offerings in Florida: For example, behavioral measures were excluded from consideration, as they historically have not been allowed to count towards utility DSM goals. Behavioral measures are intended to motivate customers to operate in a more energy-efficient manner (*e.g.*, setting an air-conditioner thermostat to a higher temperature) without accompanying: a) physical changes to more efficient end-use equipment or to their building envelope, b) utility-provided products and tools to facilitate the efficiency improvements, or c) permanent operational changes that improve efficiency which are not easily revertible to prior conditions. These types of behavioral measures were excluded because of the variability in forecasting the magnitude and persistence of energy and demand savings from the utility's perspective. Additionally, decoupling behavioral measure savings from the installation of certain EE technologies like smart thermostats can be challenging and could result in overlapping potential with other EE measures included in the study.

Upon development of the final EE measure list, utility-specific measure details were developed. RI maintains a proprietary online database of energy efficiency measures for MPS studies, which was used as a starting point for measure development for this study. Measures are added or updated at the request of project stakeholders or because of changes to the EE marketplace (for example, new codes and standards, or current practice in the market). Measure data are refined as new data or algorithms are developed for estimating measure impacts and updated for each study to incorporate inputs parameters specific to the service territory being analyzed. The database contains the following information for each of the measures:

- Measure description: measure classification by type, end-use, and subsector, and description of the base-case and the efficient-case scenarios.
- kWh savings: Energy savings associated with each measure were developed through engineering algorithms or building simulation modeling, taking climate data and customer segments into consideration as appropriate. Reference sources used for developing residential, commercial, and industrial measure savings included a variety of Florida-specific, as well as regional and national sources, such as utility-specific measurement & verification (M&V) data, technical reference manuals (TRM) from other jurisdictions, ENERGY STAR calculators, and manufacturer or retailer specifications for particular products.
- Energy savings were applied in RI's TEA-POT model as a percentage of total baseline consumption. Peak demand savings were determined using utility-specific load shapes or coincidence factors.

- Measure Expected Useful Lifetime: Sources included the Database for Energy Efficient Resources (DEER), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, TRMs, and other regional and national measure databases and EE program evaluations.
- Measure Costs: Per-unit costs (full or incremental, depending on the application) associated with measure installations. Sources included: TRMs, ENERGY STAR calculator, online market research, FEECA utility program data, and other secondary sources.

The measure details from the online measure library are exported for use in RI's TEA-POT model, accompanied by utility-specific estimates of measure applicability. Measure applicability is a general term encompassing an array of factors, including technical feasibility of installation, and the measure's current saturation as well as factors to allocate savings associated with competing measures. Information used was primarily derived from data in current regional and national databases, as well as DEF's program tracking data. These factors are described in Table 7.

Table 7. Measure Applicability Factors

Measure Impact	Explanation	Sources
Technical Feasibility	The percentage of buildings that can have the measure physically installed. Various factors may affect this, including, but not limited to, whether the building already has the baseline measure (*e.g.*, dishwasher), and limitations on installation (*e.g.*, size of unit and space available to install the unit).	Various secondary sources and engineering experience.
Measure Incomplete Factor	The percentage of buildings without the specific measure currently installed.	Utility RASS; EIA RECS, CBECS; MECS; ENERGY STAR sales figures; and engineering experience.
Measure Share	Used to distribute the percentage of market shares for competing measures (*e.g.*, only blown-in ceiling insulation or spray foam insulation, not both would be installed in an attic).	Utility customer data, Various secondary sources and engineering experience.

As shown in Table 8, the measure list includes 395 unique energy-efficiency measures. Expanding the measures to account for all appropriate installation scenarios resulted in

9,535 measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (*i.e.*, a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed).

Table 8. EE Measure Counts by Sector

Sector	Unique Measures	Permutations
Residential	119	1,173
Commercial	164	5,798
Industrial	112	2,564

4.3 DR Measures

The DR measures included in the measure list utilize the following DR strategies:

- **Direct Load Control.** Utility control of selected equipment at the customer's home or business, such as HVAC or water heaters.
- **Critical Peak Pricing (CPP) with Technology.** Electricity rate structures that vary based on time of day. Includes CPP when the rate is substantially higher for a limited number of hours or days per year (customers receive advance notification of CPP event) coupled with technology that enables customer to lower their usage in a specific end-use in response to the event (e.g., HVAC via smart thermostat).
- **Contractual DR.** Customers receive incentive payments or a rate discount for committing to reduce load by a pre-determined amount or to a pre-determined firm service level upon utility request.
- **Automated DR.** Utility dispatched control of specific end-uses at a customer facility.

DR initiatives that do not rely on the installation of a specific device or technology to implement (such as a voluntary curtailment program or time of use rates) were not included.

A workbook was developed for each measure which included the same measure inputs as previously described for the EE measures. In addition, the DR workbook included expected load reduction from the measure, based on utility technical potential, existing utility DR programs, and other nationwide DR programs if needed.

For technical potential, Resource Innovations did not break out results by specific measure or control technology because all of the developed measures target the end-uses estimated

for technical potential (*i.e.*, potential is reported for space cooling end-use and not allocated to switches, smart thermostats, etc.).

4.4 DSRE Measures

The DSRE measure list includes rooftop PV systems, battery storage systems charged from PV systems, and CHP systems.

PV Systems

PV systems utilize solar panels (a packaged collection of PV cells) to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter, a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted systems that face south-west, south, and/or, south-east. The potential associated with roof-mounted systems installed on residential and commercial buildings was analyzed.

Battery Storage Systems Charged from PV Systems

Distributed battery storage systems included in this study consist of behind-the-meter battery systems installed in conjunction with an appropriately-sized PV system at residential and commercial customer facilities. These battery systems typically consist of a DC-charged battery, a DC/AC inverter, and electrical system interconnections to a PV system. On their own battery storage systems do not generate or conserve energy, but can collect and store excess PV generation to provide power during particular time periods, which for DSM purposes would be to offset customer demand during the utility's system peak.

CHP Systems

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide other on-site needs. Common prime mover technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Internal combustion engines

A workbook was developed for each measure which included the inputs previously described for EE measures and prime mover operating parameters.

5 Technical Potential

In the previous sections, the approach for DSM measure development was summarized, and the 2025 base year load shares and reference-case load forecast were described. The outputs from these tasks provided the input for estimating the technical potential scenario, which is discussed in this section.

The technical potential scenario estimates the potential energy and demand savings when all technically feasible and commercially available DSM measures are implemented without regard for cost-effectiveness and customer willingness to adopt the most impactful EE, DR, or DSRE technologies. Since the technical potential does not consider the costs or time required to achieve these savings, the estimates provide a theoretical upper limit on electricity savings potential. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. For this study, technical potential included full application of the commercially available DSM measures to all residential, commercial, and industrial customers in the utility's service territory.

5.1 Methodology

5.1.1 EE Technical Potential

EE technical potential refers to delivering less electricity to the same end-uses. In other words, technical potential might be summarized as "doing the same thing with less energy, regardless of the cost."

DSM measures were applied to the disaggregated utility electricity sales forecasts to estimate technical potential. This involved applying estimated energy savings from equipment and non-equipment measures to all electricity end-uses and customers. Technical potential consists of the total energy and demand that can be saved in the market which Resource Innovations reported as single numerical values for each utility's service territory.

The core equation used in the residential sector EE technical potential analysis for each individual efficiency measure is shown in Equation 1 below, while the core equation used in the nonresidential sector technical potential analysis for each individual efficiency measure is shown in Equation 2.

Equation 1: Core Equation for Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Number of Households × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Baseline Equipment Energy Use Intensity** = the electricity used per customer per year by each baseline technology in each market segment. In other words, the baseline equipment energy-use intensity is the consumption of the electrical energy using equipment that the efficient technology replaces or affects.
- **Saturation Share** = the fraction of the end-use electrical energy that is applicable for the efficient technology in a given market segment. For example, for residential cooling, the saturation share would be the fraction of all residential electric customers that have central air conditioners in their household.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of central air conditioners that is not already energy efficient.
- **Feasibility Factor** = the fraction of units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (*i.e.*, it may not be possible to install LEDs in all light sockets in a home because the available styles may not fit in every socket).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

Equation 2: Core Equation for Non-Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Stock Sq. Footage by Building Type by EDC × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Total Stock Square Footage by Segment** = the forecasted square footage level for a given building type (*e.g.*, square feet of office buildings).
- **Baseline Equipment Energy Use Intensity** = the electricity used per square foot per year by each baseline equipment type in each market segment.

- **Saturation Shares** = the fraction of total end-use energy consumption associated with the efficient technology in a given market segment. For example, for packaged terminal air-conditioner (PTAC), the saturation share would be the fraction of all space cooling kWh in a given market segment that is associated with PTAC equipment.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient.
- **Feasibility Factor** = the fraction of the equipment or practice that is technically feasible for conversion to the efficient technology from an engineering perspective (*i.e*., it may not be possible to install Variable Frequency Drives (VFD) on all motors in a given market segment).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

It is important to note that the technical potential estimate represents electricity savings potential at a specific point in time. In other words, the technical potential estimate is based on data describing status quo customer electricity use and technologies known to exist today. As technology and electricity consumption patterns evolve over time, the baseline electricity consumption will also change accordingly. For this reason, technical potential is a discrete estimate of a dynamic market. Resource Innovations reported the technical potential for 2025, based on currently known DSM measures and observed electricity consumption patterns.

Measure Interaction and Competition (Overlap)

While the technical potential equations listed above focus on the technical potential of a single measure or technology, Resource Innovations' modeling approach does recognize the overlap of individual measure impacts within an end-use or equipment type, and accounts for the following interactive effects:

- Measure interaction: Installing high-efficiency equipment could reduce energy savings in absolute terms (kWh) associated with non-equipment measures that impact the same end-use. For example, installing a high-efficiency heat pump will reduce heating and cooling consumption which will reduce the baseline against which attic insulation would be applied, thus reducing savings associated with installing insulation. To account for this interaction, Resource Innovations' TEA-POT model ranks measures that interact with one another and reduces the baseline consumption for the subsequent measure based on the savings achieved by the preceding measure. For technical potential, interactive measures are ranked based on total end-use energy savings percentage.
- Measure competition (overlap): The "measure share"—as defined above—accounted for competing measures, ensuring savings were not double-counted. This interaction

occurred when two or more measures "competed" for the same end-use. For example, a T-12 lamp could be replaced with a T-8 or linear LED lamp.

Addressing Naturally-Occurring EE

Naturally occurring energy efficiency includes actions taken by customers to improve the efficiency of their homes and businesses in the absence of utility program intervention. For the analysis of technical potential, Resource Innovations verified with DEF's forecasting group that the baseline sales forecasts incorporated two known sources of naturally-occurring efficiency:

- Codes and Standards: The sales forecasts already incorporated the impacts of known Code & standards changes.
- Baseline Measure Adoption: The sales forecast excluded the projected impacts of future DSM efforts but included already implemented DSM penetration.

By properly accounting for these factors, the technical potential analysis estimated the additional EE opportunities beyond what is already included in the utility sales forecast.

5.1.2 DR Technical Potential

The concept of technical potential applies differently to DR than for EE. Technical potential for DR is effectively the magnitude of loads that can be curtailed during conditions when utilities need peak capacity reductions. In evaluating this potential at peak capacity, the following were considered: which customers are consuming electricity at those times? What end-uses are in play? Can those end-use loads be managed? Large C&I accounts generally do not provide the utility with direct control over particular end-uses. Instead, many of these customers will forego electric demand temporarily if the financial incentive is large enough. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale.

This framework makes end-use disaggregation an important element for understanding DR potential, particularly in the residential and small C&I sectors. When done properly, end-use disaggregation not only provides insights into which loads are on and off when specific grid services are needed, it also provides insight concerning how key loads and end-uses, such as air conditioning use, vary across customers. Resource Innovations' approach used for load disaggregation is more advanced than what is used for most potential studies. Instead of disaggregating annual consumption or peak demand, Resource Innovations produced end-use load disaggregation for all 8,760 hours. This was needed because the loads available at times when different grid applications are needed can vary substantially. Instead

of producing disaggregated loads for the average customer, the study was produced for several customer segments. For DEF, Resource Innovations examined three residential segments based on customer housing type, four different small C&I segments based on customer size, and four different large C&I segments based on customer size, for a total of 11 different customer segments.

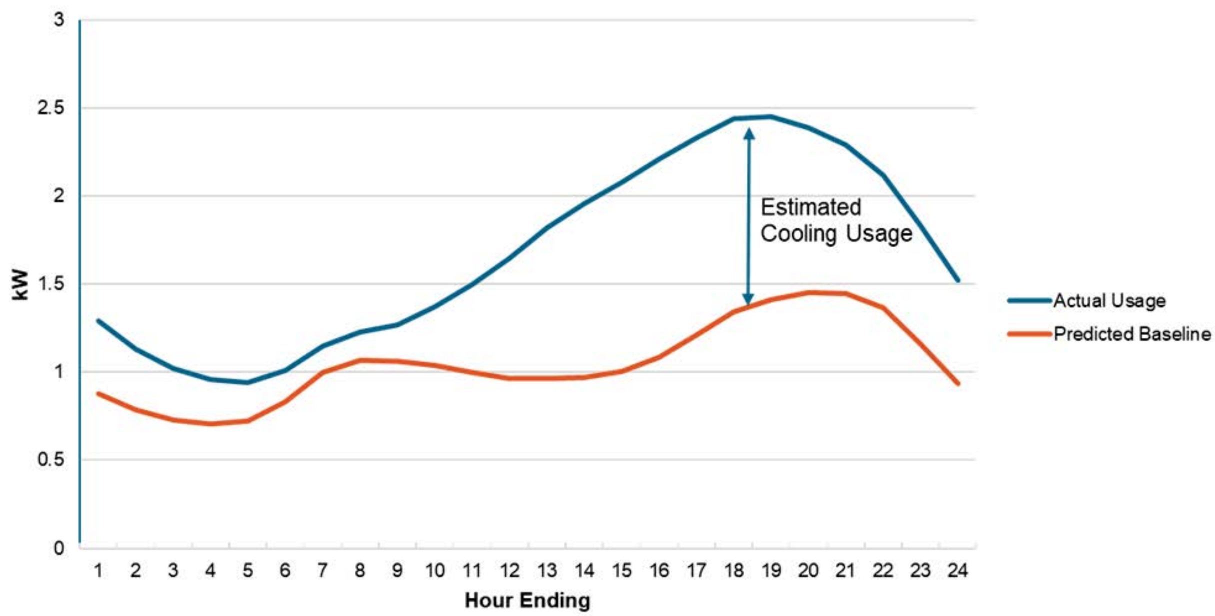
Technical potential, in the context of DR, is defined as the total amount of load available for reduction that is coincident with the period of interest; in this case, the system peak hour for the summer and winter seasons. Thus, two sets of capacity values are estimated: a summer capacity and a winter capacity.

As previously mentioned, for technical potential purposes, all coincident large C&I load is considered dispatchable, while residential and small C&I DR capacity is based on specific end-uses. Summer DR capacity for residential customers was comprised of air-conditioning (AC), pool pumps, water heaters, and managed electric vehicle charging. For small C&I customers, summer capacity was based on AC load. For winter DR capacity, residential was based on electric heating, pool pumps, and water heaters. For small C&I customers, winter capacity was based on electric heating.

AC and heating load profiles were generated for residential and small C&I customers using a sample of customer interval data provided by DEF. This sample included a customer breakout based on housing type for residential customers and size for small C&I customers. Resource Innovations then used the interval data from these customers to create an average load profile for each customer segment.

The average load profile for each customer segment was combined with historical weather data, and used to estimate hourly load as a function of weather conditions. AC and heating loads were estimated by first calculating the baseline load on days when cooling degree days (CDD) and heating degree days (HDD) were equal to zero, and then subtracting this baseline load. This methodology is illustrated by Figure 9 (a similar methodology was used to predict heating loads).

Figure 9: Methodology for Estimating Cooling Loads



This method was able to produce estimates for average AC/heating load profiles for the seven different customer segments within the residential and small C&I sectors.

Profiles for residential pool pump loads were estimated by utilizing utility-specific end-use load data provided by DEF. Profiles for residential water heater loads were estimated by using NREL's end-use load profile database.

For all eligible loads, the technical potential was defined as the amount that was coincident with system peak hours for each season, which are August from 4:00-5:00 PM for summer, and January from 7:00-8:00 AM for winter. As mentioned in Section 4, for technical potential there was also no measure breakout needed, because all measures will target the end-uses' estimated total loads.

5.1.3 DSRE Technical Potential

5.1.3.1 PV Systems

To determine technical potential for PV systems, RI estimated the percentage of rooftop square footage in Florida that is suitable for hosting PV technology. Our estimate of technical potential for PV systems in this report is based in part on the available roof area and consisted of the following steps:

- Step 1: Outcomes from the forecast disaggregation analysis were used to characterize the existing and new residential, commercial, and industrial building stocks.
    - To calculate the total roof area for residential buildings, the average roof area per household is multiplied by the number of households.
    - For commercial and industrial buildings, RI calculated the total roof area by first dividing the load forecast by the energy usage intensity, which provides an estimate of the total building square footage. This result is then divided by the average number of floors to derive the total roof area.
- Step 2: The total available roof area feasible for installing PV systems was calculated. Relevant parameters included unusable area due to other rooftop equipment and setback requirements, in addition to possible shading from trees and limitations of roof orientation (factored into a "technical suitability" multiplier).
- Step 3: Estimated the expected power density (kW per square foot of roof area).
- Step 4: Estimated the hourly PV generation profile using NREL's PV Watts Calculator
- Step 5: Calculated total energy and coincident peak demand potential by applying RI's Spatial Penetration and Integration of Distributed Energy Resources (SPIDER) Model.

The methodology presented in this report uses the following formula to estimate overall technical potential of PVs:

Equation 3: Core Equation for Solar DSRE Technical Energy Potential

$$\text{PV Technical Energy Potential} = \text{Suitable Rooftop PV Area (Sq Ft)} \times \text{PV Power Density (kW-DC/Sq Ft)} \times \text{Generation Factor (kWh/kW-DC)}$$

Where:

- **Suitable Rooftop PV Area for Residential [Square Feet]:** Number of Residential Buildings x Average Roof Area Per Building x Technical Suitability Factor
- **Suitable Rooftop PV Area for Commercial [Square Feet] :** Energy Consumption [kWh] / Energy Intensity [kWh / Square Feet] / Average No. of Stories Per Building x Technical Suitability Factor
- **PV Power Density [kW-DC/Square Feet]:** Maximum power generated in Watts per square foot of solar panel.
- **Generation Factor:** Annual Energy Generation Factor for PV, from PV Watts (dependent on local solar irradiance)

5.1.3.2 Battery Storage Systems Charged from PV Systems

Battery storage systems on their own do not generate power or create efficiency improvements, but store power for use at different times. Therefore, in analyzing the technical potential for battery storage systems, the source of the stored power and overlap with technical potential identified in other categories was considered.

Battery storage systems that are powered directly from the grid do not produce annual energy savings but may be used to shift or curtail load during particular time periods. As the DR technical potential analyzes curtailment opportunities for the summer and winter peak period, and battery storage systems can be used as a DR technology, the study concluded that no additional technical potential should be claimed for grid-powered battery systems beyond that already attributed to DR.

Battery storage systems that are connected to on-site PV systems also do not produce additional energy savings beyond the energy produced from the PV system[5]. However, PV-connected battery systems do create the opportunity to store energy during period when the PV system is generating more than the home or business is consuming and use that stored power during utility system peak periods.

To determine the additional technical potential peak demand savings for "solar plus storage" systems, our methodology consisted of the following steps:

- Assume that every PV system included in PV Technical Potential is installed with a paired storage system.
- Size the storage system assuming peak storage power is equal to peak PV generation and energy storage duration is three hours.
- Apply RI's hourly dispatch optimization module in SPIDER to create an hourly storage dispatch profile that flattens the individual customer's load profile to the greatest extent possible accounting for a) customer hourly load profile, b) hourly PV generation profile, and c) battery peak demand, energy capacity, and roundtrip charge/discharge efficiency.
- Calculate the effective hourly impact for the utility using the above storage dispatch profile, aligned with the utility's peak hour (calculated separately for summer and winter)
- Report the output storage kW impact on utility coincident peak demand in summer and winter.

---

[5] PV-connected battery systems experience some efficiency loss due to storage, charging, and discharging. However, for this study, these losses were not quantified.

5.1.3.3 CHP Systems

The CHP analysis created a series of unique distributed generation potential models for each primary market sector (commercial and industrial).

Only non-residential customer segments whose electric and thermal load profiles allow for the application of CHP were considered. The technical potential analysis followed a three-step process. First, minimum facilities size thresholds were determined for each non-residential customer segment. Next, the full population of non-residential customers were segmented and screened based on the size threshold established for that segment. Finally, the facilities that were of sufficient size were matched with the appropriately sized CHP technology.

To determine the minimum threshold for CHP suitability, a thermal factor was applied to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load in order to achieve improved efficiencies.

The study collected electric and thermal intensity data from other recent CHP studies. For industrial customers, Resource Innovations assumed that the thermal load would primarily be used for process operations and was not modified from the secondary data sources for Florida climate conditions. For commercial customers, the thermal load is more commonly made up of water heating, space heating, and space cooling (through the use of an absorption chiller). Therefore, to account for the hot and humid climate in Florida, which traditionally limits weather-dependent internal heating loads, commercial customers' thermal loads were adjusted to incorporate a higher proportion of space cooling to space heating as available opportunities for waste heat recovery.

After determination of minimum kWh thresholds by segment, Resource Innovations used the utility-provided customer data with NAICS or SIC codes as well as annual consumption data. Non-residential customers were then categorized by segment and size. Customers with annual loads below the kWh thresholds are not expected to have the consistent electric and thermal loads necessary to support CHP and were eliminated from consideration.

In general, internal combustion engines are the prime mover for systems under 500kW with gas turbines becoming progressively more popular as system size increases above that. Based on the available load by customer, adjusted by the estimated thermal factor for each segment, CHP technologies were assigned to utility customers in a top-down fashion (*i.e.*, starting with the largest CHP generators).

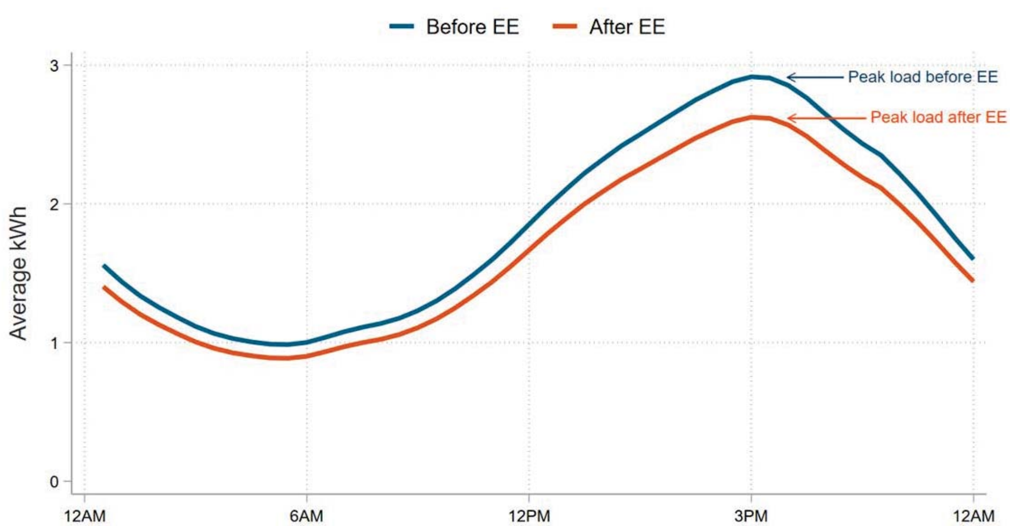
Measure Interaction

PV systems and battery storage charged from PV systems were analyzed collectively due to their common power generation source; and therefore, the identified technical potential for these systems is additive. However, CHP systems were independently analyzed for technical potential without consideration of the competition between DSRE technologies or customer preference for a particular DSRE system. Therefore, results for CHP technical potential should not be combined with PV systems or battery storage systems for overall DSRE potential but used as independent estimates.

5.1.4 Interaction of Technical Potential Impacts

As described above, the technical potential was estimated using separate models for EE, DR, and DSRE systems. However, there is interaction between these technologies; for example, a more efficient HVAC system would result in a reduced peak demand available for DR curtailment, as illustrated in Figure 10.

Figure 10: Illustration of EE Impacts on HVAC System Load Shape



Therefore, after development of the independent models, the interaction between EE, DR, and DSRE was incorporated as follows:

- The EE technical potential was assumed to be implemented first, followed by DR technical potential and DSRE technical potential.

- To account for the impact of EE technical potential on DR, the baseline load forecast for the applicable end-uses was adjusted by the EE technical potential, resulting in a reduction in baseline load available for curtailment.
- For DSRE systems, the EE and DR technical potential was incorporated in a similar fashion, adjusting the baseline load used to estimate DSRE potential.
  - For the PV analysis, this did not impact the results as the EE and DR technical potential did not affect the amount of PV that could be installed on available rooftops.
  - For the battery storage charged from PV systems, the reduced baseline load from EE resulted in additional PV-generated energy being available for the battery systems and for use during peak periods. The impact of DR events during the assumed curtailment hours was incorporated into the modeling of available battery storage and discharge loads.
- For CHP systems, the reduced baseline load from EE resulted in a reduction in the number of facilities that met the annual energy threshold needed for CHP installations. Installed DR capacity was assumed to not impact CHP potential as the CHP system feasibility was determined based on energy and thermal consumption at the facility. It should be noted that CHP systems not connected to the grid could impact the amount of load available for curtailment with utility-sponsored DR. Therefore, CHP technical potential should not be combined with DR potential but used as independent estimates.

5.2 EE Technical Potential

5.2.1 Summary

Table 9 summarizes the EE technical potential by sector:

Table 9. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	2,217	2,423	7,599
Non-Residential[6]	669	450	3,591
Total	2,886	2,873	11,190

[6] Non-Residential results include all commercial and industrial customer segments.

5.2.2 Residential

Figure 11, Figure 12, and Figure 13 summarize the residential sector EE technical potential by end-use.

Figure 11: Residential EE Technical Potential by End-Use (Summer Peak Savings)

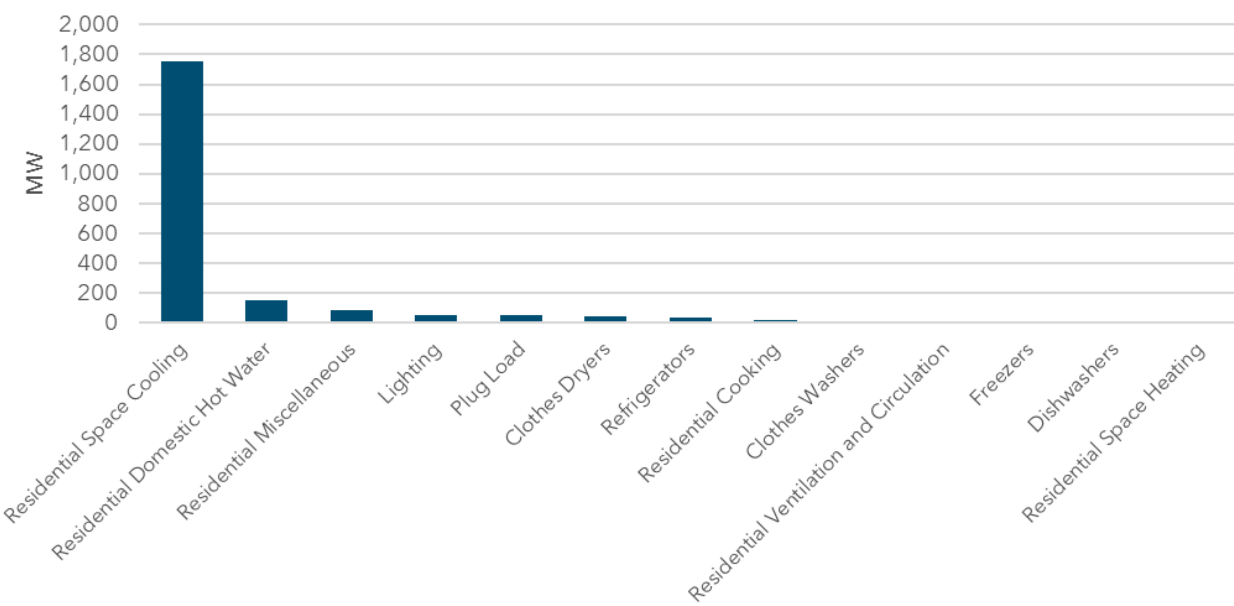


Figure 12: Residential EE Technical Potential by End-Use (Winter Peak Savings)

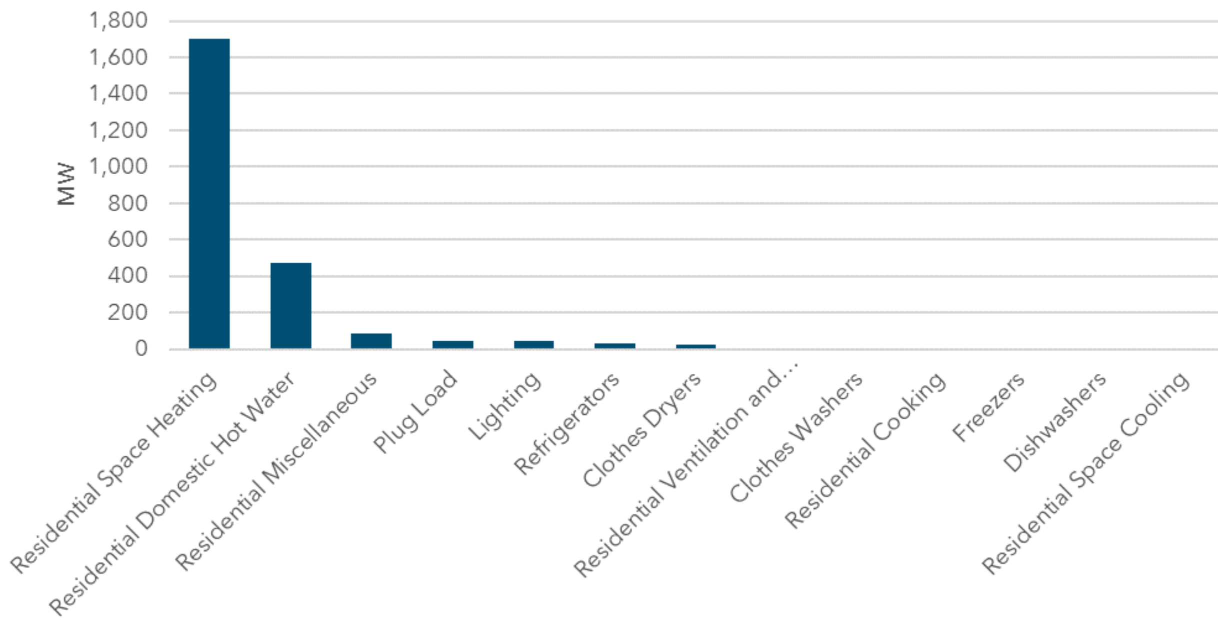
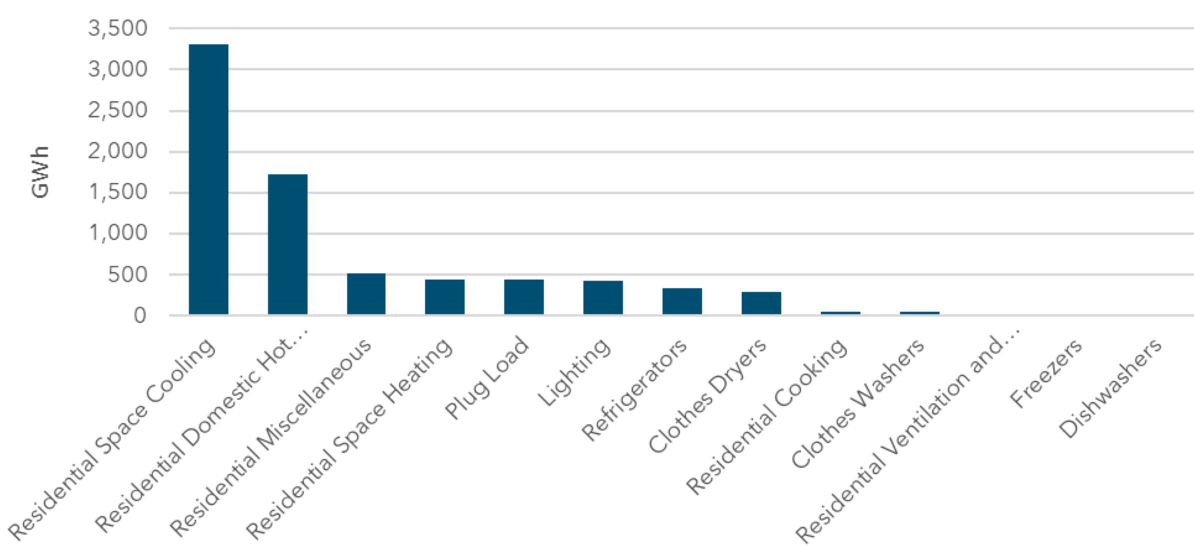


Figure 13: Residential EE Technical Potential by End-Use (Energy Savings)



5.2.3 Non-Residential

5.2.3.1 Commercial Segments

Figure 14, Figure 15, and Figure 16 summarize the commercial sector EE technical potential by end-use.

Figure 14: Commercial EE Technical Potential by End-Use (Summer Peak Savings)

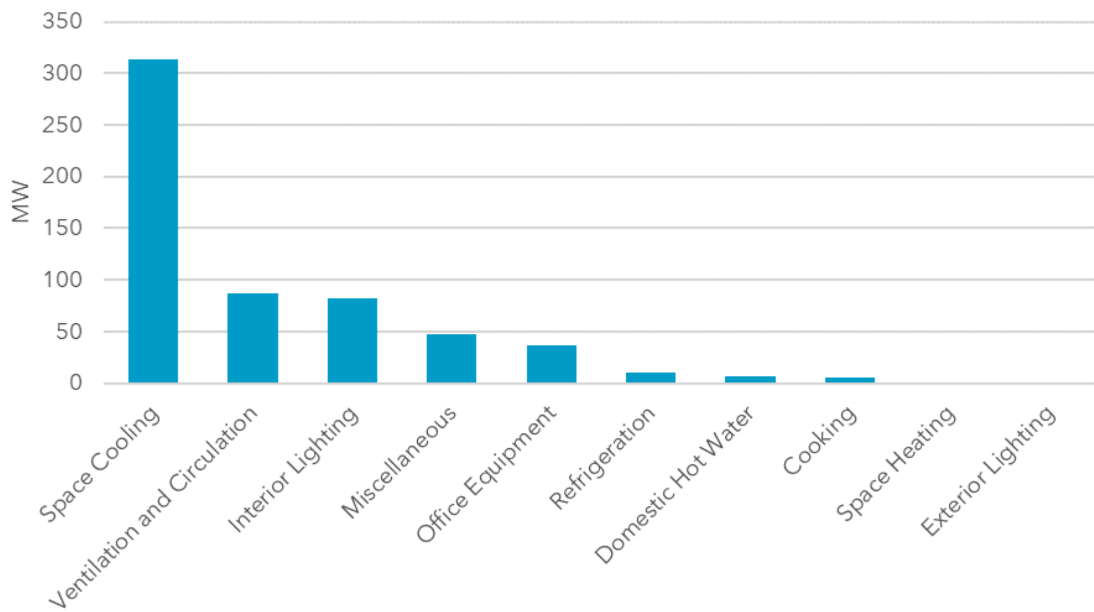


Figure 15: Commercial EE Technical Potential by End-Use (Winter Peak Savings)

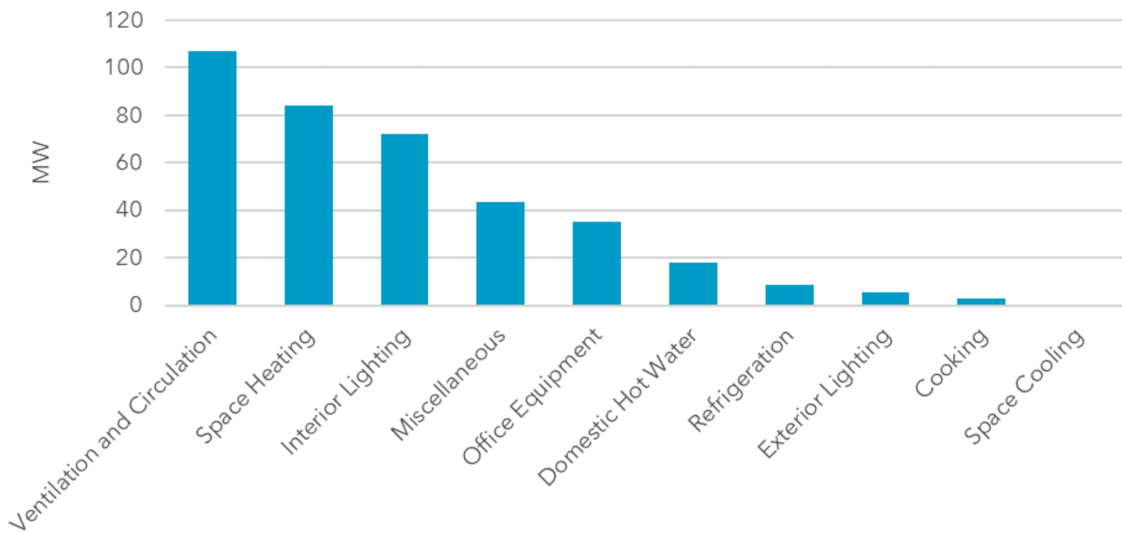
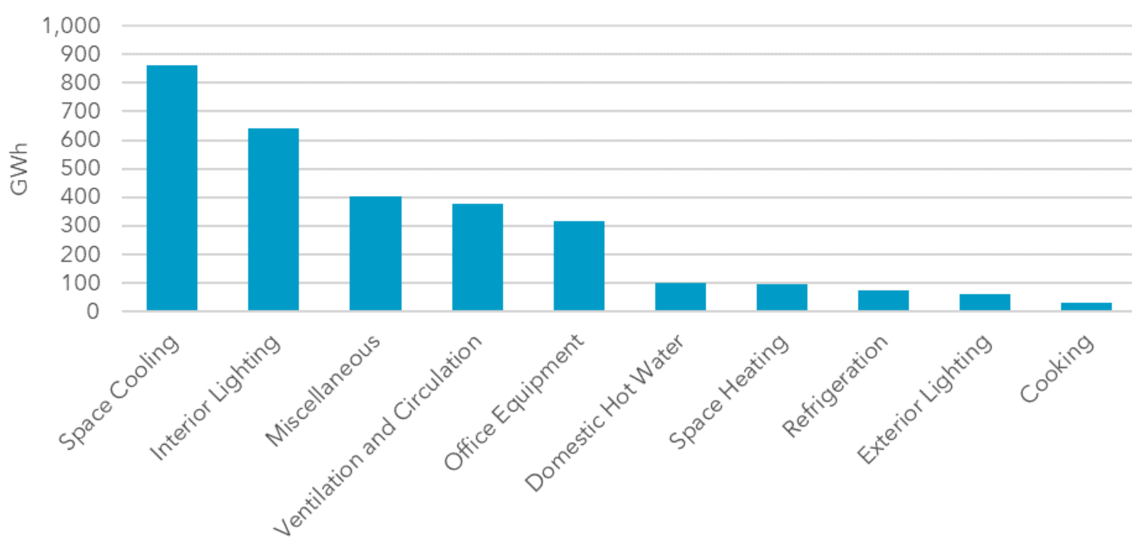


Figure 16: Commercial EE Technical Potential by End-Use (Energy Savings)



5.2.3.2 Industrial Segments

Figure 17, Figure 18, and Figure 19 summarize the industrial sector EE technical potential by end-use.

Figure 17: Industrial EE Technical Potential by End-Use (Summer Peak Savings)

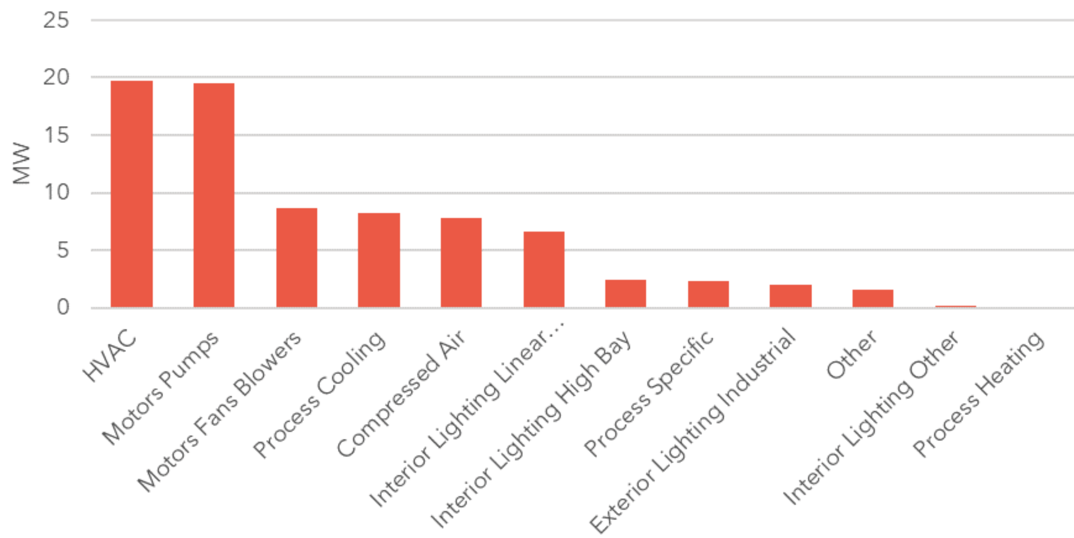


Figure 18: Industrial EE Technical Potential by End-Use (Winter Peak Savings)

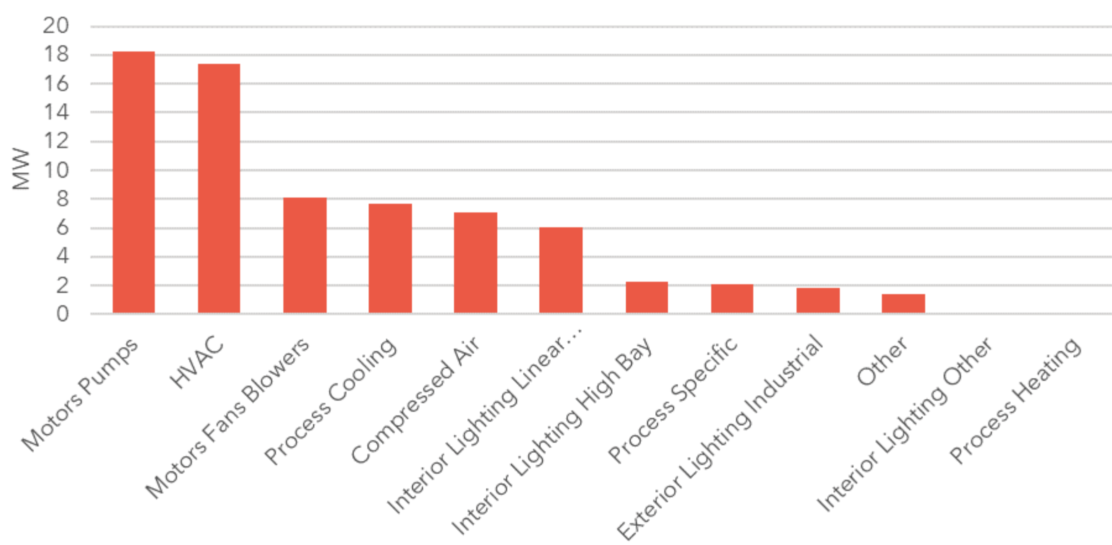
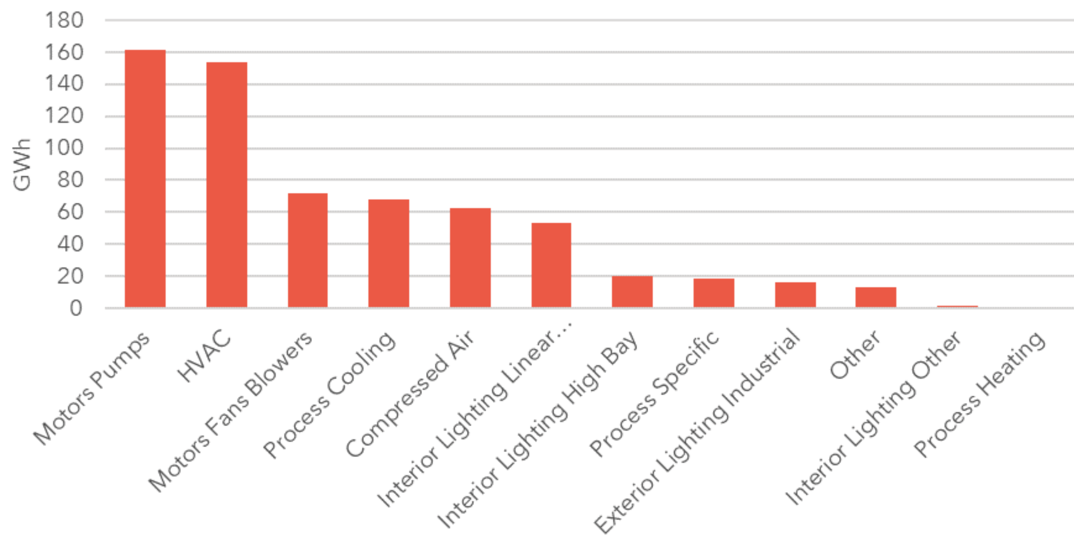


Figure 19: Industrial EE Technical Potential by End-Use (Energy Savings)



5.3 DR Technical Potential

Technical potential for DR is defined for each class of customers as follows:

- Residential & Small C&I customers – Technical potential is equal to the aggregate load for all end-uses that can participate in DEF's current programs plus DR measures not currently offered in which the utility uses specialized devices to control loads (*i.e.*, direct load control programs). This includes cooling and heating loads for residential and small C&I customers and water heater and pool pump loads for residential customers. Not all demand reductions are delivered via direct load control of end-uses. The magnitude of demand reductions from non-direct load control such as time varying pricing, peak time rebates and targeted notifications is linked to cooling and heating loads.
- Large C&I customers – Technical potential is equal to the total amount of load for each customer segment (*i.e.*, that customers reduce their total load to zero when called upon).

Table 10 summarizes the seasonal DR technical potential by sector:

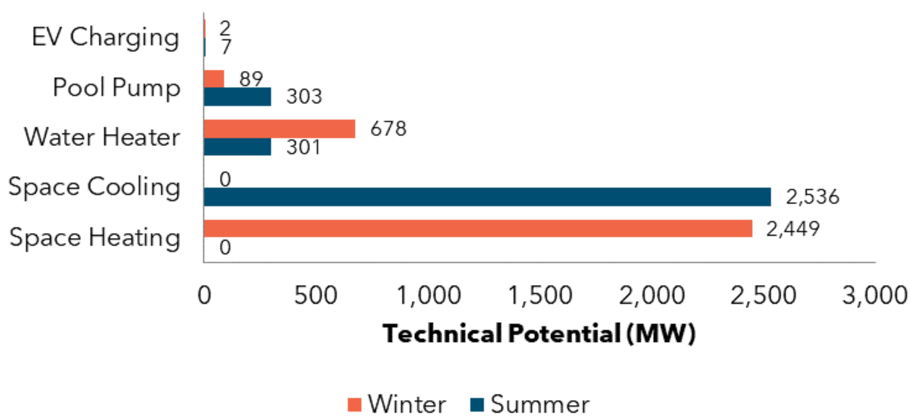
Table 10. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	3,147	3,218
Non-Residential	2,631	2,391
Total	5,778	5,609

5.3.1 Residential

Residential technical potential is summarized in Figure 20.

Figure 20: Residential DR Technical Potential by End-Use

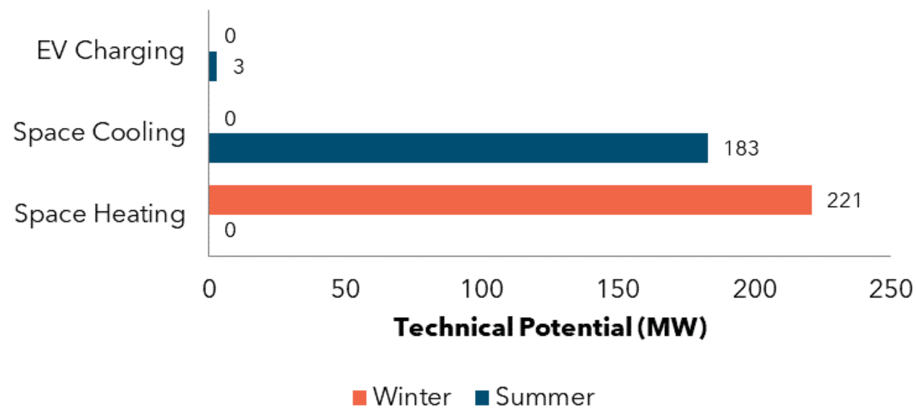


5.3.2 Non-Residential

5.3.2.1 Small C&I Customers

For small C&I technical potential, Resource Innovations looked at cooling and heating loads only. Small C&I technical potential is provided in Figure 21.

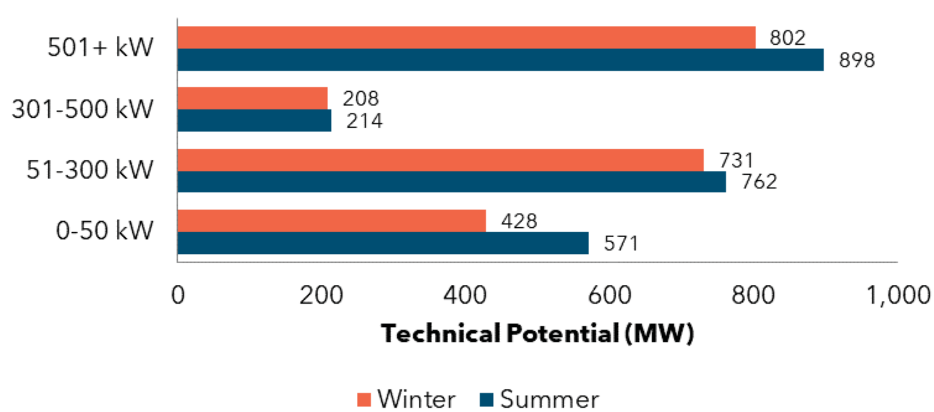
Figure 21: Small C&I DR Technical Potential by End-Use



5.3.2.2 Large C&I Customers

Figure 22 provides the technical potential for large C&I customers, broken down by customer size.

Figure 22: Large C&I DR Technical Potential by Segment



5.4 DSRE Technical Potential

Table 11 provides the results of the DSRE technical potential for each customer segment:

Table 11. DSRE Technical Potential[7]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	1,761	152	17,637
Non-Residential	444	15	4,164
Total	2,205	167	21,801
Battery Storage charged from PV Systems			
Residential	2,016	2,176	0
Non-Residential	240	315	0
Total	2,256	2,491	0
CHP Systems			
Total	773	811	3,553

[7] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

Appendix A EE Measure List

For information on how Resource Innovations developed this list, please see Section 4.

Table 12: Residential EE Measures

Measure	End-Use	Description	Baseline
120v Heat Pump Water Heater 50 Gallons	Residential Domestic Hot Water	120v Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Air Sealing-Infiltration Control	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Improved Infiltration Control	Standard Heating and Cooling System with Standard Infiltration Control
Air-to-Water Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star Air-to-Water Heat Pump, 25 SEER, 13 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - 15 SEER/14.3 SEER2 from base electric resistance	Residential Space Cooling, Residential Space Heating	ASHP 15 SEER from base electric resistance	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2 (from elec resistance)	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2, 10.5 HSPF	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating

Measure	End-Use	Description	Baseline
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2 (from elect resistance)	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
Basement or Crawlspace Wall Insulation R-15	Residential Space Cooling, Residential Space Heating	Increased Basement or Crawlspace Wall Insulation (R-15)	Code-Compliant Exterior Below-Grade Wall Insulation (R-10)
Bathroom Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
CEE Advanced Tier Clothes Dryer	Clothes Dryers	CEE Advanced Tier Clothes Dryer	One Clothes Dryer meeting Federal Standard
CEE Advanced Tier Clothes Washer	Clothes Washers	Tier 3 CEE Clothes washer	One Clothes Washer meeting Federal Standard
CEE Tier 3 Refrigerator	Refrigerators	Residential Tier 3 Refrigerator	One Refrigerator meeting Federal Standard
Ceiling Insulation (R11 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Ceiling Insulation (R38 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Residential Space Cooling	Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - 24 SEER/22.9 SEER2	Residential Space Cooling	Central AC - 24 SEER/22.9 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Residential Space Cooling	Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - ENERGY STAR/ CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling	Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC Tune Up	Residential Space Cooling	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Existing Typical Central AC without Regular Maintenance/tune-up
Dehumidifier Recycling	Plug Load	No dehumidifier	One Dehumidifier meeting Federal Standard
Drain Water Heat Recovery	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Duct Insulation	Residential Space Cooling, Residential Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork	Standard Electric Heating and Central AC with Uninsulated Ductwork
Duct Repair	Residential Space Cooling, Residential Space Heating	Duct Repair to eliminate/minimize leaks, includes testing and sealing	Standard Electric Heating and Central AC with typical duct leakage
ECM Circulator Pump	Residential Miscellaneous	Install ECM Circulator Pump	Install Standard Circulator Pump
Energy Star Air Purifier	Plug Load	One Air Purifier meeting ENERGY STAR 2.0 Standards	One Standard Conventional Air Purifier
Energy Star Audio-Video Equipment	Plug Load	One DVD/Blu-Ray Player meeting current ENERGY STAR Standards	One Market Average DVD/Blu-Ray Player
Energy Star Bathroom Ventilating Fan	Residential Ventilation and Circulation	Bathroom Exhaust Fan meeting current ENERGY STAR Standards	Bathroom Exhaust Fan meeting Federal Standard
Energy Star Ceiling Fan	Residential Miscellaneous	60" Ceiling Fan Meeting ENERGY STAR 3.1 Standards	Standard 60" Ceiling Fan
Energy Star Clothes Dryer	Clothes Dryers	One Electric Resistance Clothes Dryer meeting ENERGY STAR 1.1 Standards	One Clothes Dryer meeting Federal Standard

Measure	End-Use	Description	Baseline
Energy Star Clothes Washer	Clothes Washers	One Clothes Washer meeting ENERGY STAR 8.1 Standards	One Clothes Washer meeting Federal Standard
Energy Star Dehumidifier	Plug Load	One Dehumidifier meeting ENERGY STAR 5.0 Standards	One Dehumidifier meeting Federal Standard
Energy Star Dishwasher	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements (effective on July 19, 2023), electric water heating	One Dishwasher meeting Federal Standard
Energy Star Dishwasher (Gas Water Heating)	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements, gas water heating	One Dishwasher meeting Federal Standard; gas water heating
Energy Star Door	Residential Space Cooling, Residential Space Heating	100ft2 of Opaque Door meeting Energy Star Version 6.0 Requirements (U-Value: 0.17)	100ft2 of Opaque Door meeting current FL Code Requirements
ENERGY STAR EV supply equipment (level 2 charger)	Residential Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Freezer	Freezers	One Freezer meeting current ENERGY STAR 5.1 Standards	One Freezer meeting Federal Standard
Energy Star Ground Source Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star GSHP, 17.1 SEER, 12 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Energy Star Imaging Equipment	Plug Load	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star Monitor	Plug Load	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star Personal Computer	Plug Load	One Personal Computer meeting ENERGY STAR 8.0 Standards	One Personal Computer meeting ENERGY STARÂ® 3.0 Standards
Energy Star Refrigerator	Refrigerators	One Refrigerator/Freezer meeting ENERGY STAR 5.1 Standards	One Refrigerator/Freezer meeting Federal Standard
Energy Star Room AC	Residential Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star Set-Top Receiver	Plug Load	One Set-top Box meeting ENERGY STAR 4.1 Standards	One Market Average Set-top Box
Energy Star TV	Plug Load	One Television meeting ENERGY STAR 9.0 Standards	One non-ENERGY STAR Television
Energy Star Windows	Residential Space Cooling, Residential Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window current FL energy code requirements

Measure	End-Use	Description	Baseline
Exterior Wall Insulation	Residential Space Cooling, Residential Space Heating	Increased Exterior Above-Grade Wall Insulation (R-13)	Market Average Existing Exterior Above-Grade Wall Insulation
Filter Whistle	Residential Ventilation and Circulation	Install the Furnace Filter Alarm	No Furnace Filter Alarm on a Central Forced-Air Furnace
Floor Insulation	Residential Space Heating	Increased Floor Insulation (R-30)	Code-Compliant Floor Insulation
Freezer Recycling	Freezers	No Freezer	Current Market Freezer
Green Roof	Residential Space Cooling	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
Heat Pump Clothes Dryer	Clothes Dryers	One Heat Pump Clothes Dryer	One Clothes Dryer meeting Federal Standard
Heat Pump Pool Heater	Residential Miscellaneous	Heat Pump Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Heat Pump Tune Up	Residential Space Cooling, Residential Space Heating	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Standard Heating and Cooling System without Regular Maintenance/tune-up
Heat Pump Water Heater 50 Gallons- CEE Advanced Tier	Residential Domestic Hot Water	CEE Advanced Tier Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 50 Gallons- ENERGY STAR	Residential Domestic Hot Water	Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 80 Gallons- ENERGY STAR	Residential Domestic Hot Water	Energy Star Heat Pump Water Heater 80 Gallons	Code-Compliant 80 Gallon Electric Resistance Water Heater
Heat Trap	Residential Domestic Hot Water	Heat Trap	Existing Water Heater without heat trap
High Efficiency Convection Oven	Residential Cooking	One Full-Size Convection Oven meeting ENERGY STAR 3.0 Standards	One Standard Economy-Grade Full-Size Oven
High Efficiency Induction Cooktop	Residential Cooking	One residential induction cooktop	One standard residential electric cooktop
Home Energy Management System	Lighting, Plug Load, Residential Space Cooling, Residential Space Heating	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Hot Water Pipe Insulation	Residential Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-5	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
HVAC ECM Motor	Residential Ventilation and Circulation	A brushless permanent magnet (ECM) blower motor for electric furnace	Permanent Split Capacitor Motor for Electric Furnace
HVAC Economizer	Residential Space Cooling	Install residential economizer	No economizer

Measure	End-Use	Description	Baseline
HVAC Zoning System	Residential Space Cooling, Residential Space Heating	Install dampers in the ducts, dividing home into multiple zones, each controlled by its own thermostat	Single zone HVAC system
Indoor Daylight Sensor	Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Range	Residential Cooking	Residential induction range	Electric range
Instantaneous Hot Water System	Residential Domestic Hot Water	Instantaneous Hot Water System	Standard Efficiency Storage Tank Water Heater
Kitchen Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
LED - 9W_CFL Baseline	Lighting	LED (assume 9W) replacing CFL baseline lamp	14W CFL (60W equivalent)
LED - 9W_Halogen Baseline	Lighting	LED (assume 9W) replacing EISA-2020 compliant baseline lamp	EISA-2020 compliant baseline lamp (60W equivalent)
LED Specialty Lamps-5W Chandelier	Lighting	5 W Chandelier LED	Standard incandescent chandelier lamp
Linear LED	Lighting	Linear LED Lamps in Linear Fluorescent Fixture	Standard (32w) T8 lamps in Linear Fluorescent Fixture
Low Flow Showerhead	Residential Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
New Construction - Whole Home Improvements - Tier 1	Whole Home	Performance-based improvements in new homes - 20% savings	Residential New Construction (Baseline Efficiency)
New Construction - Whole Home Improvements - Tier 2	Whole Home	Performance-based improvements in new homes - 35% savings	Residential New Construction (Baseline Efficiency)
Occupancy Sensors Switch Mounted	Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Timer	Lighting	Timer on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Outdoor Motion Sensor	Lighting	Motion Sensor on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Ozone Laundry	Clothes Washers	Add a New, Single-Unit Ozone Laundry System to the Clothes Washer	One Clothes Washer meeting Federal Standard

Measure	End-Use	Description	Baseline
Programmable Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Properly Sized CAC	Residential Space Cooling	Properly Sized Central Air Conditioning	Standard Central Air Conditioning, Oversized
Radiant Barrier	Residential Space Cooling	Radiant Barrier	No radiant barrier
Reflective Roof	Residential Space Cooling	Reflective Roof Treatment	Standard dark shingle
Refrigerator Coil Cleaning	Refrigerators	Refrigerator Coil Cleaning	
Refrigerator Recycling	Refrigerators	No Refrigerator	Current Market Average Refrigerator
Residential Whole House Fan	Residential Space Cooling	Standard Central Air Conditioning with Whole House Fan	Standard Central Air Conditioning, No Whole House Fan
Sealed crawlspace	Residential Space Cooling, Residential Space Heating	Encapsulated and semi-conditioned crawlspace	Naturally vented, unconditioned crawlspace
Smart Breaker	Whole Home	Smart Breaker	standard electric breakers
Smart Panel	Whole Home	Multi-channel device that attaches to customer's circuit breaker to enable monitoring and control of major end-use appliances by customer	standard electric panel
Smart Power Strip	Plug Load	Smart plug strips for entertainment centers and home office	Standard entertainment center or home office usage, no smart strip controls
Smart Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Solar Attic Fan	Residential Space Cooling	Standard Central Air Conditioning with Solar Attic Fan	Standard Central Air Conditioning, No Solar Attic Fan
Solar Pool Heater	Residential Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pumps	Residential Miscellaneous	Solar Powered Pool Pump	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System	Residential Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Spray Foam Insulation (Base R11)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R19)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Spray Foam Insulation (Base R2)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation(Base R30)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Thermostatic Shower Restriction Valve	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Thermostatic Shower Valves	50 Gallon Electric Resistance Heater and Standard Shower Valves
Variable Refrigerant Flow (VRF) HVAC Systems	Residential Space Cooling, Residential Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Water Heater Blanket	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Insulated Tank Wrap	Code-Compliant 50 Gallon Electric Resistance Water Heater, No Tank Wrap
Water Heater Thermostat Setback	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Temperature Setpoint of 119°F	Code-Compliant 50 Gallon Electric Resistance Water Heater (Temp. Setpoint = 130Â°F)
Water Heater Timeclock	Residential Domestic Hot Water	Water Heater Timeclock	Existing Water Heater without time clock
Weather stripping	Residential Space Cooling, Residential Space Heating	Specific quantity of weather stripping to seal	
Window Caulking	Residential Space Cooling, Residential Space Heating	Window caulking	
Window Sun Protection	Residential Space Cooling	Window Film Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

Table 13: Commercial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency

Measure	End-Use	Description	Baseline
Advanced Rooftop Controller	Ventilation and Circulation	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Miscellaneous	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air Curtains	Space Cooling, Space Heating	Air Curtain across door opening	Door opening with no air curtain
Airside Economizer	Space Cooling	Airside Economizer	No economizer
Anti-Sweat Controls	Refrigeration	One Medium Temperature Reach-In Case with Anti-Sweat Heater Controls	One Medium Temperature Reach-In Case without Anti-Sweat Heater Controls
Auto Off Time Switch	Interior Lighting	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Automatic Door Closer for Walk-in Coolers and Freezers	Refrigeration	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Beverage Vending Machine Controls	Refrigeration	One non-ENERGY STAR beverage vending machine equipped with infrared occupancy sensing controls	One non-ENERGY STAR beverage vending machine, no controls
Bi-Level Lighting Control (Exterior)	Exterior Lighting	Bi-Level Controls on Exterior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Interior)	Interior Lighting	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ceiling Insulation (R19 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Chilled Water Reset	Space Cooling	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature

Measure	End-Use	Description	Baseline
Chiller maintenance	Space Cooling	O&M improvements to restore chiller performance	
CO Sensors for Parking Garage Exhaust	Miscellaneous	Enclosed Parking Garage Exhaust with CO Control	Constant Volume Enclosed Parking Garage Exhaust
Commercial Duct Sealing	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Commercial Strategic Energy Management	Whole Building	Commercial Strategic Energy Management	No active energy management
Custom measure - Non-lighting	Space Cooling, Space Heating	Custom Improvement to Facility's Operations	Baseline Technology/Process
Data Center Hot Cold Aisle	Office Equipment	Equipment configuration that saves HVAC	No hot, cold aisle containment
Dedicated Outside Air System (DOAS)	Space Cooling, Space Heating	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Circulating Systems	Domestic Hot Water	Recirculation Pump with Demand Control Mechanism	Uncontrolled Recirculation Pump
Demand Controlled Ventilation	Ventilation and Circulation	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Refrigeration	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Destratification Fans	Space Heating	Destratification Fans improve temperature distribution by circulating warmer air from the ceiling back down to the floor level	No destratification fan
Door Gasket (Cooler)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Door Gasket (Freezer)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Drain water heat recovery	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Dual Enthalpy Economizer	Ventilation and Circulation	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
Duct Insulation	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork (R-8)	Standard Electric Heating and Central AC with Uninsulated Ductwork (R-4)
Ductless Mini-Split AC	Space Cooling	Ductless Mini-Split AC, 4 Ton, 16 SEER	Code-Compliant AC Unit, 4 Ton, 15 SEER

Measure	End-Use	Description	Baseline
Ductless Mini-Split HP	Space Cooling, Space Heating	Ductless Mini-Split HP, 17 SEER, 9.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
DX Coil Cleaning	Space Cooling	DX Coil Cleaning	DX Coil Not Cleaned
ECM Motors on Furnaces	Space Heating	Variable Speed Electronically Commutated Motor for an Electric Furnace	Permanent Split Capacitor Motor for Electric Furnace
Efficient Battery Charger	Miscellaneous	Efficient Battery Charger	FR or SCR charging stations with power conversion efficiency < 89% or > 10 W
Efficient Exhaust Hood	Cooking	Kitchen ventilation with automatically adjusting fan controls	Kitchen ventilation with constant speed ventilation motor
Efficient Motor Belts	Miscellaneous	Synchronous belt, 98% efficiency	Standard V-belt drive
Efficient New Construction Lighting	Interior Lighting	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Energy Recovery Ventilation System (ERV)	Space Cooling	Unitary Cooling Equipment that Incorporates Energy Recovery	Current Market Packaged or Split DX Unit
Energy Star Combination Oven	Cooking	Energy Star Combination Oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade 10-Pan Combination Oven
Energy Star Commercial Clothes Washer	Miscellaneous	One Commercial Clothes Washer meeting current ENERGY STAR Version 8.1 Standards	One Commercial Clothes Washer meeting Federal Standard
Energy Star Commercial Dishwasher	Domestic Hot Water	One Commercial Dishwasher meeting ENERGY STAR Version 3.0 Standards	One Dishwasher meeting Federal Standard
Energy Star Commercial Glass Door Freezer	Refrigeration	One Glass Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Glass Door Freezer meeting Federal Standards
Energy Star Commercial Glass Door Refrigerator	Refrigeration	One Glass Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Glass Door Refrigerator meeting Federal Standards
Energy Star Commercial Solid Door Freezer	Refrigeration	One Solid Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Solid Door Freezer meeting Federal Standards
Energy Star Commercial Solid Door Refrigerator	Refrigeration	One Solid Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Solid Door Refrigerator meeting Federal Standards
Energy Star convection oven	Cooking	Energy Star convection oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Full-Size Convection Oven
Energy Star EV Chargers	Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)

Measure	End-Use	Description	Baseline
Energy Star Fryer	Cooking	One Standard Vat Electric Fryer meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Standard Vat Electric Fryer
Energy Star Griddle	Cooking	One Griddle meeting current ENERGY STAR Version 1.2 Standards	One Conventional Griddle
Energy Star Hot Food Holding Cabinet	Cooking	One Hot Food Holding Cabinet meeting current ENERGY STAR Version 2.0 Standards	One Standard Hot Food Holding Cabinet
Energy Star Ice Maker	Refrigeration	One Continuous Self-Contained Ice Maker meeting ENERGY STAR Version 3.0 Standards	One Continuous Self-Contained Ice Maker meeting Federal Standard
ENERGY STAR Imaging Equipment	Office Equipment	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star LED Directional Lamp	Interior Lighting	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star Monitors	Office Equipment	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star PCs	Office Equipment	One Personal Computer (desktop or laptop) meeting current ENERGY STARÂ® Standards	One non-ENERGY STARÂ® Personal Computer
Energy Star room AC	Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC, 1 Ton, 10.9 CEER
Energy Star Servers	Office Equipment	One Server meeting ENERGY STAR 2.0 Standards	One Standard Server
Energy Star Steamer	Cooking	One 4-Pan Electric Steamer meeting ENERGY STARÂ® 2.0 Standards	One Standard Economy-Grade 4-Pan Steamer
Energy Star Uninterruptable Power Supply	Office Equipment	Standard Desktop Plugged into Energy Star Uninterruptable Power Supply at 25% Load	Standard Desktop Plugged into Average Rotary Uninterruptable Power Supply at 25% Load
Energy Star Vending Machine	Refrigeration	One Refrigerated Vending Machine meeting ENERGY STAR Version 4.0 Standards	One Refrigerated Vending Machine meeting ENERGY STARÂ® 1.0 Standards
ENERGY STAR Water Cooler	Miscellaneous	One Storage Type Hot/Cold Water Cooler Unit meeting ENERGY STAR Version 3.0 Standards	One Standard Storage Type Hot/Cold Water Cooler Unit
Energy Star windows	Space Cooling, Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)

Measure	End-Use	Description	Baseline
Engine Block Timer	Miscellaneous	Plug-in timer that activates engine block timer to reduce unnecessary run time	Engine block heater (typically used for backup generators) running continuously
Escalator Motor Efficiency Controller	Miscellaneous	Install Escalator Motor Efficiency Controller	Escalator without Motor Efficiency Controller
Facility Commissioning	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility commissioning to optimize building operations in new facilities	Standard new construction facility with no commissioning
Facility Energy Management System	Space Cooling, Space Heating, Ventilation and Circulation	Typical HVAC by Building Type Controlled by Energy Management System	Standard/manual facility equipment controls
Faucet Aerator	Domestic Hot Water	Low-flow lavatory faucet aerator, flow rate: 1.0 gpm	Federal lavatory flow rate standard, 1994, flow rate: 2.2 gpm
Floating Head Pressure Controls	Refrigeration	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Floor Insulation	Space Cooling, Space Heating	Increased Floor Insulation (R-19)	Market Average Existing Floor Insulation
Geothermal Heat Pump	Space Cooling, Space Heating	Geothermal Heat Pump	Code-Compliant Air Source Heat Pump
Green roof	Space Cooling, Space Heating	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
HE Air Cooled Chiller - All Compressor Types - 100 Tons	Space Cooling	HE Air Cooled Chiller - Air Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE DX 11.25-20.0 Tons Elec Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER

Measure	End-Use	Description	Baseline
HE DX Less than 5.4 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
Heat Pump Pool Heater Commercial	Miscellaneous	High Efficiency Pool Heater Eff. >=84%	Standard Efficiency Pool Heater 78% Eff.
Heat Pump Water Heater	Domestic Hot Water	Efficient 50 Gallon Electric Heat Pump Water Heater	Code-Compliant 50 Gallon Electric Heat Pump Water Heater
High Efficiency Air Compressor	Miscellaneous	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Data Center Cooling	Space Cooling	High Efficiency CRAC (computer room air conditioner)	Standard Efficiency CRAC
High Efficiency PTAC	Space Cooling	High Efficiency PTAC	Code-Compliant PTAC
High Efficiency PTHP	Space Cooling, Space Heating	High Efficiency PTHP	Code-Compliant PTHP
High Efficiency Refrigeration Compressor_Discus	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor_Scroll	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Speed Fans	Ventilation and Circulation	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
Hot water pipe insulation	Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-4	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
Hotel Card Energy Control Systems	Space Cooling, Space Heating	Guest Room HVAC Unit Controlled by Hotel-Key-Card Activated Energy Control System	Guest Room HVAC Unit, Manually Controlled by Guest

Measure	End-Use	Description	Baseline
Indoor daylight sensor	Interior Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Cooktops	Cooking	Efficient Induction Cooktop	One Standard Electric Cooktop
Infiltration Reduction - Air Sealing	Space Cooling, Space Heating	Reduced leakage through caulking, weather-stripping	Standard Heating and Cooling System with Moderate Infiltration
Instantaneous Hot Water System Commercial	Domestic Hot Water	Instantaneous Hot Water System	Code-Compliant Electric Storage Water Heater
LED - 14W_CFL Baseline	Interior Lighting	LED (assume 14W) replacing CFL	100W equivalent CFL
LED - 9W Flood_CFL Baseline	Exterior Lighting	LED (assume 9W) replacing CFL	14W CFL
LED Canopy Lighting (Exterior)	Exterior Lighting	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Exit Sign	Interior Lighting	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting	2x4 LED Troffer	Lumen-Equivalent 32-Watt T8 Lamp
LED Linear - Lamp Replacement	Interior Lighting	Linear LED (16W)	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	Space Cooling, Space Heating	LEED New Construction Whole Building	Comparable facility, code-compliance construction
Light Tube	Interior Lighting	One 14" Light Tube, Delivering light to 250 S.F. of Commercial Space	250 S.F. of Commercial Space Lit by Typical Lighting Strategies

Measure	End-Use	Description	Baseline
Low Flow Shower Head	Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.50 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
Low-Flow Pre-Rinse Sprayers	Domestic Hot Water	Low-Flow Pre-Rinse Sprayer with Flow Rate of 1.6 gpm	Pre-Rinse Sprayer with Federal Standard Flow Rate of 2.25 gpm
Network PC Power Management	Office Equipment	One computer and monitor attached to centralized energy management system that controls when desktop computers and monitors plugged into a n	One computer and monitor, manually controlled
Networked Lighting Controls	Interior Lighting	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Night Covers for Display Cases	Refrigeration	One Open Vertical Case with Night Covers	One Existing Open Vertical Case, No Night Covers
Occupancy Sensors, Ceiling Mounted	Interior Lighting	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy Sensors, Switch Mounted	Interior Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ozone Laundry Commercial	Miscellaneous	Add a new ozone laundry system onto a commercial clothes washer	One commercial clothes washer without ozone laundry system
Programmable thermostat	Space Cooling, Space Heating	Pre-set programmable thermostat that replaces manual thermostat	Standard Heating and Cooling System with Manual Thermostat
PSC to ECM Evaporator Fan Motor (Reach-In)	Refrigeration	Medium Temperature Reach-In Case with equivalent size Electronically Commutated Evaporator Fan Motor	Medium Temperature Reach-In Case with Permanent Split Capacitor Evaporator Fan Motor
PSC to ECM Evaporator Fan Motor (Walk-In, Refrigerator)	Refrigeration	Medium Temperature Walk-In Case with Electronically Commutated Evaporator Fan Motor	Medium Temperature Walk-In Case with Permanent Split Capacitor Evaporator Fan Motor

Measure	End-Use	Description	Baseline
Q-Sync Evaporator Fan Motor	Refrigeration	Medium Temperature Reach-In Case with equivalent size Q-Sync Evaporator Fan Motor	Medium Temperature Reach-In Case with 20W Permanent Split Capacitor Fan Motor
Reflective Roof Treatment	Space Cooling	Reflective Roof Treatment	Standard Black Roof
Refrigerated Display Case LED Lighting	Refrigeration	60" Refrigerated Case LED Strip	Lumen-Equivalent 32-Watt T8 Fixture
Refrigerated Display Case Lighting Controls	Refrigeration	Occupancy Sensors for Refrigerated Case Lighting to reduce run time	Market-Share Weighted Existing Linear Fluorescent Fixture
Refrigeration Commissioning	Refrigeration	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Refrigeration Economizer	Refrigeration	Walk-in refrigerator with economizer	Walk-in refrigerator without economizer
Regenerative Drive Elevator Motor	Miscellaneous	Regenerative drive produced energy when motor in overhaul condition	Standard motor
Retro-Commissioning (Existing Construction)	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	
Retro-Commissioning (Existing Construction)_VT	Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	
Roof Insulation	Space Cooling, Space Heating	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Server Virtualization	Office Equipment	2 Virtual Host Server	20 Single Application Servers
Smart Strip Plug Outlet	Office Equipment	One Smart Strip Plug Outlet	One Standard plug strip/outlet
Smart thermostat	Space Cooling, Space Heating	Thermostats that include "smart" features such as occupancy sensors, geo-fencing, multi-zone sensors	Standard Heating and Cooling System with Manual Thermostat
Solar Pool Heater Commercial	Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pump	Miscellaneous	Solar Powered Pool Pump Motor	Variable Speed Pool Pump Motor

Measure	End-Use	Description	Baseline
Solar Thermal Water Heating System Commercial	Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Strip Curtains - Freezers	Refrigeration	Walk-in freezer with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in freezer without strip curtains
Strip Curtains - Refrigerators	Refrigeration	Walk-in cooler with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in cooler without strip curtains
Suction Pipe Insulation - Freezers	Refrigeration	Suction Pipe Insulation - Freezers	Uninsulated freezer suction lines
Suction Pipe Insulation - Refrigerators	Refrigeration	Suction Pipe Insulation - Refrigerators	Uninsulated refrigeration suction lines
Thermal Energy Storage	Space Cooling	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Thermostatic Shower Restriction Valve Commercial	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Pressure Balance Shower Valves	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater and Standard Shower Valves
Time Clock Control	Interior Lighting	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Variable Refrigerant Flow (VRF) HVAC Systems	Space Cooling, Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant PTHP
VAV System	Ventilation and Circulation	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Cooling Tower Fans	Space Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Pump	Space Cooling, Space Heating	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VSD Controlled Compressor	Refrigeration	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Wall Insulation	Space Cooling, Space Heating	Increased Exterior Above-Grade Wall Insulation	Market Average Existing Exterior Above-Grade Wall Insulation
Warehouse Loading Dock Seals	Space Cooling, Space Heating	Seals to reduce infiltration losses at loading dock	Loading dock with no seals
Water Cooled Refrigeration Heat Recovery	Domestic Hot Water	The heat reclaim system transfers waste heat from	No heat recovery

Measure	End-Use	Description	Baseline
		refrigeration system to space heating or hot water	
Water Heater Setback	Domestic Hot Water	A 50 gallon electric hot water tank with a thermostat setting reduced to no lower than 120 degrees.	A 50 gallon electric hot water tank with a thermostat setting that is higher than 120 degrees, typically hot water tanks with settings of 130 degrees or higher.
Water source heat pump	Space Cooling, Space Heating	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside Economizer	Space Cooling	Waterside Economizer	No economizer
Window shade film	Space Cooling	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC
Zero Energy Doors	Refrigeration	Install zero energy doors for a reach-in refrigerated cooler or freezer	Standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors

Table 14: Industrial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
3-phase High Frequency Battery Charger - 1 shift	Other	3-phase High Frequency Battery Charger	Standard Charger
Advanced Rooftop Controller	HVAC	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Compressed Air	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air curtains	HVAC	Air Curtain across door opening	Door opening with no air curtain
Airside economizer	HVAC	Airside Economizer	No economizer

Measure	End-Use	Description	Baseline
Auto Closer on Refrigerator Door	Process Cooling	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Auto Off Time Switch	Interior Lighting High Bay	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Exterior)	Exterior Lighting Industrial	Install Exterior Bi-Level Lighting Control, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Bi-Level Lighting Control (Interior)	Interior Lighting High Bay	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Chilled Water Reset	HVAC	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Cogged Belt on 15hp ODP Motor	Motors Pumps	15HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	15HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Cogged Belt on 40hp ODP Motor	Motors Pumps	40HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	40HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Compressed Air Desiccant Dryer	Process Specific	heated regenerative desiccant dryer without dew point demand controls	heatless regenerative desiccant dryer without dew point demand controls
Compressed Air No-Loss Condensate Drains	Process Specific	Install no-loss condensate drains	Install standard condensate drains
Compressed Air Storage Tank	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Receiver Tank	20 HP Inlet Modulation Fixed-Speed Compressor, No Receiver Tank
Custom Measure - Non-Lighting	HVAC	Custom Improvement to Facility's Operations	Baseline Technology/Process
Dairy Refrigeration Heat Recovery	Other	refrigeration equipment with refrigeration heat recovery tank installed	existing dairy farm with refrigeration equipment and a water heater unit without an RHR unit
Dedicated Outside Air System (DOAS)	HVAC	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Ventilation	HVAC	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Process Cooling	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle

Measure	End-Use	Description	Baseline
Dew Point Sensor Control for Dessicant CA Dryer	Compressed Air	1000 CFM Heated Desicant Air Dryer with Dew Point Controls	1000 CFM Modulating Heated Desicant Air Dryer
Drip Irrigation Nozzles	Other	Flow Control Nozzles	Standard Irrigation Nozzles
Dual Enthalpy Economizer	Process Cooling	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
DX Coil Cleaning	HVAC	DX Coil Cleaning	DX Coil Not Cleaned
Efficient Compressed Air Nozzles	Compressed Air	1/4" Engineered Air Nozzle	1/4" Open-End Air Nozzle
Efficient New Construction Lighting	Interior Lighting High Bay	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Electric Actuators	Other	Electric Actuator	Pneumatic Actuator
Energy Efficient Laboratory Fume Hood	HVAC	Variable Air Volume High Performance Fume Hood	Constant Volume Conventional Bypass Fume Hood
Energy Efficient Transformers	Other	Energy Efficient Dry Type Transformer (CSL-3)	Standard Transformer (TP-1)
Energy Recovery Ventilation System	HVAC	Unitary Cooling Equipment that Incorporates Energy Recovery	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11.2 EER
Energy Star LED Directional Lamp	Interior Lighting Other	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star room ac	HVAC	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star windows	HVAC	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Other	An engine block heater operated by an outdoor plug-in timer	An engine block heater that is manually plugged in
Facility Commissioning	HVAC	Perform facility commissioning	Comparable facility, no commissioning
Facility Energy Management System	HVAC	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Fan Thermostat Controller	HVAC	Typical HVAC by Building Type with Fan Thermostat Controller Installed	Typical HVAC by Building Type with Programmable Thermostat

Measure	End-Use	Description	Baseline
Floating Head Pressure Controller	Process Cooling	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Grain Bin Aeration Control System	Process Specific	Grain Storage Fan System with Automatic Controls	Grain Storage Fan System with Manual Controls
HE Air Cooled Chiller - All Compressor Types - 100 Tons	HVAC	HE Air Cooled Chiller - All Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE Air Cooled Chiller - All Compressor Types - 300 Tons	HVAC	Air Cooled Positive Displacement Chiller with Integral VFD, 300 Tons, 13.7 EER	Code-Compliant Air Cooled Positive Displacement Chiller, 300 Tons, 12.5 EER
HE DX 11.25-20.0 Tons Elec Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons

Measure	End-Use	Description	Baseline
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
High Bay Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 800 Watts Controlled	800 Watts of Lighting, Manually Controlled
High Efficiency Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Refrigeration Compressor - Discus	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor - Scroll	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Welder	Process Specific	High Efficiency Welder	Standard Welding Practices
High Speed Fans	HVAC	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
High Volume Low Speed Fan (HVLS)	Motors Fans Blowers	20' High Volume Low Speed Fan	Conventional Circulating Fan
Indoor Agriculture - LED Grow Lights	Interior Lighting High Bay	LED grow light	1000W High Pressure Sodium
Indoor daylight sensor	Interior Lighting High Bay	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Industrial Duct Sealing	HVAC	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Injection Mold and Extruder Barrel Wraps	Other	2' Diameter, 20' Long Machine Barrel with 1" Insulation	2' Diameter, 20' Long Machine Barrel with no Insulation
Insulated Pellet Dryer Tanks and Ducts	Process Heating	Insulation for Pellet Tank and Duct	Uninsulated Pellet Tank and Duct
LED - 14W_CFL Baseline	Interior Lighting Other	LED (assume 14W) replacing CFL	100W equivalent CFL
LED Canopy Lighting (Exterior)	Exterior Lighting Industrial	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting Industrial	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height

resource innovations

Measure	End-Use	Description	Baseline
LED Display Lighting (Interior)	Interior Lighting Other	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED exit sign	Interior Lighting Other	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting Industrial	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting Linear Fluorescent	2x4 LED Troffer Fixture	Lumen-Equivalent 32-Watt T8 Fixture
LED Linear - Lamp Replacement	Interior Lighting Linear Fluorescent	Linear LED	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting Industrial	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	HVAC	LEED Qualifying New Construction	Comparable facility, code-compliance construction
Light Tube	Interior Lighting Other	One 14" Light Tube, Delivering light to 250 S.F. of Industrial Space	250 S.F. of Industrial Space Lit by Typical Lighting Strategies
Low Energy Livestock Waterer	Motors Pumps	Install Thermostatically Controlled Livestock Watering System	Standard Livestock Watering System
Low Pressure Sprinkler Nozzles	Motors Pumps	Low Pressure Irrigation Nozzles operate at 35 psi or lower	Standard high pressure irrigation nozzles that operate at 50 psi or greater
Low Pressure-drop Filters	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Low Pressure Drop Filter	20 HP Inlet Modulation Fixed-Speed Compressor, No Particulate Removal
Milk Pre-Cooler	Other	Installed pre-cooler heat exchanger	no pre-cooler heat exchanger installed
Networked Lighting Controls	Interior Lighting Linear Fluorescent	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy sensors, switch mounted	Interior Lighting Linear Fluorescent	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled

Measure	End-Use	Description	Baseline
Outdoor Lighting Controls	Exterior Lighting Industrial	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting Industrial	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Packaged Terminal AC	HVAC	High Efficiency Packaged Terminal AC	Code-Compliant PTAC, 10.9 EER
Process Cooling Ventilation Reduction	Process Cooling	Standard Process Cooling with Reduced Ventilation	Standard Process Cooling
Programmable thermostat	HVAC	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Reflective Roof Treatment	HVAC	Reflective Roof Treatment	Standard Black Roof
Refrigeration Commissioning	Process Cooling	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Retro-Commissioning (Existing Construction)	HVAC	Perform Facility Retro-commissioning	
Roof insulation	HVAC	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Smart thermostat	HVAC	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Strategic Energy Management	HVAC	SEM goal setting and tracking	No active energy management
Synchronous Belt on 15hp ODP Motor	Motors Pumps	15 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	15 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 5hp ODP Motor	Motors Pumps	5 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	5 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 75hp ODP Motor	Motors Pumps	75 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	75 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Thermal energy storage	HVAC	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Time Clock Control	Interior Lighting High Bay	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled

Measure	End-Use	Description	Baseline
VAV System	HVAC	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
VFD on Cooling Tower Fans	Process Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Fan	Motors Fans Blowers	5 HP HVAC Fan Motor, with VFD Control	5 HP HVAC Fan Motor, no VFD Control
VFD on HVAC Pump	Motors Pumps	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VFD on process pump	Motors Pumps	20 HP Process Pump Equipped with VFD Control	20 HP Process Pump, Constant Speed
VSD Controlled Compressor	Process Cooling	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Water source heat pump	HVAC	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside economizer	HVAC	Waterside Economizer	No economizer
Window shade film	HVAC	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

The following EE measures from the 2019 Technical Potential Study were eliminated from the current study[8]:

Table 15: 2019 EE Measures Eliminated from Current Study

Sector	Measure	End-Use	Reason for Removal
Residential	CFL – 15W Flood	Lighting	Better technology (LED) available
Residential	CFL – 15W Flood (Exterior)	Lighting	Better technology (LED) available
Residential	CFL – 13W	Lighting	Better technology (LED) available
Residential	CFL – 23W	Lighting	Better technology (LED) available
Residential	Low Wattage T8 Fixture	Lighting	Better technology (LED) available

[8] Additional measures from the 2019 study were updated to reflect current vintage/technology for the current study.

Sector	Measure	End-Use	Reason for Removal
Residential	15 SEER Central AC	Space Cooling	Updated Federal Standard
Residential	15 SEER Air Source Heat Pump	Space Cooling, Space Heating	Updated Federal Standard
Residential	14 SEER ASHP from base electric resistance heating	Space Cooling, Space Heating	Updated Federal Standard
Residential	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Storm Door	Space Cooling, Space Heating	Minimal/uncertain energy savings
Commercial	CFL – 15W Flood	Exterior Lighting	Better technology (LED) available
Commercial	High Efficiency HID Lighting	Exterior Lighting	Better technology (LED) available
Commercial	LED Street Lights	Exterior Lighting	Market standard
Commercial	LED Traffic and Crosswalk Lighting	Exterior Lighting	Market standard
Commercial	High Efficiency HID Lighting	Exterior Lighting	Market standard
Commercial	CFL-23W	Interior Lighting	Better technology (LED) available
Commercial	High Bay Fluorescent (T5)	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Fixture Replacement	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Lamp Replacement	Interior Lighting	Better technology (LED) available
Commercial	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Tank Wrap on Water Heater	Domestic Hot Water	Limited applicability
Commercial	Ceiling Insulation (R12 to R38)	Space Cooling, Space Heating	Consolidated measure baseline assumptions
Commercial	Ceiling Insulation (R30 to R38)	Miscellaneous	Consolidated measure baseline assumptions

Appendix B DR Measure List

Table 16: Residential DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Water heater control	Direct load control	Summer and Winter	Load control installed on a water heater (integrated or external switch)
Pool pump switches	Direct load control	Summer and Winter	Load control program with switch installed on pool pump
Room AC	Direct load control	Summer	Load control program that is focused on room AC units rather than central AC
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 17: Small C&I DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 18: Large C&I DR Measures

Measure	Type	Season	Description
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of

Measure	Type	Season	Description
			CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Auto DR	Utility-controlled loads	Summer and Winter	Custom load control of specific end-uses/processes that is triggered by utility signal to building management system; customer can sometimes opt-out of specific events
Firm Service Level	Contractual	Summer and Winter	Customer commits to a maximum usage level during peak periods and, when notified by the utility, agrees to cut usage to that level.
Guaranteed Load Drop	Contractual	Summer and Winter	Customer agrees to reduce usage by an agreed upon amount when notified

No DR measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix C DSRE Measure List

Table 19: Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation

Table 20: Non-Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation
CHP – Fuel Cell	An electrochemical cell-based generator that reacts hydrogen fuel with oxygen
CHP – Micro Turbine	Small combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Gas Turbine	A combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Reciprocating Engine	An engine that uses one or more pistons to convert pressure into rotational motion
CHP - Steam Turbine	A turbine that extracts thermal energy from pressured steam to drive a generator

No DSRE measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix D External Measure Suggestions

Table 21: External Measure Suggestions and Actions

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Efficient Electrification Measures	All measures that can produce substantial site energy savings by converting from natural gas or other fossil fuels should be included in the Florida electric utilities' next efficiency potential study. Key examples include efficient heat pumps to displace gas furnaces and efficient heat pump water heaters to displace gas water heaters. It is important to note that these electrification measures provide not only heating energy savings and water heating energy savings, but can also potentially provide cooling efficiency benefits as well. In the case of heat pumps, that can occur because efficient heat pumps can operate in cooling mode more efficiently than standard central air conditioners. In the case of heat pump water heaters, cooling and dehumidification benefits can occur when/if the water heater is in conditioned space because they transfer heat (particularly latent heat) from the air around them to the water they are heating. A growing number of jurisdictions – including Illinois, Minnesota and some northeastern states – have begun to include efficient electrification measures in their efficiency programs portfolios.	Fuel-switching and electrification are outside the scope of this study
Networked Lighting Controls	LED lighting technology has become increasingly accepted and installed in commercial buildings. The next big efficiency opportunity in commercial lighting efficiency is in sophisticated controls integrated into the light fixtures themselves – both luminaire level lighting controls and networked lighting controls. For example, a 2017 report for both the Northwest Energy Efficiency Alliance and the Design Lights Consortium, a non-profit that works with utilities and manufacturers of lighting products (and which many utilities across the country reference for determination of eligibility of lighting products for efficiency program rebates), found that networked lighting controls can provide on the order of 50% additional savings after LED conversion. Other studies have also found the national savings potential from such products to be enormous. Moreover, these products can be designed to provide not only lighting energy savings but also a number of other non-energy benefits (e.g., asset tracking, such as the ability of hospitals to know the location of all wheel chairs). Numerous utilities across the country now actively promote this technology through their efficiency programs. For example, Commonwealth Edison, the utility serving Chicago and other parts of northern Illinois, is currently getting a significant portion of its commercial lighting savings from promotion of networked lighting controls	Added to measure list for 2024 study

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Ductless mini-split heat pumps to displace inefficient electric baseboard heating	While most Florida residential buildings with electric heat provide that heat with heat pumps, at least some (perhaps most likely being older multi-family rental buildings) still use inefficient electric resistance heat. Ductless mini- split heat pump retrofits can very efficiently displace such inefficient electric heat and should be added to the residential measure list.	Added to measure list for 2024 study
Air Source Heat Pump baseline assumptions	There are seven air source heat pump (ASHP) measures included in the residential measure list. Two of them – one at SEER 14 and a second at SEER 21 – are listed as relative to an electric resistance baseline. Five of them – SEER 15, SEER 16, SEER 17, SEER 18 and SEER 21 – appear to be relative to a baseline of a standard new ASHP. Are we interpreting this correctly? If so, we have a couple of comments/questions/suggestions: • The efficiency standards assessed need to be modified to be consistent with new federal standards, including new testing procedures. • For cases where the baseline is "electric resistance", why only assessing two efficiency tiers (i.e., fewer than for standard ASHP baselines)? The same number of efficiency tiers should be assessed for both baselines.	Incorporated suggestions into 2024 study, including updated baseline standard and assessing same efficiency tiers for both baselines
Heat Pump Water Heater Efficiency	The Res EE tab of the utilities draft measure list suggests that the efficiency of a heat pump water heater is an EF of 2.50. That is unrealistically low. In fact, of the 222 products listed on the Energy Star website, none had UEFs less than 2.80 and only 29 (13%) had UEFs that were less than 3.4; the average was 3.57. Indeed, the first product listed on a search of heat pump water heaters on Home Depot's website is a 50 gallon, Rheem (Pro Terra) product with a UEF of 3.75 and a cost of $1699.	Incorporated suggestion into 2024 study
New Construction Measure Packages	The measures lists did not appear to include packages of measures for building new residential and/or new commercial buildings to levels of efficiency beyond those required by code. Utilities in many jurisdictions run new construction efficiency programs supporting such measure packages. In the residential sector, many base their programs on the long-standing Federal Energy Star standard. However, increasingly utility programs are promoting additional efficiency tiers – often as part of all-electric new construction program offerings – that go well beyond the Energy Star standard. For example, Consumers Energy (Michigan) offers $1000 rebates to builders who construct Energy Star single family homes	Incorporated suggestion into 2024 study with 2 tiers of residential new construction whole-home improvement measures.

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
	with a Home Energy Rating (HERS) score of 57 or less, but offer higher rebates for more efficient buildings – up to $4000 for all electric homes with a HERS score of 40 or less. The Florida utilities potential study should assess savings potential for both the Energy Star level and a tier or two of additional efficiency beyond that level. Similar assessments of new commercial building savings potential should also be assessed.	
Custom Industrial Measures	The utilities' list of industrial efficiency measures addresses common industrial efficiency opportunities. However, it does not address efficiency opportunities that may be unique to individual industries or even to individual industrial facilities. That can include such things as changes in types of materials used in manufacturing, reductions in waste streams, improved use of water delivered by agricultural irrigation systems, and/or other things that are not directly related to energy using equipment or controls of such equipment. It is obviously not possible to list all such measures. However, a potential study will understate savings potential if it does not include a way of capturing such potential in its estimates. One potential way to get a sense of such potential is to review results of comprehensive industrial efficiency programs run by other utilities to identify the portion of actual program savings from such unique custom measures – and then assume that portion of custom savings could be added to the savings estimated in the study for named measures.	Added to measure list for 2024 study
Electric Vehicle measures	Some EV chargers are more efficient than others. The Federal Energy Star program has a standard for them. Savings potential may not be huge, but should be considered in the study. With a growing number of EV sales, the study should also consider the potential savings from promoting the most efficient EVs within different size/style categories	Added to measure list for 2024 study
Removing screw-based LEDs	The screw-based LEDs on both the Residential and Commercial measure lists should now be considered baseline due to federal efficiency standards adopted earlier this year. Utility load forecasts for IRPs should reflect resulting improvements in end use efficiency.	Screw-based LEDs were included in the study but with limited applicability to reflect current market
Removing Commercial fluorescent lighting	LED technology – for both fixtures and lamps – has advanced significantly in recent years, to the point where it should be the only technology considered for commercial lighting. Measures such as high performance T-8 fluorescent fixtures and high bay T-5 fluorescent fixtures should be replaced with LED alternatives in the study.	Updated measure list for 2024 study to only include LED-based lamps for linear fluorescent replacements

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Removing fossil-gas fueled CHP	Fossil-fuel fired CHP systems should not be considered "renewable" and have questionable benefits if electric generation is expected to get increasingly more renewable and clean. Biogas-fueled CHP – such as systems installed in wastewater treatment facilities that use methane byproducts of processing waste – should be included in the study.	2024 study will continue to assess all CHP options
Adding livestock methane power generation to renewables list	For example, see the "cow power" program currently being run by Green Mountain Power, Vermont's largest electric utility	2024 study will continue to assess DSRE options consistent with prior study, including customer-sited solar, solar plus storage, and CHP
Adding EV managed charging to DR list	With national market shares for EVs growing, it is important that utilities consider programs for managing when charging occurs. Numerous utilities are currently running managed charging programs. This does not currently appear to be on the measure list and should be added to the Florida utilities' potential study.	Added to measure list for 2024 study
Residential "smart thermostat" measure can provide both efficiency savings and demand response potential	This is recognized in the inclusion of smart thermostats in both the Res EE and DR tabs of the measure list spreadsheet. We simply want to flag that it is important when assessing cost-effectiveness of this measure that these two potential benefits are considered together. In other words, the cost should be considered compared to the combined efficiency and DR potential rather than separately considered relative to just EE savings and then separately again compared to just DR potential	2024 study will include interactive impacts of EE and DR opportunities
Emerging Technologies	The efficiency potential study measure list appears to be somewhat outdated. It does not include a number of new and emerging technologies. The potential list of such technologies is long. We suggest reviewing the attached list of emerging technologies developed almost two years ago by Consumers Energy (Michigan) and including them in the study.	Consumers Energy study was reviewed and commercially available measures were added to measure list for 2024 study, including heat pump water heaters - CEE advanced tier, heat pump clothes dryers, ozone laundry systems, and 21+ SEER HVAC units

Docket Nos. 20240012-EG to 20240017-EG
TPS for Duke Energy Florida
Exhibit JH-3, Page 83 of 84

Docket Nos. 20240012-EG to 20240017-EG
TPS for Duke Energy Florida
Exhibit JH-3, Page 84 of 84

Technical Potential Study of Demand Side Management

Tampa Electric Company

Date: 03.07.2024

Table of Contents

Executive Summary

In October 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems.

The main objective of the study was to assess the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of Tampa Electric Company's (TECO) service territory.

1.1 Methodology

Resource Innovations estimates DSM savings potential by applying an analytical framework that aligns baseline market conditions for energy consumption and demand with DSM opportunities. After describing the baseline condition, Resource Innovations applies estimated measure savings to disaggregated consumption and demand data. The approach varies slightly according to the type of DSM resources and available data; the specific approaches used for each type of DSM are described below.

1.1.1 EE Potential

This study utilized Resource Innovations' proprietary EE modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual program savings. The methodology for the EE potential assessment was based on a hybrid "top-down/bottom-up" approach, which started with the current utility load forecast, then disaggregated it into its constituent customer-class and end-use components. Our assessment examined the effect of the range of EE measures and practices on each end-use, taking into account current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the end-use, customer class, and system levels for TECO.

1.1.2 DR Potential

The assessment of DR potential in TECO's service territory was an analysis of mass market direct load control programs for residential and small commercial and industrial (C&I) customers, and an analysis of DR programs for large C&I customers. The direct load control program assessment focused on the potential for demand reduction through heating, ventilation, and air conditioning (HVAC), water heater, managed electric vehicle charging, and pool pump load control. These end-uses were of particular interest because of their large contribution to peak period system load. For this analysis, a range of direct load control measures were examined for each customer segment to highlight the range of potential. The assessment further accounted for existing DR programs for TECO when calculating the total DR potential.

1.1.3 DSRE Potential

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from customers' PV systems, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

1.2 Savings Potential

Technical potential for EE, DR, and DSRE are as follows:

1.2.1 EE Potential

EE technical potential describes the savings potential when all technically feasible EE measures are fully implemented, ignoring all non-technical constraints on electricity savings, such as cost-effectiveness and customer willingness to adopt EE.

The estimated EE technical potential results are summarized in Table 1.

Table 1. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	992	445	3,197
Non-Residential[1]	398	334	2,272
Total	1,390	779	5,469

1.2.2 DR Potential

DR technical potential describes the magnitude of loads that can be managed during conditions when grid operators need peak capacity. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale such as heating, cooling, water heaters, managed electric vehicle charging, and pool pumps. For large C&I customers, this included their entire electric demand during a utility's system peak, as many of these types of customers will forego virtually all electric demand temporarily if the financial incentive is large enough.

The estimated DR technical potential results are summarized in Table 2.

Table 2. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	1,541	1,439
Non-Residential	1,571	1,691
Total	3,112	3,130

[1] Non-Residential results include all commercial and industrial customer segments.

1.2.3 DSRE Potential

DSRE technical potential estimates quantify all technically feasible distributed generation opportunities from PV systems, battery storage systems charged from PV, and CHP technologies based on the customer characteristics of TECO's customer base.

The estimated DSRE technical potential results are summarized in Table 3.

Table 3. DSRE Technical Potential[2]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	484	51	8,000
Non-Residential	165	6	2,236
Total	649	57	10,236
Battery Storage charged from PV Systems			
Residential	598	876	0
Non-Residential	120	205	0
Total	718	1081	0
CHP Systems			
Total	358	286	1,768

[2] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

2 Introduction

In October 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems. The main objective of the study was:

- Assessing the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of TECO's service territory.

The following deliverables were developed by Resource Innovations as part of the project and are addressed in this report:

- DSM measure list and detailed assumption workbooks
- Disaggregated baseline demand and energy use by year, sector, and end-use
- Baseline technology saturations, energy consumption, and demand
- Technical potential demand and energy savings
- Supporting calculation spreadsheets

2.1 Technical Potential Study Approach

Resource Innovations estimates technical potential according to the industry standard categorization, as follows:

> Technical Potential is the theoretical maximum amount of energy and capacity that could be displaced by DSM, regardless of cost and other barriers that may prevent the installation or adoption of a DSM measure.

For this study, technical potential included full application of commercially available DSM technologies to all residential, commercial, and industrial customers in the utility's service territory.

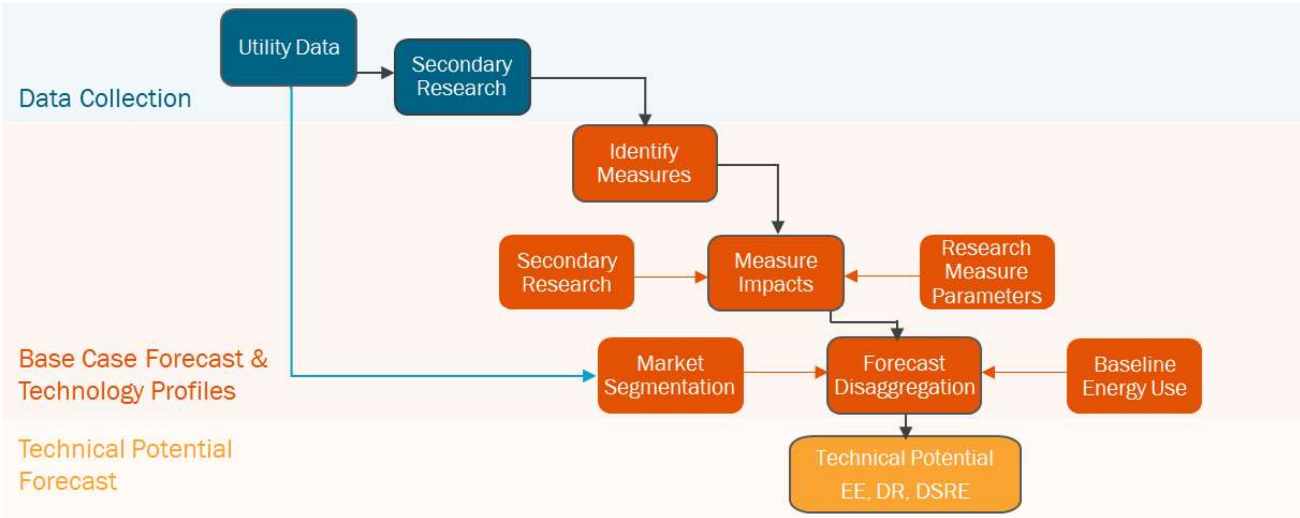
Quantifying DSM technical potential is the result of an analytical process that refines DSM opportunities that align with TECO's customers' electric consumption patterns. Resource Innovations' general methodology for estimating technical potential is a hybrid "top-

down/bottom-up" approach, which is described in detail in Sections 3 through 5 of this report and includes the following steps:

- Develop a baseline forecast: the study began with a disaggregation of the utility's official electric energy forecast to create a baseline electric energy forecast. This forecast does not include any utility-specific assumptions around DSM performance. Resource Innovations applied customer segmentation and consumption data from each utility and data from secondary sources to describe baseline customer-class and end-use components. Additional details on the forecast disaggregation are included in Section 3.
- Identify DSM opportunities: A comprehensive set of DSM opportunities applicable to TECO's climate and customers were analyzed to best depict DSM technical potential. Effects for a range of DSM technologies for each end-use could then be examined while accounting for current market saturations, technical feasibility, and impacts.
- Collect cost and impact data for measures: For those measures applicable to TECO's customers, Resource Innovations conducted primary and secondary research and estimated costs, energy savings, measure life, and demand savings. We differentiated between the type of cost (capital, installation labor, maintenance, etc.) to separately evaluate different implementation modes: retrofit (capital plus installation labor plus incremental maintenance); new construction (incremental capital and incremental maintenance); and burnout costs (incremental capital and incremental maintenance costs for replacement of appliances and equipment that has reached the end of its useful life). Additional details on measure development are included in Section 4.

Figure 1 provides an illustration of the technical potential modeling process conducted for TECO, with the assessment starting with the current utility load forecast, disaggregated into its constituent customer-class and end-use components, and calibrated to ensure consistency with the overall forecast. Resource Innovations considered the range of DSM measures and practices application to each end-use, accounting for current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the technology, end-use, customer class, and system levels.

Figure 1. Approach to Technical Potential Modeling



Resource Innovations estimated DSM technical potential based on a combination of market research, utility load forecasts and customer data, and measure impact analysis, all in coordination with TECO. Resource Innovations examined the technical potential for EE, DR, and DSRE opportunities; this report is organized to offer detail on each DSM category, with additional details on technical potential methodology presented in Section 5.

2.2 EE Potential Overview

To estimate EE potential, this study utilized Resource Innovations' modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual utility program savings, as described in Section 5.1.1 below. While the analysis estimates the impacts of individual EE measures, the model accounts for interactions and overlap of individual measure impacts within an end-use or equipment type. The model provides transparency into the assumptions and calculations for estimating EE potential.

2.3 DR Potential Overview

To estimate DR market potential, Resource Innovations considered customer demand during utility peaking conditions and projected customer response to DR measures. Customer demand was determined by looking at account-level interval data for a sample of customers within each segment. For each segment, Resource Innovations determined the portion of a customer's load that could be curtailed during the system peak.

2.4 DSRE Potential Overview

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from PV, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

3 Baseline Forecast Development

3.1 Market Characterization

The TECO base year energy use and sales forecast provided the reference point to determine potential savings. The end-use market characterization of the base year energy use and reference case forecast included customer segmentation and load forecast disaggregation. The characterization is described in this section, while the subsequent section addresses the measures and market potential energy and demand savings scenarios.

3.1.1 Customer Segmentation

In order to estimate EE, DR, and DSRE potential, the sales forecast and peak load forecasts were segmented by customer characteristics. As electricity consumption patterns vary by customer type, Resource Innovations segmented customers into homogenous groups to identify which customer groups are eligible to adopt specific DSM technologies, have similar building characteristics and load profiles, or are able to provide DSM grid services.

Resource Innovations segmented customers according to the following:

1) By Sector – how much of TECO's energy sales, summer and winter peak demand forecast is attributable to the residential, commercial, and industrial sectors?
2) By Customer – how much electricity does each customer typically consume annually and during system peaking conditions?
3) By End-Use – within a home or business, what equipment is using electricity during the system peak? How much energy does this end-use consume over the course of a year?

Table 4 summarizes the segmentation within each sector. In addition to the segmentation described here for the EE and DSRE analyses, the residential customer segments were further segmented by heating type (electric heat, gas heat, or unknown) and by annual consumption bins within each sub-segment for the DR analysis.

Table 4. Customer Segmentation

Residential	Commercial		Industrial	
Single Family	Assembly	Miscellaneous	Agriculture and Assembly	Primary Resources Industries
Multi-Family	College and University	Offices	Chemicals and Plastics	Stone/Glass/ Clay/Concrete
Manufactured Homes	Grocery	Restaurant	Construction	Textiles and Leather
	Healthcare	Retail	Electrical and Electronic Equipment	Transportation Equipment
	Hospitals	Schools K-12	Lumber/Furniture/ Pulp/Paper	Water and Wastewater
	Institutional	Warehouse	Metal Products and Machinery	Other
	Lodging/ Hospitality		Miscellaneous Manufacturing	

From an equipment and energy use perspective, each segment has variation within each building type or sub-sector. For example, the energy consuming equipment in a convenience store will vary significantly from the equipment found in a supermarket. To account for this variation, the selected end-uses describe energy consumption patterns that are consistent with those typically studied in national or regional surveys, such as the U.S. Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS), Commercial Building Energy Consumption Survey (CBECS) and Manufacturing Energy Consumption Survey (MECS), among others. The end-uses selected for this study are listed in Table 5.

Table 5. End-Uses

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Space heating[3]	Space heating[3]	Process heating
Space cooling[3]	Space cooling[3]	Process cooling
Domestic hot water	Domestic hot water	Compressed air
Ventilation and circulation	Ventilation and circulation	Motors/pumps

[3] Includes the contribution of building envelope measures and efficiencies.

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Lighting	Interior lighting	Fan, blower motors
Cooking	Exterior lighting	Process-specific
Appliances	Cooking	Industrial lighting
Electronics	Refrigeration	Exterior lighting
Miscellaneous	Office equipment	HVAC[3]
	Miscellaneous	Other

For DR, the end-uses targeted were those with controllable load for residential customers (i.e., HVAC, water heaters, pool pumps, and electric vehicles) and small C&I customers (HVAC and electric vehicles). For large C&I customers, all load during peak hours was included assuming these customers would potentially be willing to reduce electricity consumption for a limited time if offered a large enough incentive during temporary system peak demand conditions.

3.1.2 Forecast Disaggregation

A common understanding of the assumptions and granularity in the baseline load forecast was developed with input from TECO. Key discussion topics reviewed included:

- How current DSM offerings are reflected in the energy and demand forecast.
- Assumed weather conditions and hour(s) of the day when the system is projected to peak.
- Are there portions of the load forecast attributable to customers or equipment not eligible for DSM programs?
- How are projections of population increase, changes in appliance efficiency, and evolving distribution of end-use load shares accounted for in the peak demand forecast?

3.1.2.1 Electricity Consumption (kWh) Forecast

Resource Innovations segmented TECO's electricity consumption forecast into electricity consumption load shares by customer class and end-use. The baseline customer segmentation represents the electricity market by describing how electricity was consumed within the service territory. Resource Innovations developed the forecast for the year 2025, and based it on data provided by TECO, primarily their 2023 Ten-Year Site Plan, which was the most recent plan available at the time the studies were initiated. The data addressed current baseline consumption, system load, and sales forecasts.

3.1.2.2 Peak Demand (kW) Forecast

A fundamental component of DR potential was establishing a baseline forecast of what loads or operational requirements would be absent due to existing dispatchable DR or time varying rates. This baseline was necessary to assess how DR can assist in meeting specific planning and operational requirements. We utilized TECO's summer and winter peak demand forecast, which was developed for system planning purposes.

3.1.2.3 Estimating Consumption by End-Use Technology

As part of the forecast disaggregation, Resource Innovations developed a list of electricity end-uses by sector (Table 5). To develop this list, Resource Innovations began with TECO's estimates of average end-use consumption by customer and sector. Resource Innovations combined these data with other information, such as utility residential appliance saturation surveys, as available, to develop estimates of customers' baseline consumption. Resource Innovations calibrated the utility-provided data with data available from public sources, such as the EIA's recurring data-collection efforts that describe energy end-use consumption for the residential, commercial, and manufacturing sectors.

To develop estimates of end-use electricity consumption by customer segment and end-use, Resource Innovations applied estimates of end-use and equipment-type saturation to the average energy consumption for each sector. The following data sources and adjustments were used in developing the base year 2025 sales by end-use:

Residential Sector:

- The disaggregation was based on TECO's rate class load shares and intensities.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - TECO rate class load share is based on average per customer.
    - Resource Innovations made conversions to usage estimates generated by applying TECO's customer audit & saturation survey, EIA RECS data, residential end-use study data received from other FEECA utilities, and EIA's Annual Energy Outlook (AEO) 2023.

Commercial Sector:

- The disaggregation was based on TECO's rate class load shares, intensities, and EIA CBECS data.
- Segment data from EIA and TECO.

- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
  - Rate class load share based on EIA CBECS and end-use forecasts from TECO.

Industrial Sector:

- The disaggregation was based on rate class load shares, intensities, and EIA MECS data.
- Segment data from EIA and TECO.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
  - Rate class load share based on EIA MECS and end-use forecasts from TECO.

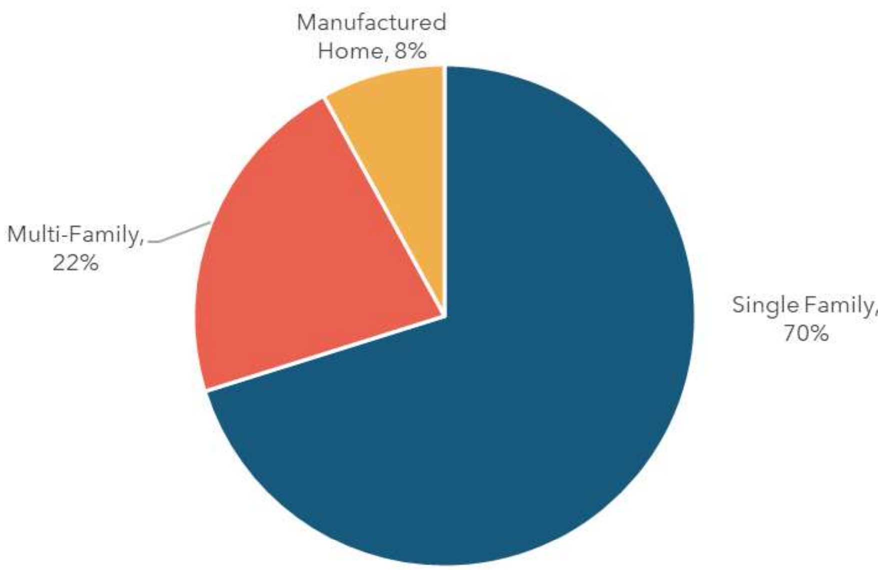
3.2 Analysis of Customer Segmentation

Customer segmentation is important to ensuring that a MPS examines DSM measure savings potential in a manner that reflects the diversity of energy savings opportunities existing across the utility's customer base. TECO provided Resource Innovations with data concerning the premise type and loads characteristics for all customers for the MPS analysis. Resource Innovations examined the provided data from multiple perspectives to identify customer segments. Resource Innovations' approach to segmentation varied slightly for non-residential and residential accounts, but the overall logic was consistent with the concept of expressing the accounts in terms that were relevant to DSM opportunities.

3.2.1 Residential Customers (EE, DR, and DSRE Analysis)

Segmentation of residential customer accounts enabled Resource Innovations to align DSM opportunities with appropriate DSM measures. Resource Innovations used utility customer data, supplemented with EIA data, to segment the residential sector by customer dwelling type (single family, multi-family, or manufactured home). The resulting distribution of customers according to dwelling unit type is presented in Figure 2.

Figure 2. Residential Customer Segmentation



3.2.2 Non-Residential (Commercial and Industrial) Customers (EE and DSRE Analysis)

For the EE and DSRE analysis, Resource Innovations segmented C&I accounts using the utility's North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes, supplemented by data produced by the EIA's CBECS and MECS. Resource Innovations classified the customers in this group as either commercial or industrial, on the basis of DSM measure information available and applicable to each. For example, agriculture and forestry DSM measures are commonly considered industrial savings opportunities. Resource Innovations based this classification on the types of DSM measures applicable by segment, rather than on the annual energy consumption or maximum instantaneous demand from the segment as a whole. The estimated energy sales distributions Resource Innovations applied are shown below in Figure 3 and Figure 4.

Figure 3. Commercial Customer Segmentation

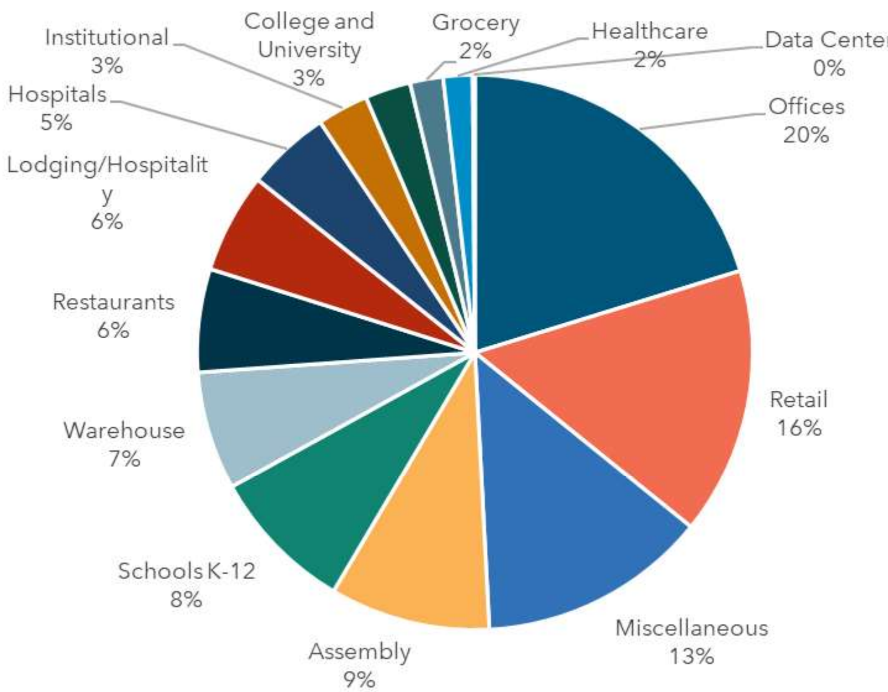
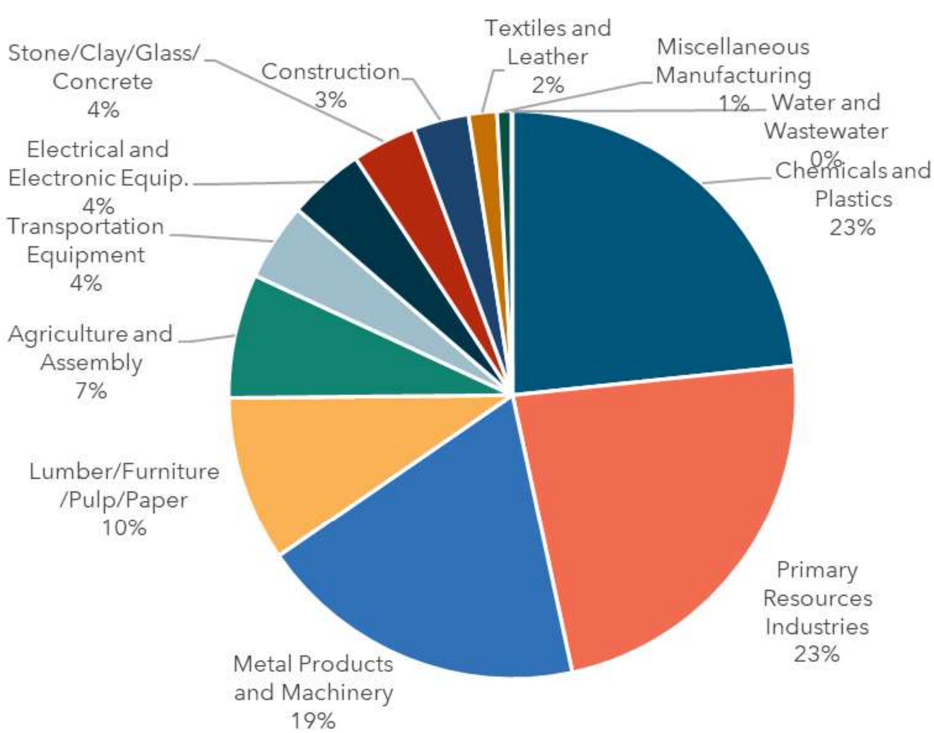


Figure 4. Industrial Customer Segmentation



3.2.3 Commercial and Industrial Accounts (DR Analysis)

For the DR analysis, Resource Innovations divided the non-residential customers into the two customer classes of small C&I and large C&I using rate class and annual consumption. For the purposes of this analysis, small C&I customers are those on the General Service (GS) tariff. Large C&I customers are all customers on the General Service Demand (GSD) tariff or on the General Service Large Demand (GSLD) tariff. Resource Innovations further segmented these two groups based on customer size. For small C&I, segmentation was determined using annual customer consumption and for large C&I the customer's maximum demand was used. Both customer maximum demand and customer annual consumption were calculated using billing data provided by TECO.

Table 6 shows the account breakout between small C&I and large C&I.

Table 6. Summary of Customer Classes for DR Analysis

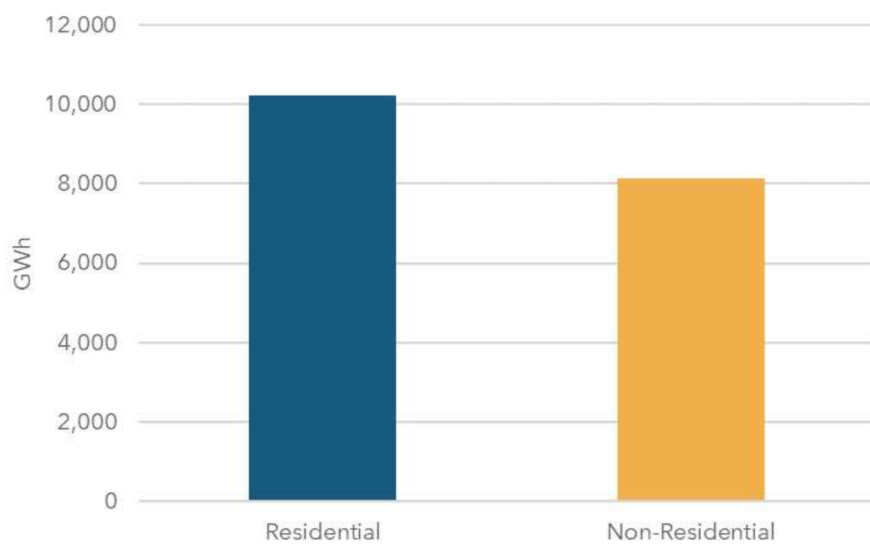
Customer Class	Annual kWh	Estimated Number of Accounts
Small C&I	0-15,000 kWh	43,294
	15,001-25,000 kWh	9,444
	25,001-50,000 kWh	9,104
	50,001 kWh +	3,304
	Total	65,146
Large C&I	0-50 kW	8,716
	51-300 kW	6,487
	301-500 kW	738
	501 kW +	738
	Total	16,679

3.3 Analysis of System Load

3.3.1 System Energy Sales

Technical potential is based on TECO's load forecast for the year 2025 from their 2023 Ten Year Site Plan, which is illustrated in Figure 5.

Figure 5. 2025 Electricity Sales Forecast by Sector



3.3.2 System Demand

To determine the technical potential for DR, Resource Innovations first established peaking conditions for each utility by looking at when each utility historically experienced its maximum demand. The primary data source used to determine when maximum DR impact was the historical system load for TECO. The data provided contained the system loads for all 8,760 hours of the most recent five years leading up to the study (2016-2021). The utility summer and winter peaks were then identified within the utility-defined peaking conditions. For TECO the summer peaking conditions were defined as August from 5:00-6:00 PM and the winter peaking conditions were defined as January from 7:00-8:00 AM. The seasonal peaks were then selected as the maximum demand during utility peaking conditions.

3.3.3 Load Disaggregation

The disaggregated annual electric loads[4] for the base year 2025 by sector and end-use are summarized in Figure 6, Figure 7, and Figure 8.

---

[4] Full disaggregation of system demand by end-use was not conducted, as DR potential for residential and small C&I customers focused on specific end-uses of particular interest because of their large contribution to peak period system load, and was not end-use specific for large C&I customers. A description of the end-use analysis for residential and small C&I customers is included in Section 5.1.2

Figure 6. Residential Baseline (2025) Energy Sales by End-Use

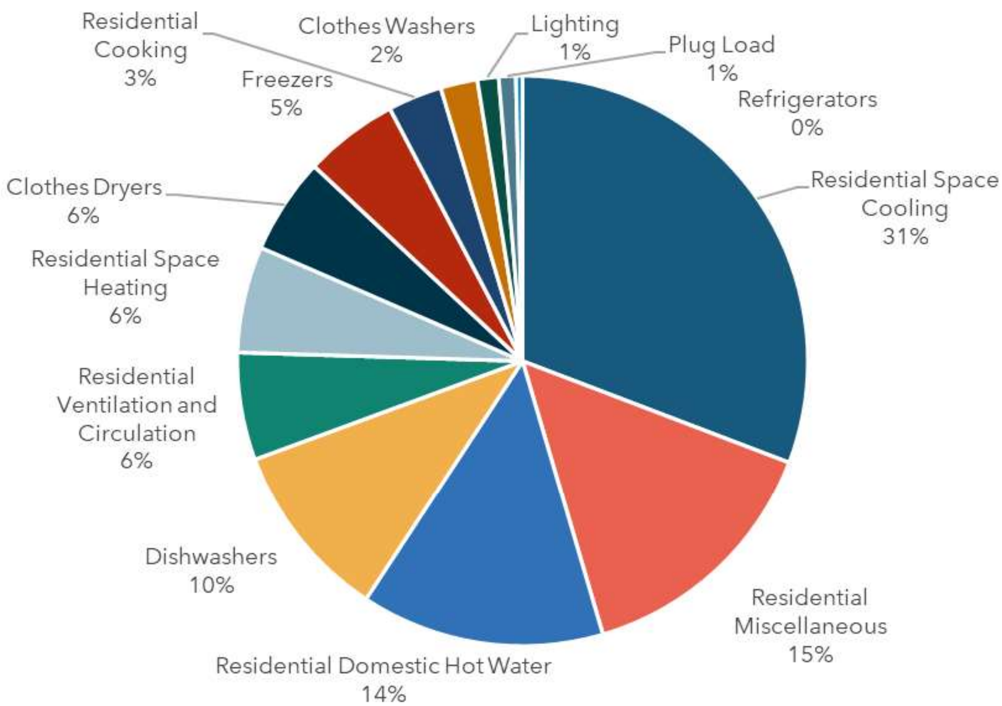


Figure 7. Commercial Baseline (2025) Energy Sales by End-Use

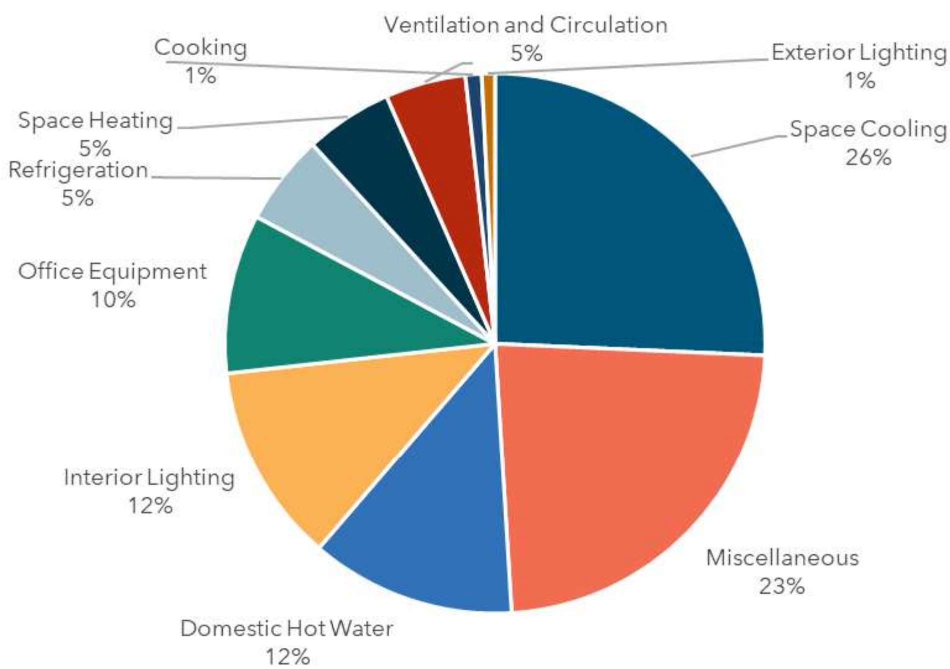
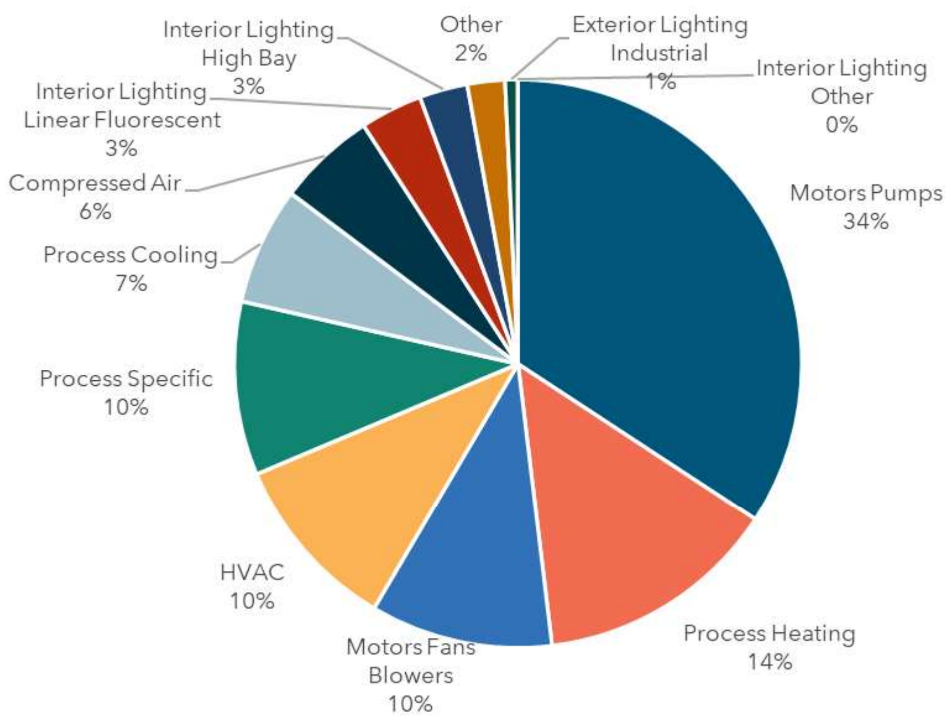


Figure 8. Industrial Baseline (2025) Energy Sales by End-Use



4 DSM Measure Development

DSM potential is described by comparing baseline market consumption with opportunities for savings. Describing these individual savings opportunities results in a list of DSM measures to analyze. This section presents the methodology to develop the EE, DR, and DSRE measure lists.

4.1 Methodology

Resource Innovations identified a comprehensive catalog of DSM measures for the study. The measure list is the same for all FEECA Utilities. The iterative vetting process with the utilities to develop the measure list began by initially examining the list of measures included in the 2019 Goals docket. This list was then adjusted based on proposed measure additions and revisions provided by the FEECA Utilities. Resource Innovations further refined the measure list based on reviews of Resource Innovations' DSM measure library, compiled from similar market potential studies conducted in recent years throughout the United States, as well as measures included in other utility programs where Resource Innovations is involved with program design, implementation, or evaluation. The FEECA Utilities also reached out to interested parties and received input with recommendations on measure additions to the 2019 measure list. Their measure suggestions were reviewed and incorporated into the study as appropriate. External measure suggestions and actions are summarized in Appendix D. The extensive, iterative review process involving multiple parties has ensured that the study included a robust and comprehensive set of DSM measures.

See Appendix A for the list of EE measures, Appendix B for the list of DR measures, and Appendix C for the list of DSRE measures analyzed in the study.

4.2 EE Measures

EE measures represent technologies applicable to the residential, commercial, and industrial customers in the FEECA Utilities' service territories. The development of EE measures included consideration of:

- EE technologies that are applicable to Florida and commercially available: Measures that are not applicable due to climate or customer characteristics were excluded, as were "emerging" technologies that are not currently commercially available to FEECA utility customers.
- Current and planned Florida Building Codes and Federal equipment standards (Codes & Standards) for baseline equipment: Measures included from prior studies

were adjusted to reflect current Codes & Standards as well as updated efficiency tiers, as appropriate.

- Eligibility for utility DSM offerings in Florida: For example, behavioral measures were excluded from consideration, as they historically have not been allowed to count towards utility DSM goals. Behavioral measures are intended to motivate customers to operate in a more energy-efficient manner (e.g., setting an air-conditioner thermostat to a higher temperature) without accompanying: a) physical changes to more efficient end-use equipment or to their building envelope, b) utility-provided products and tools to facilitate the efficiency improvements, or c) permanent operational changes that improve efficiency which are not easily revertible to prior conditions. These types of behavioral measures were excluded because of the variability in forecasting the magnitude and persistence of energy and demand savings from the utility's perspective. Additionally, decoupling behavioral measure savings from the installation of certain EE technologies like smart thermostats can be challenging and could result in overlapping potential with other EE measures included in the study.

Upon development of the final EE measure list, utility-specific measure details were developed. RI maintains a proprietary online database of energy efficiency measures for MPS studies, which was used as a starting point for measure development for this study. Measures are added or updated at the request of project stakeholders or because of changes to the EE marketplace (for example, new codes and standards, or current practice in the market). Measure data are refined as new data or algorithms are developed for estimating measure impacts, and updated for each study to incorporate inputs parameters specific to the service territory being analyzed. The database contains the following information for each of the measures:

- Measure description: measure classification by type, end-use, and subsector, and description of the base-case and the efficient-case scenarios.
- kWh savings: Energy savings associated with each measure were developed through engineering algorithms or building simulation modeling, taking climate data and customer segments into consideration as appropriate. Reference sources used for developing residential, commercial, and industrial measure savings included a variety of Florida-specific, as well as regional and national sources, such as utility-specific measurement & verification (M&V) data, technical reference manuals (TRM) from other jurisdictions, ENERGY STAR calculators, and manufacturer or retailer specifications for particular products.
- Energy savings were applied in RI's TEA-POT model as a percentage of total baseline consumption. Peak demand savings were determined using utility-specific load shapes or coincidence factors.

- Measure Expected Useful Lifetime: Sources included the Database for Energy Efficient Resources (DEER), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, TRMs, and other regional and national measure databases and EE program evaluations.
- Measure Costs: Per-unit costs (full or incremental, depending on the application) associated with measure installations. Sources included: TRMs, ENERGY STAR calculator, online market research, FEECA utility program data, and other secondary sources.

The measure details from the online measure library are exported for use in RI's TEA-POT model, accompanied by utility-specific estimates of measure applicability. Measure applicability is a general term encompassing an array of factors, including technical feasibility of installation, and the measure's current saturation as well as factors to allocate savings associated with competing measures. Information used was primarily derived from data in current regional and national databases, as well as TECO's program tracking data. These factors are described in Table 7.

Table 7. Measure Applicability Factors

Measure Impact	Explanation	Sources
Technical Feasibility	The percentage of buildings that can have the measure physically installed. Various factors may affect this, including, but not limited to, whether the building already has the baseline measure (e.g., dishwasher), and limitations on installation (e.g., size of unit and space available to install the unit).	Various secondary sources and engineering experience.
Measure Incomplete Factor	The percentage of buildings without the specific measure currently installed.	Utility RASS; EIA RECS, CBECS; MECS; ENERGY STAR sales figures; and engineering experience.
Measure Share	Used to distribute the percentage of market shares for competing measures (e.g., only blown-in ceiling insulation or spray foam insulation, not both would be installed in an attic).	Utility customer data, Various secondary sources and engineering experience.

As shown in Table 8, the measure list includes 395 unique energy-efficiency measures. Expanding the measures to account for all appropriate installation scenarios resulted in

9,535 measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (i.e., a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed).

Table 8. EE Measure Counts by Sector

Sector	Unique Measures	Permutations
Residential	119	1,173
Commercial	164	5,798
Industrial	112	2,564

4.3 DR Measures

The DR measures included in the measure list utilize the following DR strategies:

- **Direct Load Control.** Utility control of selected equipment at the customer's home or business, such as HVAC or water heaters.
- **Critical Peak Pricing (CPP) with Technology.** Electricity rate structures that vary based on time of day. Includes CPP when the rate is substantially higher for a limited number of hours or days per year (customers receive advance notification of CPP event) coupled with technology that enables customer to lower their usage in a specific end-use in response to the event (e.g., HVAC via smart thermostat).
- **Contractual DR.** Customers receive incentive payments or a rate discount for committing to reduce load by a pre-determined amount or to a pre-determined firm service level upon utility request.
- **Automated DR.** Utility dispatched control of specific end-uses at a customer facility.

DR initiatives that do not rely on the installation of a specific device or technology to implement (such as a voluntary curtailment program or time of use rates) were not included.

A workbook was developed for each measure which included the same measure inputs as previously described for the EE measures. In addition, the DR workbook included expected load reduction from the measure, based on utility technical potential, existing utility DR programs, and other nationwide DR programs if needed.

For technical potential, Resource Innovations did not break out results by specific measure or control technology because all of the developed measures target the end-uses estimated

for technical potential (i.e., potential is reported for space cooling end-use and not allocated to switches, smart thermostats, etc.).

4.4 DSRE Measures

The DSRE measure list includes rooftop PV systems, battery storage systems charged from PV systems, and CHP systems.

PV Systems

PV systems utilize solar panels (a packaged collection of PV cells) to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter, a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted systems that face south-west, south, and/or, south-east. The potential associated with roof-mounted systems installed on residential and commercial buildings was analyzed.

Battery Storage Systems Charged from PV Systems

Distributed battery storage systems included in this study consist of behind-the-meter battery systems installed in conjunction with an appropriately-sized PV system at residential and commercial customer facilities. These battery systems typically consist of a DC-charged battery, a DC/AC inverter, and electrical system interconnections to a PV system. On their own battery storage systems do not generate or conserve energy, but can collect and store excess PV generation to provide power during particular time periods, which for DSM purposes would be to offset customer demand during the utility's system peak.

CHP Systems

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide other on-site needs. Common prime mover technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Internal combustion engines

A workbook was developed for each measure which included the inputs previously described for EE measures and prime mover operating parameters.

5 Technical Potential

In the previous sections, the approach for DSM measure development was summarized, and the 2025 base year load shares and reference-case load forecast were described. The outputs from these tasks provided the input for estimating the technical potential scenario, which is discussed in this section.

The technical potential scenario estimates the potential energy and demand savings when all technically feasible and commercially available DSM measures are implemented without regard for cost-effectiveness and customer willingness to adopt the most impactful EE, DR, or DSRE technologies. Since the technical potential does not consider the costs or time required to achieve these savings, the estimates provide a theoretical upper limit on electricity savings potential. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. For this study, technical potential included full application of the commercially available DSM measures to all residential, commercial, and industrial customers in the utility's service territory.

5.1 Methodology

5.1.1 EE Technical Potential

EE technical potential refers to delivering less electricity to the same end-uses. In other words, technical potential might be summarized as "doing the same thing with less energy, regardless of the cost."

DSM measures were applied to the disaggregated utility electricity sales forecasts to estimate technical potential. This involved applying estimated energy savings from equipment and non-equipment measures to all electricity end-uses and customers. Technical potential consists of the total energy and demand that can be saved in the market which Resource Innovations reported as single numerical values for each utility's service territory.

The core equation used in the residential sector EE technical potential analysis for each individual efficiency measure is shown in Equation 1 below, while the core equation used in the nonresidential sector technical potential analysis for each individual efficiency measure is shown in Equation 2.

Equation 1: Core Equation for Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Number of Households × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Baseline Equipment Energy Use Intensity** = the electricity used per customer per year by each baseline technology in each market segment. In other words, the baseline equipment energy-use intensity is the consumption of the electrical energy using equipment that the efficient technology replaces or affects.
- **Saturation Share** = the fraction of the end-use electrical energy that is applicable for the efficient technology in a given market segment. For example, for residential cooling, the saturation share would be the fraction of all residential electric customers that have central air conditioners in their household.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of central air conditioners that is not already energy efficient.
- **Feasibility Factor** = the fraction of units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (i.e., it may not be possible to install LEDs in all light sockets in a home because the available styles may not fit in every socket).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

Equation 2: Core Equation for Non-Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Stock Sq. Footage by Building Type by EDC × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Total Stock Square Footage by Segment** = the forecasted square footage level for a given building type (e.g., square feet of office buildings).
- **Baseline Equipment Energy Use Intensity** = the electricity used per square foot per year by each baseline equipment type in each market segment.

- **Saturation Shares** = the fraction of total end-use energy consumption associated with the efficient technology in a given market segment. For example, for packaged terminal air-conditioner (PTAC), the saturation share would be the fraction of all space cooling kWh in a given market segment that is associated with PTAC equipment.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient.
- **Feasibility Factor** = the fraction of the equipment or practice that is technically feasible for conversion to the efficient technology from an engineering perspective (i.e., it may not be possible to install Variable Frequency Drives (VFD) on all motors in a given market segment).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

It is important to note that the technical potential estimate represents electricity savings potential at a specific point in time. In other words, the technical potential estimate is based on data describing status quo customer electricity use and technologies known to exist today. As technology and electricity consumption patterns evolve over time, the baseline electricity consumption will also change accordingly. For this reason, technical potential is a discrete estimate of a dynamic market. Resource Innovations reported the technical potential for 2025, based on currently known DSM measures and observed electricity consumption patterns.

Measure Interaction and Competition (Overlap)

While the technical potential equations listed above focus on the technical potential of a single measure or technology, Resource Innovations' modeling approach does recognize the overlap of individual measure impacts within an end-use or equipment type, and accounts for the following interactive effects:

- Measure interaction: Installing high-efficiency equipment could reduce energy savings in absolute terms (kWh) associated with non-equipment measures that impact the same end-use. For example, installing a high-efficiency heat pump will reduce heating and cooling consumption which will reduce the baseline against which attic insulation would be applied, thus reducing savings associated with installing insulation. To account for this interaction, Resource Innovations' TEA-POT model ranks measures that interact with one another and reduces the baseline consumption for the subsequent measure based on the savings achieved by the preceding measure. For technical potential, interactive measures are ranked based on total end-use energy savings percentage.
- Measure competition (overlap): The "measure share"—as defined above—accounted for competing measures, ensuring savings were not double-counted. This interaction

occurred when two or more measures "competed" for the same end-use. For example, a T-12 lamp could be replaced with a T-8 or linear LED lamp.

Addressing Naturally-Occurring EE

Naturally occurring energy efficiency includes actions taken by customers to improve the efficiency of their homes and businesses in the absence of utility program intervention. For the analysis of technical potential, Resource Innovations verified with TECO's forecasting group that the baseline sales forecasts incorporated two known sources of naturally-occurring efficiency:

- Codes and Standards: The sales forecasts already incorporated the impacts of known Code & standards changes.
- Baseline Measure Adoption: The sales forecast excluded the projected impacts of future DSM efforts but included already implemented DSM penetration.

By properly accounting for these factors, the technical potential analysis estimated the additional EE opportunities beyond what is already included in the utility sales forecast.

5.1.2 DR Technical Potential

The concept of technical potential applies differently to DR than for EE. Technical potential for DR is effectively the magnitude of loads that can be curtailed during conditions when utilities need peak capacity reductions. In evaluating this potential at peak capacity, the following were considered: which customers are consuming electricity at those times? What end-uses are in play? Can those end-use loads be managed? Large C&I accounts generally do not provide the utility with direct control over particular end-uses. Instead, many of these customers will forego electric demand temporarily if the financial incentive is large enough. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale.

This framework makes end-use disaggregation an important element for understanding DR potential, particularly in the residential and small C&I sectors. When done properly, end-use disaggregation not only provides insights into which loads are on and off when specific grid services are needed, it also provides insight concerning how key loads and end-uses, such as air conditioning use, vary across customers. Resource Innovations' approach used for load disaggregation is more advanced than what is used for most potential studies. Instead of disaggregating annual consumption or peak demand, Resource Innovations produced end-use load disaggregation for all 8,760 hours. This was needed because the loads available at times when different grid applications are needed can vary substantially. Instead

of producing disaggregated loads for the average customer, the study was produced for several customer segments. For TECO, Resource Innovations examined three residential segments based on customer housing type, four different small C&I segments based on customer size, and four different large C&I segments based on customer size, for a total of 11 different customer segments.

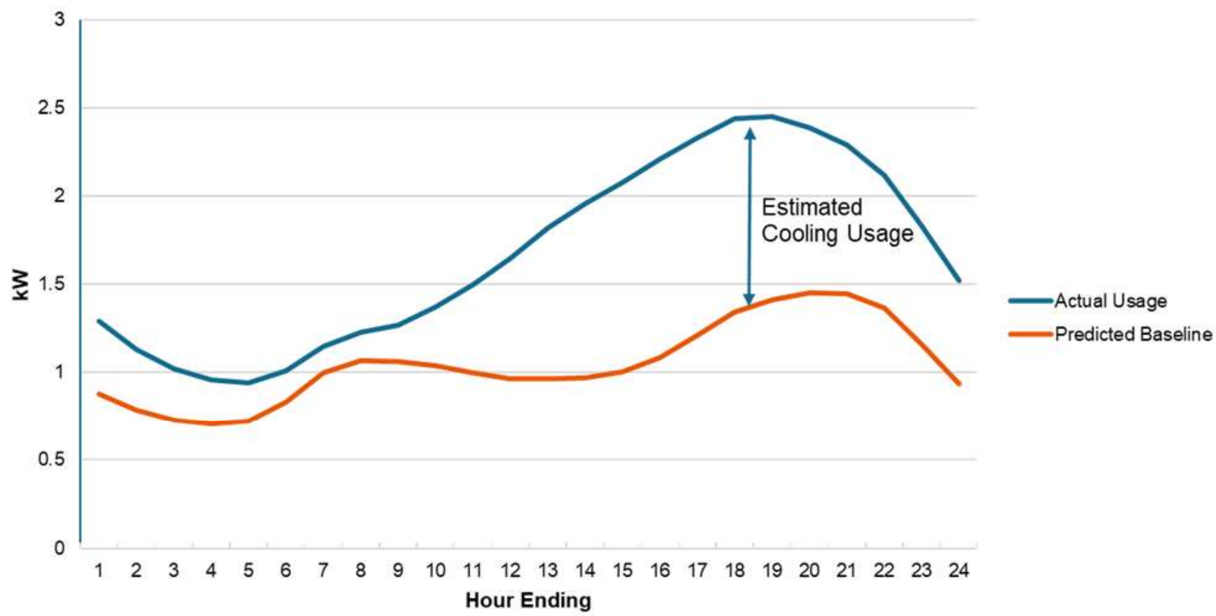
Technical potential, in the context of DR, is defined as the total amount of load available for reduction that is coincident with the period of interest; in this case, the system peak hour for the summer and winter seasons. Thus, two sets of capacity values are estimated: a summer capacity and a winter capacity.

As previously mentioned, for technical potential purposes, all coincident large C&I load is considered dispatchable, while residential and small C&I DR capacity is based on specific end-uses. Summer DR capacity for residential customers was comprised of air-conditioning (AC), pool pumps, water heaters, and managed electric vehicle charging. For small C&I customers, summer capacity was based on AC load. For winter DR capacity, residential was based on electric heating, pool pumps, and water heaters. For small C&I customers, winter capacity was based on electric heating.

AC and heating load profiles were generated for residential and small C&I customers using a sample of customers' interval data provided by TECO. This sample included a customer breakout based on housing type for residential customers and size for small C&I customers. Resource Innovations then used the interval data from these customers to create an average load profile for each customer segment.

The average load profile for each customer segment was combined with historical weather data, and used to estimate hourly load as a function of weather conditions. AC and heating loads were estimated by first calculating the baseline load on days when cooling degree days (CDD) and heating degree days (HDD) were equal to zero, and then subtracting this baseline load. This methodology is illustrated by Figure 9 (a similar methodology was used to predict heating loads).

Figure 9: Methodology for Estimating Cooling Loads



This method was able to produce estimates for average AC/heating load profiles for the seven different customer segments within the residential and small C&I sectors.

Profiles for residential water heater and pool pump loads were estimated by utilizing end-use load data from NREL's residential end-use load profile database.

For all eligible loads, the technical potential was defined as the amount that was coincident with system peak hours for each season, which are August from 5:00-6:00 PM for summer, and January from 7:00-8:00 AM for winter. As mentioned in Section 4, for technical potential there was also no measure breakout needed, because all measures will target the end-uses' estimated total loads.

5.1.3 DSRE Technical Potential

5.1.3.1 PV Systems

To determine technical potential for PV systems, RI estimated the percentage of rooftop square footage in Florida that is suitable for hosting PV technology. Our estimate of technical potential for PV systems in this report is based in part on the available roof area and consisted of the following steps:

- Step 1: Outcomes from the forecast disaggregation analysis were used to characterize the existing and new residential, commercial, and industrial building stocks.
  - To calculate the total roof area for residential buildings, the average roof area per household is multiplied by the number of households.
  - For commercial and industrial buildings, RI calculated the total roof area by first dividing the load forecast by the energy usage intensity, which provides an estimate of the total building square footage. This result is then divided by the average number of floors to derive the total roof area.
- Step 2: The total available roof area feasible for installing PV systems was calculated. Relevant parameters included unusable area due to other rooftop equipment and setback requirements, in addition to possible shading from trees and limitations of roof orientation (factored into a "technical suitability" multiplier).
- Step 3: Estimated the expected power density (kW per square foot of roof area).
- Step 4: Estimated the hourly PV generation profile using NREL's PV Watts Calculator
- Step 5: Calculated total energy and coincident peak demand potential by applying RI's Spatial Penetration and Integration of Distributed Energy Resources (SPIDER) Model.

The methodology presented in this report uses the following formula to estimate overall technical potential of PVs:

Equation 3: Core Equation for Solar DSRE Technical Energy Potential

$$\text{PV Technical Energy Potential} = \text{Suitable Rooftop PV Area (Sq Ft)} \times \text{PV Power Density (kW-DC/Sq Ft)} \times \text{Generation Factor (kWh/kW-DC)}$$

Where:

- **Suitable Rooftop PV Area for Residential [Square Feet]:** Number of Residential Buildings x Average Roof Area Per Building x Technical Suitability Factor
- **Suitable Rooftop PV Area for Commercial [Square Feet] :** Energy Consumption [kWh] / Energy Intensity [kWh / Square Feet] / Average No. of Stories Per Building x Technical Suitability Factor
- **PV Power Density [kW-DC/Square Feet]:** Maximum power generated in Watts per square foot of solar panel.
- **Generation Factor:** Annual Energy Generation Factor for PV, from PV Watts (dependent on local solar irradiance)

5.1.3.2 Battery Storage Systems Charged from PV Systems

Battery storage systems on their own do not generate power or create efficiency improvements, but store power for use at different times. Therefore, in analyzing the technical potential for battery storage systems, the source of the stored power and overlap with technical potential identified in other categories was considered.

Battery storage systems that are powered directly from the grid do not produce annual energy savings but may be used to shift or curtail load during particular time periods. As the DR technical potential analyzes curtailment opportunities for the summer and winter peak period, and battery storage systems can be used as a DR technology, the study concluded that no additional technical potential should be claimed for grid-powered battery systems beyond that already attributed to DR.

Battery storage systems that are connected to on-site PV systems also do not produce additional energy savings beyond the energy produced from the PV system[5]. However, PV-connected battery systems do create the opportunity to store energy during period when the PV system is generating more than the home or business is consuming and use that stored power during utility system peak periods.

To determine the additional technical potential peak demand savings for "solar plus storage" systems, our methodology consisted of the following steps:

- Assume that every PV system included in PV Technical Potential is installed with a paired storage system.
- Size the storage system assuming peak storage power is equal to peak PV generation and energy storage duration is three hours.
- Apply RI's hourly dispatch optimization module in SPIDER to create an hourly storage dispatch profile that flattens the individual customer's load profile to the greatest extent possible accounting for a) customer hourly load profile, b) hourly PV generation profile, and c) battery peak demand, energy capacity, and roundtrip charge/discharge efficiency.
- Calculate the effective hourly impact for the utility using the above storage dispatch profile, aligned with the utility's peak hour (calculated separately for summer and winter)
- Report the output storage kW impact on utility coincident peak demand in summer and winter.

[5] PV-connected battery systems experience some efficiency loss due to storage, charging, and discharging. However, for this study, these losses were not quantified.

5.1.3.3 CHP Systems

The CHP analysis created a series of unique distributed generation potential models for each primary market sector (commercial and industrial).

Only non-residential customer segments whose electric and thermal load profiles allow for the application of CHP were considered. The technical potential analysis followed a three-step process. First, minimum facilities size thresholds were determined for each non-residential customer segment. Next, the full population of non-residential customers were segmented and screened based on the size threshold established for that segment. Finally, the facilities that were of sufficient size were matched with the appropriately sized CHP technology.

To determine the minimum threshold for CHP suitability, a thermal factor was applied to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load in order to achieve improved efficiencies.

The study collected electric and thermal intensity data from other recent CHP studies. For industrial customers, Resource Innovations assumed that the thermal load would primarily be used for process operations and was not modified from the secondary data sources for Florida climate conditions. For commercial customers, the thermal load is more commonly made up of water heating, space heating, and space cooling (through the use of an absorption chiller). Therefore, to account for the hot and humid climate in Florida, which traditionally limits weather-dependent internal heating loads, commercial customers' thermal loads were adjusted to incorporate a higher proportion of space cooling to space heating as available opportunities for waste heat recovery.

Resource Innovations worked with the utility-provided customer data, focusing on annual consumption due to the absence of NAICS or SIC codes for this utility data. Non-residential customers were subsequently classified based on annual consumption and size. Since NAICS or SIC codes were unavailable, no formal segmentation occurred. Instead, the analysis focused exclusively on annual utility usage. Facilities with annual loads below the kWh thresholds were deemed unlikely to possess the consistent electric and thermal loads necessary to support CHP and were consequently excluded from consideration. Conversely, those meeting the size criteria were aligned with the corresponding CHP technology.

In general, internal combustion engines are the prime mover for systems under 500kW with gas turbines becoming progressively more popular as system size increases above that. Based on the available load by customer, adjusted by the estimated thermal factor for each

segment, CHP technologies were assigned to utility customers in a top-down fashion (i.e., starting with the largest CHP generators).

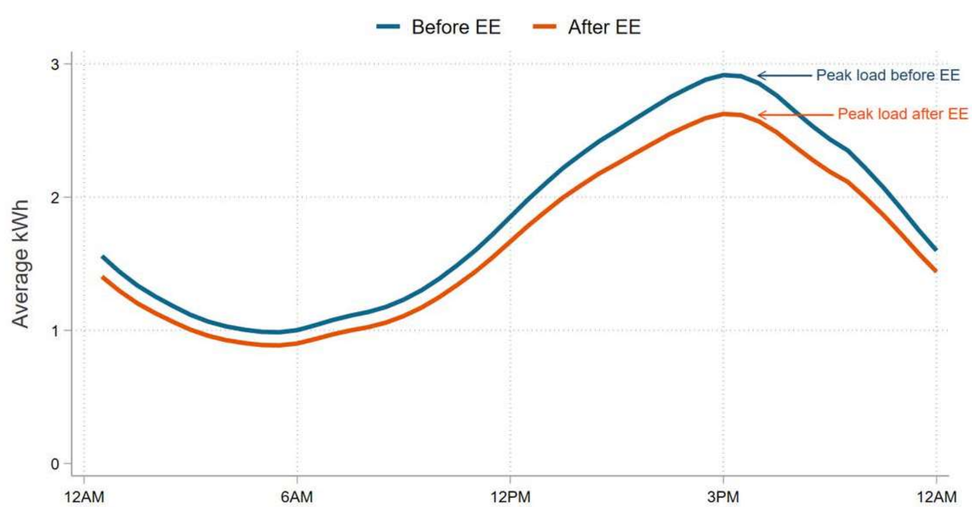
Measure Interaction

PV systems and battery storage charged from PV systems were analyzed collectively due to their common power generation source; and therefore, the identified technical potential for these systems is additive. However, CHP systems were independently analyzed for technical potential without consideration of the competition between DSRE technologies or customer preference for a particular DSRE system. Therefore, results for CHP technical potential should not be combined with PV systems or battery storage systems for overall DSRE potential but used as independent estimates.

5.1.4 Interaction of Technical Potential Impacts

As described above, the technical potential was estimated using separate models for EE, DR, and DSRE systems. However, there is interaction between these technologies; for example, a more efficient HVAC system would result in a reduced peak demand available for DR curtailment, as illustrated in Figure 10.

Figure 10: Illustration of EE Impacts on HVAC System Load Shape



Therefore, after development of the independent models, the interaction between EE, DR, and DSRE was incorporated as follows:

- The EE technical potential was assumed to be implemented first, followed by DR technical potential and DSRE technical potential.

- To account for the impact of EE technical potential on DR, the baseline load forecast for the applicable end-uses was adjusted by the EE technical potential, resulting in a reduction in baseline load available for curtailment.
- For DSRE systems, the EE and DR technical potential was incorporated in a similar fashion, adjusting the baseline load used to estimate DSRE potential.
  - For the PV analysis, this did not impact the results as the EE and DR technical potential did not affect the amount of PV that could be installed on available rooftops.
  - For the battery storage charged from PV systems, the reduced baseline load from EE resulted in additional PV-generated energy being available for the battery systems and for use during peak periods. The impact of DR events during the assumed curtailment hours was incorporated into the modeling of available battery storage and discharge loads.
- For CHP systems, the reduced baseline load from EE resulted in a reduction in the number of facilities that met the annual energy threshold needed for CHP installations. Installed DR capacity was assumed to not impact CHP potential as the CHP system feasibility was determined based on energy and thermal consumption at the facility. It should be noted that CHP systems not connected to the grid could impact the amount of load available for curtailment with utility-sponsored DR. Therefore, CHP technical potential should not be combined with DR potential but used as independent estimates.

5.2 EE Technical Potential

5.2.1 Summary

Table 9 summarizes the EE technical potential by sector:

Table 9. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	992	445	3,197
Non-Residential[6]	398	334	2,272
Total	1,390	779	5,469

[6] Non-Residential results include all commercial and industrial customer segments.

5.2.2 Residential

Figure 11, Figure 12, and Figure 13 summarize the residential sector EE technical potential by end-use.

Figure 11: Residential EE Technical Potential by End-Use (Summer Peak Savings)

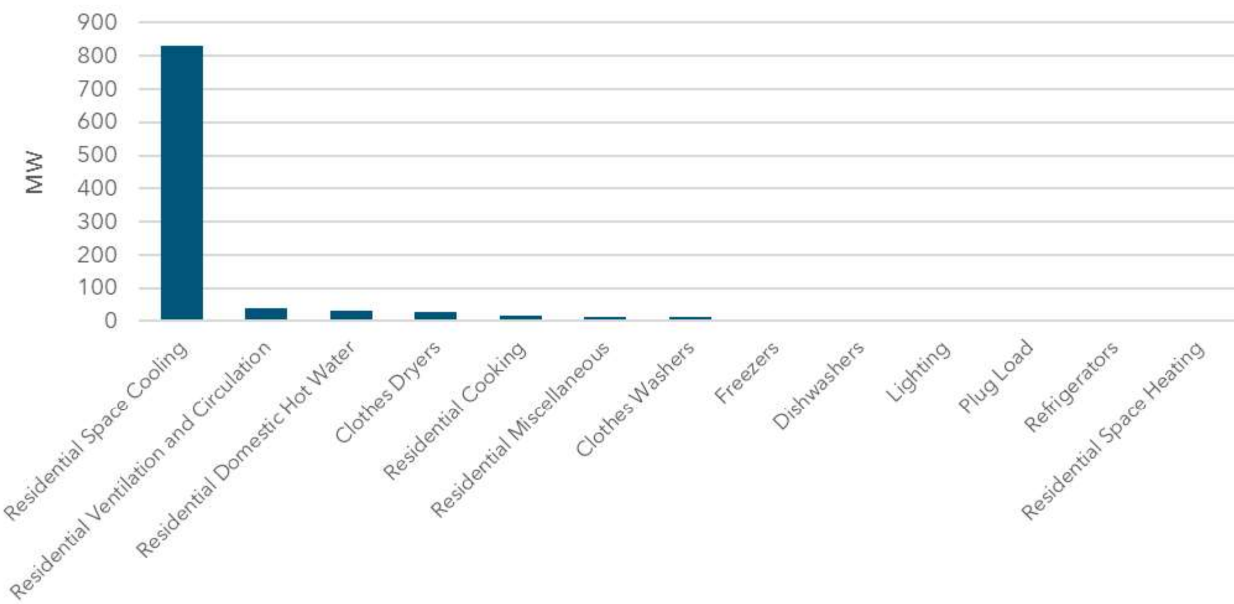


Figure 12: Residential EE Technical Potential by End-Use (Winter Peak Savings)

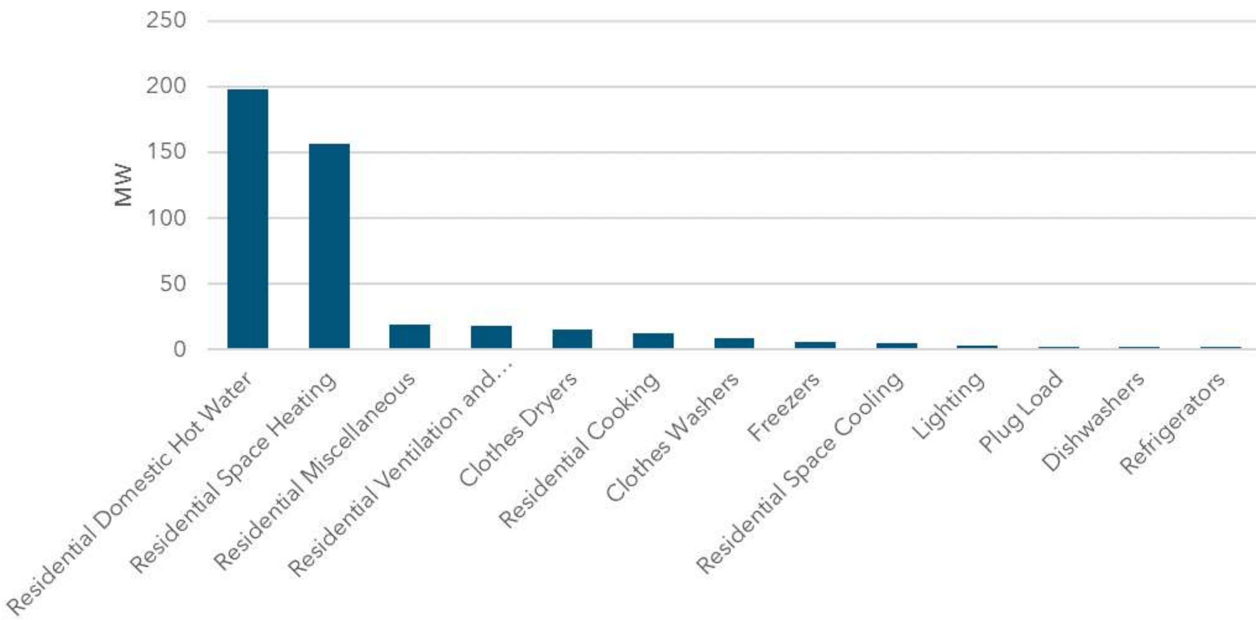
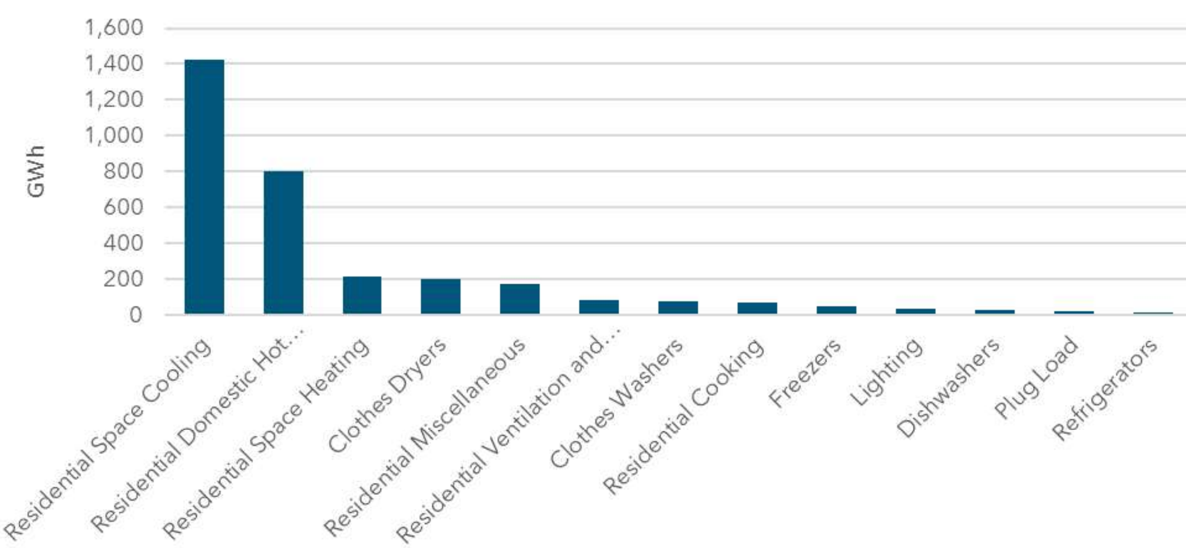


Figure 13: Residential EE Technical Potential by End-Use (Energy Savings)



5.2.3 Non-Residential

5.2.3.1 Commercial Segments

Figure 14, Figure 15, and Figure 16 summarize the commercial sector EE technical potential by end-use.

Figure 14: Commercial EE Technical Potential by End-Use (Summer Peak Savings)

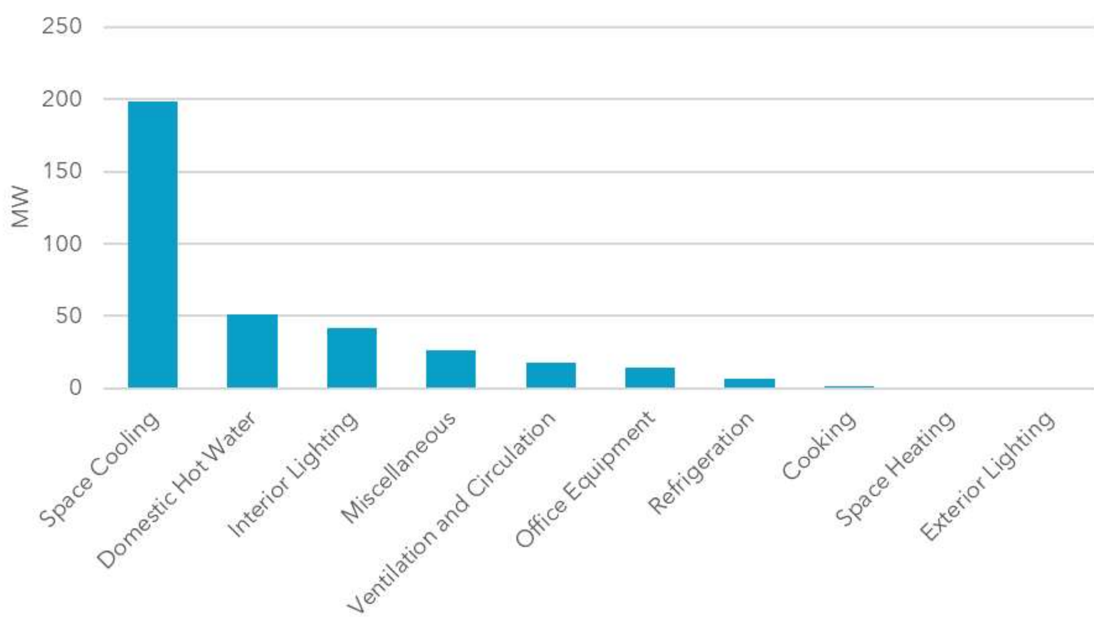


Figure 15: Commercial EE Technical Potential by End-Use (Winter Peak Savings)

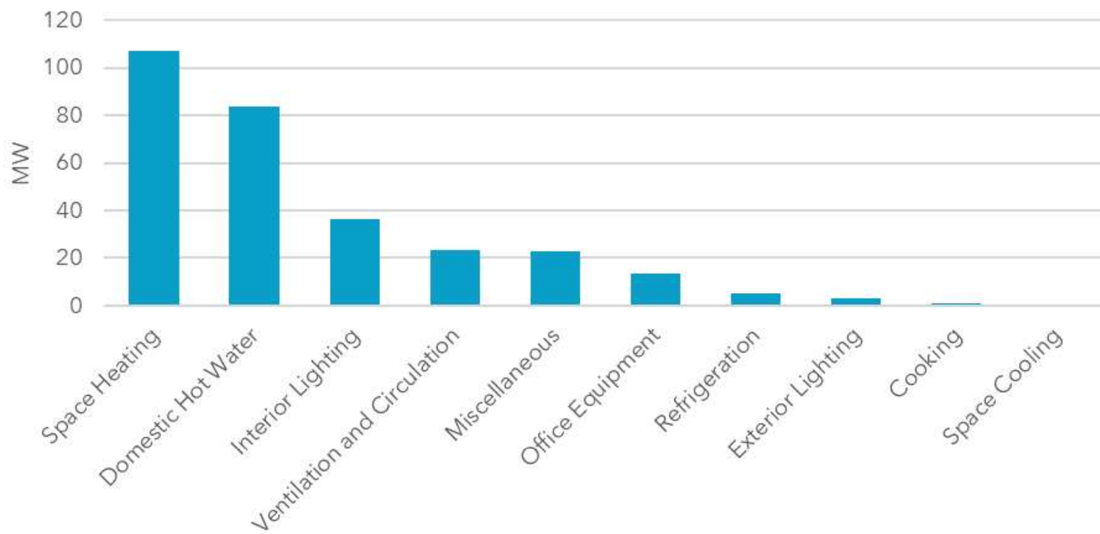
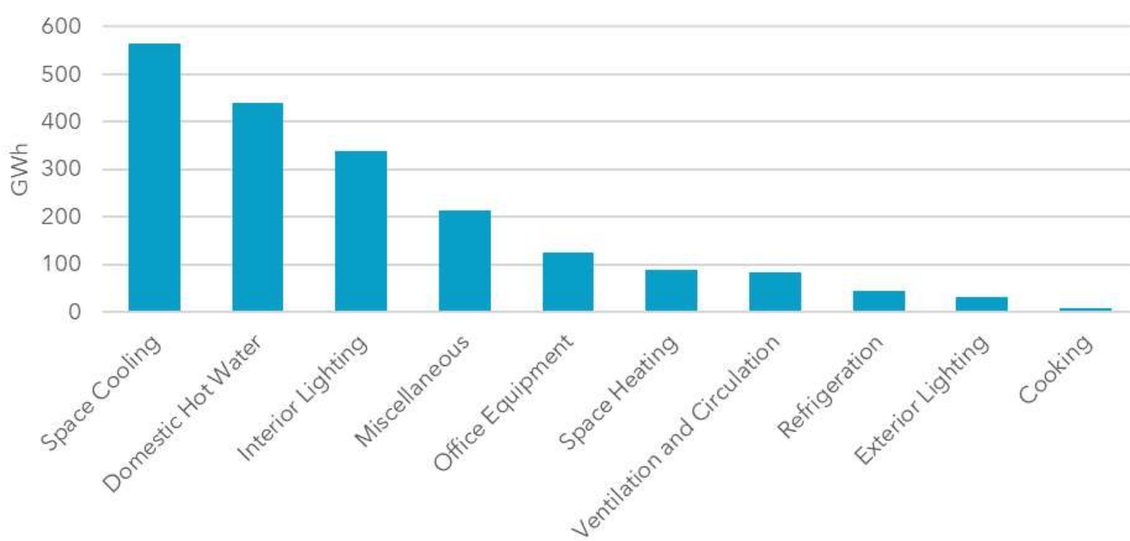


Figure 16: Commercial EE Technical Potential by End-Use (Energy Savings)



5.2.3.2 Industrial Segments

Figure 17, Figure 18, and Figure 19 summarize the industrial sector EE technical potential by end-use.

Figure 17: Industrial EE Technical Potential by End-Use (Summer Peak Savings)

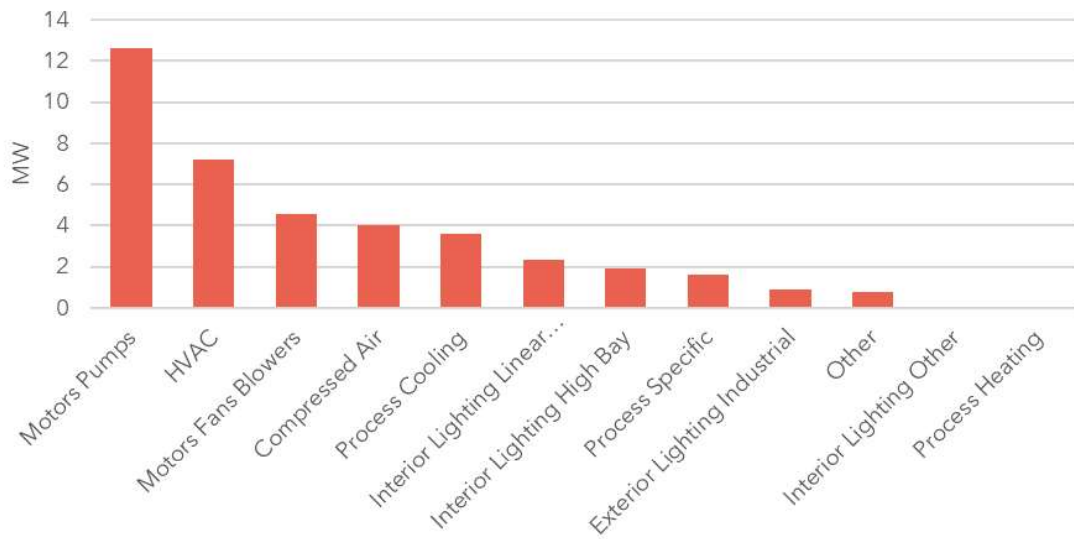


Figure 18: Industrial EE Technical Potential by End-Use (Winter Peak Savings)

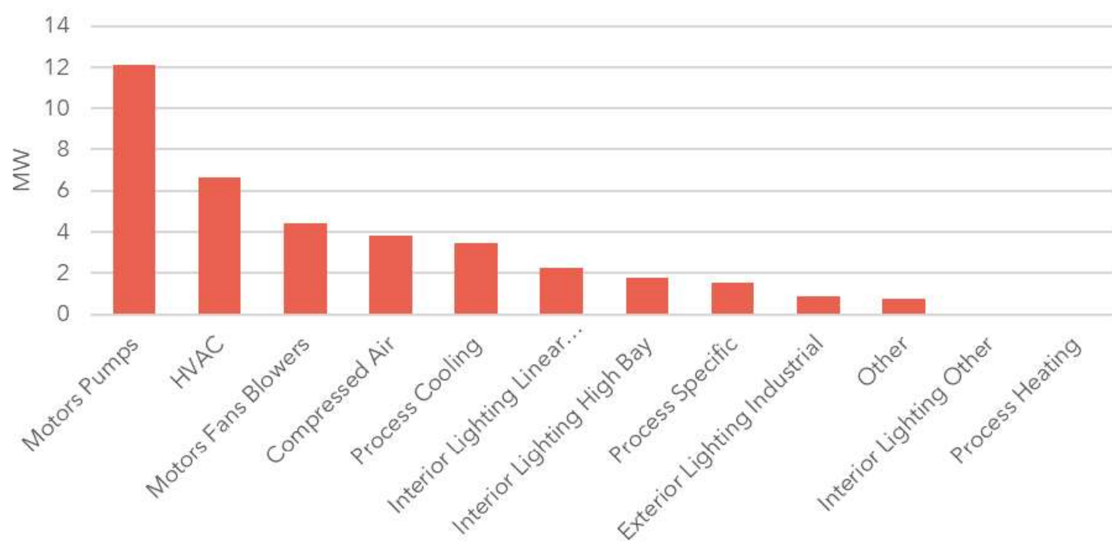
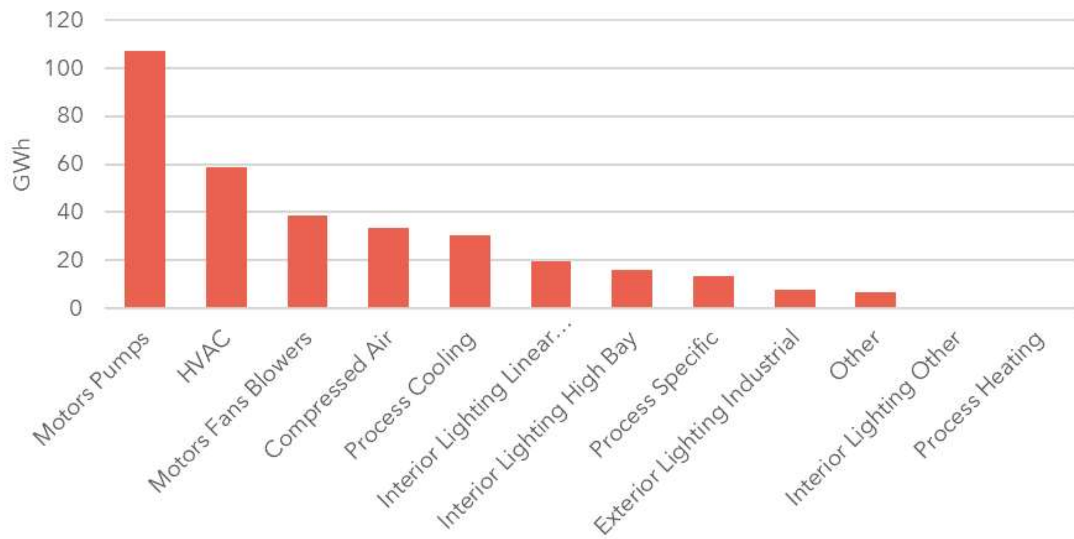


Figure 19: Industrial EE Technical Potential by End-Use (Energy Savings)



5.3 DR Technical Potential

Technical potential for DR is defined for each class of customers as follows:

- Residential & Small C&I customers – Technical potential is equal to the aggregate load for all end-uses that can participate in TECO's current programs plus DR measures not currently offered in which the utility uses specialized devices to control loads (i.e., direct load control programs). This includes cooling and heating loads for residential and small C&I customers and water heater and pool pump loads for residential customers. Not all demand reductions are delivered via direct load control of end-uses. The magnitude of demand reductions from non-direct load control such as time varying pricing, peak time rebates and targeted notifications is linked to cooling and heating loads.
- Large C&I customers – Technical potential is equal to the total amount of load for each customer segment (i.e., that customers reduce their total load to zero when called upon).

Table 10 summarizes the seasonal DR technical potential by sector:

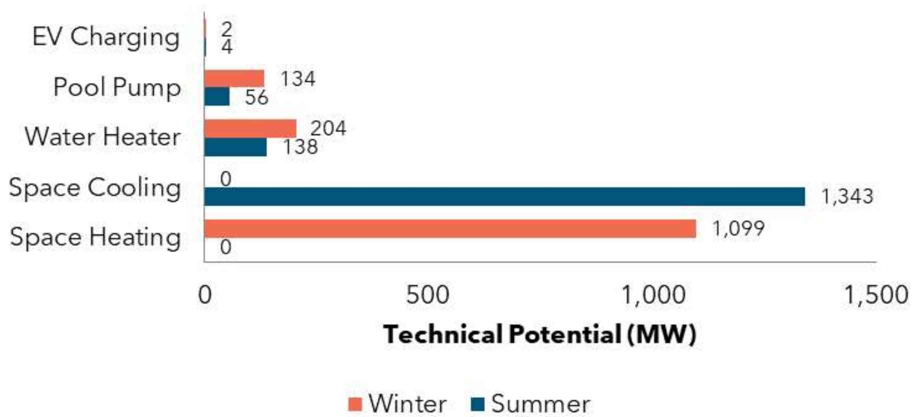
Table 10. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	1,541	1,439
Non-Residential	1,571	1,691
Total	3,112	3,130

5.3.1 Residential

Residential technical potential is summarized in Figure 20.

Figure 20: Residential DR Technical Potential by End-Use

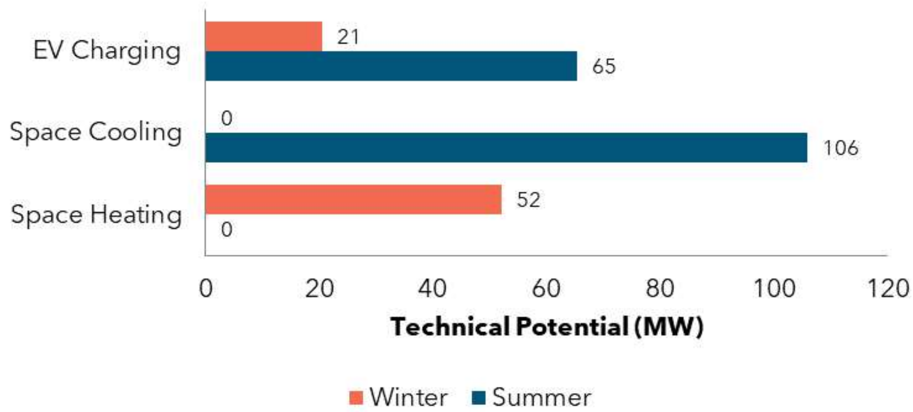


5.3.2 Non-Residential

5.3.2.1 Small C&I Customers

For small C&I technical potential, Resource Innovations looked at cooling and heating loads only. Small C&I technical potential is provided in Figure 21.

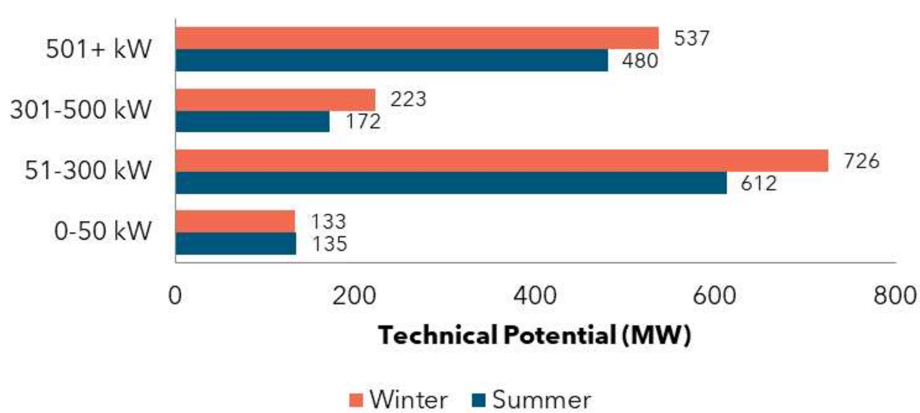
Figure 21: Small C&I DR Technical Potential by End-Use



5.3.2.2 Large C&I Customers

Figure 22 provides the technical potential for large C&I customers, broken down by customer size.

Figure 22: Large C&I DR Technical Potential by Segment



5.4 DSRE Technical Potential

Table 11 provides the results of the DSRE technical potential for each customer segment:

Table 11. DSRE Technical Potential[7]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	484	51	8,000
Non-Residential	165	6	2,236
Total	649	57	10,236
Battery Storage charged from PV Systems			
Residential	598	876	0
Non-Residential	120	205	0
Total	718	1081	0
CHP Systems			
Total	358	286	1,768

[7] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

Appendix A EE Measure List

For information on how Resource Innovations developed this list, please see Section 4.

Table 12: Residential EE Measures

Measure	End-Use	Description	Baseline
120v Heat Pump Water Heater 50 Gallons	Residential Domestic Hot Water	120v Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Air Sealing-Infiltration Control	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Improved Infiltration Control	Standard Heating and Cooling System with Standard Infiltration Control
Air-to-Water Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star Air-to-Water Heat Pump, 25 SEER, 13 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - 15 SEER/14.3 SEER2 from base electric resistance	Residential Space Cooling, Residential Space Heating	ASHP 15 SEER from base electric resistance	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2 (from elec resistance)	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2, 10.5 HSPF	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating

Measure	End-Use	Description	Baseline
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2 (from elect resistance)	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
Basement or Crawlspace Wall Insulation R-15	Residential Space Cooling, Residential Space Heating	Increased Basement or Crawlspace Wall Insulation (R-15)	Code-Compliant Exterior Below-Grade Wall Insulation (R-10)
Bathroom Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
CEE Advanced Tier Clothes Dryer	Clothes Dryers	CEE Advanced Tier Clothes Dryer	One Clothes Dryer meeting Federal Standard
CEE Advanced Tier Clothes Washer	Clothes Washers	Tier 3 CEE Clothes washer	One Clothes Washer meeting Federal Standard
CEE Tier 3 Refrigerator	Refrigerators	Residential Tier 3 Refrigerator	One Refrigerator meeting Federal Standard
Ceiling Insulation (R11 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Ceiling Insulation (R38 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Residential Space Cooling	Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - 24 SEER/22.9 SEER2	Residential Space Cooling	Central AC - 24 SEER/22.9 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Residential Space Cooling	Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling	Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC Tune Up	Residential Space Cooling	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Existing Typical Central AC without Regular Maintenance/tune-up
Dehumidifier Recycling	Plug Load	No dehumidifier	One Dehumidifier meeting Federal Standard
Drain Water Heat Recovery	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Duct Insulation	Residential Space Cooling, Residential Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork	Standard Electric Heating and Central AC with Uninsulated Ductwork
Duct Repair	Residential Space Cooling, Residential Space Heating	Duct Repair to eliminate/minimize leaks, includes testing and sealing	Standard Electric Heating and Central AC with typical duct leakage
ECM Circulator Pump	Residential Miscellaneous	Install ECM Circulator Pump	Install Standard Circulator Pump
Energy Star Air Purifier	Plug Load	One Air Purifier meeting ENERGY STAR 2.0 Standards	One Standard Conventional Air Purifier
Energy Star Audio-Video Equipment	Plug Load	One DVD/Blu-Ray Player meeting current ENERGY STAR Standards	One Market Average DVD/Blu-Ray Player
Energy Star Bathroom Ventilating Fan	Residential Ventilation and Circulation	Bathroom Exhaust Fan meeting current ENERGY STAR Standards	Bathroom Exhaust Fan meeting Federal Standard
Energy Star Ceiling Fan	Residential Miscellaneous	60" Ceiling Fan Meeting ENERGY STAR 3.1 Standards	Standard 60" Ceiling Fan
Energy Star Clothes Dryer	Clothes Dryers	One Electric Resistance Clothes Dryer meeting ENERGY STAR 1.1 Standards	One Clothes Dryer meeting Federal Standard

Measure	End-Use	Description	Baseline
Energy Star Clothes Washer	Clothes Washers	One Clothes Washer meeting ENERGY STAR 8.1 Standards	One Clothes Washer meeting Federal Standard
Energy Star Dehumidifier	Plug Load	One Dehumidifier meeting ENERGY STAR 5.0 Standards	One Dehumidifier meeting Federal Standard
Energy Star Dishwasher	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements (effective on July 19, 2023), electric water heating	One Dishwasher meeting Federal Standard
Energy Star Dishwasher (Gas Water Heating)	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements, gas water heating	One Dishwasher meeting Federal Standard; gas water heating
Energy Star Door	Residential Space Cooling, Residential Space Heating	100ft2 of Opaque Door meeting Energy Star Version 6.0 Requirements (U-Value: 0.17)	100ft2 of Opaque Door meeting current FL Code Requirements
ENERGY STAR EV supply equipment (level 2 charger)	Residential Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Freezer	Freezers	One Freezer meeting current ENERGY STAR 5.1 Standards	One Freezer meeting Federal Standard
Energy Star Ground Source Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star GSHP, 17.1 SEER, 12 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Energy Star Imaging Equipment	Plug Load	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star Monitor	Plug Load	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star Personal Computer	Plug Load	One Personal Computer meeting ENERGY STAR 8.0 Standards	One Personal Computer meeting ENERGY STARÂ® 3.0 Standards
Energy Star Refrigerator	Refrigerators	One Refrigerator/Freezer meeting ENERGY STAR 5.1 Standards	One Refrigerator/Freezer meeting Federal Standard
Energy Star Room AC	Residential Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star Set-Top Receiver	Plug Load	One Set-top Box meeting ENERGY STAR 4.1 Standards	One Market Average Set-top Box
Energy Star TV	Plug Load	One Television meeting ENERGY STAR 9.0 Standards	One non-ENERGY STAR Television
Energy Star Windows	Residential Space Cooling, Residential Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window current FL energy code requirements

Measure	End-Use	Description	Baseline
Exterior Wall Insulation	Residential Space Cooling, Residential Space Heating	Increased Exterior Above-Grade Wall Insulation (R-13)	Market Average Existing Exterior Above-Grade Wall Insulation
Filter Whistle	Residential Ventilation and Circulation	Install the Furnace Filter Alarm	No Furnace Filter Alarm on a Central Forced-Air Furnace
Floor Insulation	Residential Space Heating	Increased Floor Insulation (R-30)	Code-Compliant Floor Insulation
Freezer Recycling	Freezers	No Freezer	Current Market Freezer
Green Roof	Residential Space Cooling	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
Heat Pump Clothes Dryer	Clothes Dryers	One Heat Pump Clothes Dryer	One Clothes Dryer meeting Federal Standard
Heat Pump Pool Heater	Residential Miscellaneous	Heat Pump Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Heat Pump Tune Up	Residential Space Cooling, Residential Space Heating	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Standard Heating and Cooling System without Regular Maintenance/tune-up
Heat Pump Water Heater 50 Gallons-CEE Advanced Tier	Residential Domestic Hot Water	CEE Advanced Tier Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 50 Gallons-ENERGY STAR	Residential Domestic Hot Water	Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 80 Gallons-ENERGY STAR	Residential Domestic Hot Water	Energy Star Heat Pump Water Heater 80 Gallons	Code-Compliant 80 Gallon Electric Resistance Water Heater
Heat Trap	Residential Domestic Hot Water	Heat Trap	Existing Water Heater without heat trap
High Efficiency Convection Oven	Residential Cooking	One Full-Size Convection Oven meeting ENERGY STAR 3.0 Standards	One Standard Economy-Grade Full-Size Oven
High Efficiency Induction Cooktop	Residential Cooking	One residential induction cooktop	One standard residential electric cooktop
Home Energy Management System	Lighting, Plug Load, Residential Space Cooling, Residential Space Heating	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Hot Water Pipe Insulation	Residential Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-5	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
HVAC ECM Motor	Residential Ventilation and Circulation	A brushless permanent magnet (ECM) blower motor for electric furnace	Permanent Split Capacitor Motor for Electric Furnace
HVAC Economizer	Residential Space Cooling	Install residential economizer	No economizer

Measure	End-Use	Description	Baseline
HVAC Zoning System	Residential Space Cooling, Residential Space Heating	Install dampers in the ducts, dividing home into multiple zones, each controlled by its own thermostat	Single zone HVAC system
Indoor Daylight Sensor	Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Range	Residential Cooking	Residential induction range	Electric range
Instantaneous Hot Water System	Residential Domestic Hot Water	Instantaneous Hot Water System	Standard Efficiency Storage Tank Water Heater
Kitchen Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
LED - 9W_CFL Baseline	Lighting	LED (assume 9W) replacing CFL baseline lamp	14W CFL (60W equivalent)
LED - 9W_Halogen Baseline	Lighting	LED (assume 9W) replacing EISA-2020 compliant baseline lamp	EISA-2020 compliant baseline lamp (60W equivalent)
LED Specialty Lamps-5W Chandelier	Lighting	5 W Chandelier LED	Standard incandescent chandelier lamp
Linear LED	Lighting	Linear LED Lamps in Linear Fluorescent Fixture	Standard (32w) T8 lamps in Linear Fluorescent Fixture
Low Flow Showerhead	Residential Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
New Construction - Whole Home Improvements - Tier 1	Whole Home	Performance-based improvements in new homes - 20% savings	Residential New Construction (Baseline Efficiency)
New Construction - Whole Home Improvements - Tier 2	Whole Home	Performance-based improvements in new homes - 35% savings	Residential New Construction (Baseline Efficiency)
Occupancy Sensors Switch Mounted	Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Timer	Lighting	Timer on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Outdoor Motion Sensor	Lighting	Motion Sensor on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Ozone Laundry	Clothes Washers	Add a New, Single-Unit Ozone Laundry System to the Clothes Washer	One Clothes Washer meeting Federal Standard

Measure	End-Use	Description	Baseline
Programmable Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Properly Sized CAC	Residential Space Cooling	Properly Sized Central Air Conditioning	Standard Central Air Conditioning, Oversized
Radiant Barrier	Residential Space Cooling	Radiant Barrier	No radiant barrier
Reflective Roof	Residential Space Cooling	Reflective Roof Treatment	Standard dark shingle
Refrigerator Coil Cleaning	Refrigerators	Refrigerator Coil Cleaning	
Refrigerator Recycling	Refrigerators	No Refrigerator	Current Market Average Refrigerator
Residential Whole House Fan	Residential Space Cooling	Standard Central Air Conditioning with Whole House Fan	Standard Central Air Conditioning, No Whole House Fan
Sealed crawlspace	Residential Space Cooling, Residential Space Heating	Encapsulated and semi-conditioned crawlspace	Naturally vented, unconditioned crawlspace
Smart Breaker	Whole Home	Smart Breaker	standard electric breakers
Smart Panel	Whole Home	Multi-channel device that attaches to customer's circuit breaker to enable monitoring and control of major end-use appliances by customer	standard electric panel
Smart Power Strip	Plug Load	Smart plug strips for entertainment centers and home office	Standard entertainment center or home office usage, no smart strip controls
Smart Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Solar Attic Fan	Residential Space Cooling	Standard Central Air Conditioning with Solar Attic Fan	Standard Central Air Conditioning, No Solar Attic Fan
Solar Pool Heater	Residential Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pumps	Residential Miscellaneous	Solar Powered Pool Pump	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System	Residential Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Spray Foam Insulation(Base R11)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation(Base R19)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Spray Foam Insulation(Base R2)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation(Base R30)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Thermostatic Shower Restriction Valve	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Thermostatic Shower Valves	50 Gallon Electric Resistance Heater and Standard Shower Valves
Variable Refrigerant Flow (VRF) HVAC Systems	Residential Space Cooling, Residential Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Water Heater Blanket	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Insulated Tank Wrap	Code-Compliant 50 Gallon Electric Resistance Water Heater, No Tank Wrap
Water Heater Thermostat Setback	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Temperature Setpoint of 119°F	Code-Compliant 50 Gallon Electric Resistance Water Heater (Temp. Setpoint = 130Â°F)
Water Heater Timeclock	Residential Domestic Hot Water	Water Heater Timeclock	Existing Water Heater without time clock
Weather stripping	Residential Space Cooling, Residential Space Heating	Specific quantity of weather stripping to seal	
Window Caulking	Residential Space Cooling, Residential Space Heating	Window caulking	
Window Sun Protection	Residential Space Cooling	Window Film Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

Table 13: Commercial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency

Measure	End-Use	Description	Baseline
Advanced Rooftop Controller	Ventilation and Circulation	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Miscellaneous	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air Curtains	Space Cooling, Space Heating	Air Curtain across door opening	Door opening with no air curtain
Airside Economizer	Space Cooling	Airside Economizer	No economizer
Anti-Sweat Controls	Refrigeration	One Medium Temperature Reach-In Case with Anti-Sweat Heater Controls	One Medium Temperature Reach-In Case without Anti-Sweat Heater Controls
Auto Off Time Switch	Interior Lighting	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Automatic Door Closer for Walk-in Coolers and Freezers	Refrigeration	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Beverage Vending Machine Controls	Refrigeration	One non-ENERGY STAR beverage vending machine equipped with infrared occupancy sensing controls	One non-ENERGY STAR beverage vending machine, no controls
Bi-Level Lighting Control (Exterior)	Exterior Lighting	Bi-Level Controls on Exterior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Interior)	Interior Lighting	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ceiling Insulation(R19 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation(R19 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation(R2 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation(R2 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building

Measure	End-Use	Description	Baseline
Chilled Water Reset	Space Cooling	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Chiller maintenance	Space Cooling	O&M improvements to restore chiller performance	
CO Sensors for Parking Garage Exhaust	Miscellaneous	Enclosed Parking Garage Exhaust with CO Control	Constant Volume Enclosed Parking Garage Exhaust
Commercial Duct Sealing	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Commercial Strategic Energy Management	Whole Building	Commercial Strategic Energy Management	No active energy management
Custom measure - Non-lighting	Space Cooling, Space Heating	Custom Improvement to Facility's Operations	Baseline Technology/Process
Data Center Hot Cold Aisle	Office Equipment	Equipment configuration that saves HVAC	No hot, cold aisle containment
Dedicated Outside Air System (DOAS)	Space Cooling, Space Heating	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Circulating Systems	Domestic Hot Water	Recirculation Pump with Demand Control Mechanism	Uncontrolled Recirculation Pump
Demand Controlled Ventilation	Ventilation and Circulation	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Refrigeration	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Destratification Fans	Space Heating	Destratification Fans improve temperature distribution by circulating warmer air from the ceiling back down to the floor level	No destratification fan
Door Gasket (Cooler)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Door Gasket (Freezer)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Drain water heat recovery	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Dual Enthalpy Economizer	Ventilation and Circulation	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer

Measure	End-Use	Description	Baseline
Duct Insulation	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork (R-8)	Standard Electric Heating and Central AC with Uninsulated Ductwork (R-4)
Ductless Mini-Split AC	Space Cooling	Ductless Mini-Split AC, 4 Ton, 16 SEER	Code-Compliant AC Unit, 4 Ton, 15 SEER
Ductless Mini-Split HP	Space Cooling, Space Heating	Ductless Mini-Split HP, 17 SEER, 9.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
DX Coil Cleaning	Space Cooling	DX Coil Cleaning	DX Coil Not Cleaned
ECM Motors on Furnaces	Space Heating	Variable Speed Electronically Commutated Motor for an Electric Furnace	Permanent Split Capacitor Motor for Electric Furnace
Efficient Battery Charger	Miscellaneous	Efficient Battery Charger	FR or SCR charging stations with power conversion efficiency < 89% or > 10 W
Efficient Exhaust Hood	Cooking	Kitchen ventilation with automatically adjusting fan controls	Kitchen ventilation with constant speed ventilation motor
Efficient Motor Belts	Miscellaneous	Synchronous belt, 98% efficiency	Standard V-belt drive
Efficient New Construction Lighting	Interior Lighting	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Energy Recovery Ventilation System (ERV)	Space Cooling	Unitary Cooling Equipment that Incorporates Energy Recovery	Current Market Packaged or Split DX Unit
Energy Star Combination Oven	Cooking	Energy Star Combination Oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade 10-Pan Combination Oven
Energy Star Commercial Clothes Washer	Miscellaneous	One Commercial Clothes Washer meeting current ENERGY STAR Version 8.1 Standards	One Commercial Clothes Washer meeting Federal Standard
Energy Star Commercial Dishwasher	Domestic Hot Water	One Commercial Dishwasher meeting ENERGY STAR Version 3.0 Standards	One Dishwasher meeting Federal Standard
Energy Star Commercial Glass Door Freezer	Refrigeration	One Glass Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Glass Door Freezer meeting Federal Standards
Energy Star Commercial Glass Door Refrigerator	Refrigeration	One Glass Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Glass Door Refrigerator meeting Federal Standards
Energy Star Commercial Solid Door Freezer	Refrigeration	One Solid Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Solid Door Freezer meeting Federal Standards
Energy Star Commercial Solid Door Refrigerator	Refrigeration	One Solid Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Solid Door Refrigerator meeting Federal Standards

Measure	End-Use	Description	Baseline
Energy Star convection oven	Cooking	Energy Star convection oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Full-Size Convection Oven
Energy Star EV Chargers	Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Fryer	Cooking	One Standard Vat Electric Fryer meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Standard Vat Electric Fryer
Energy Star Griddle	Cooking	One Griddle meeting current ENERGY STAR Version 1.2 Standards	One Conventional Griddle
Energy Star Hot Food Holding Cabinet	Cooking	One Hot Food Holding Cabinet meeting current ENERGY STAR Version 2.0 Standards	One Standard Hot Food Holding Cabinet
Energy Star Ice Maker	Refrigeration	One Continuous Self-Contained Ice Maker meeting ENERGY STAR Version 3.0 Standards	One Continuous Self-Contained Ice Maker meeting Federal Standard
ENERGY STAR Imaging Equipment	Office Equipment	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star LED Directional Lamp	Interior Lighting	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star Monitors	Office Equipment	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star PCs	Office Equipment	One Personal Computer (desktop or laptop) meeting current ENERGY STARÂ® Standards	One non-ENERGY STARÂ® Personal Computer
Energy Star room AC	Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC, 1 Ton, 10.9 CEER
Energy Star Servers	Office Equipment	One Server meeting ENERGY STAR 2.0 Standards	One Standard Server
Energy Star Steamer	Cooking	One 4-Pan Electric Steamer meeting ENERGY STARÂ® 2.0 Standards	One Standard Economy-Grade 4-Pan Steamer
Energy Star Uninterruptable Power Supply	Office Equipment	Standard Desktop Plugged into Energy Star Uninterruptable Power Supply at 25% Load	Standard Desktop Plugged into Average Rotary Uninterruptable Power Supply at 25% Load
Energy Star Vending Machine	Refrigeration	One Refrigerated Vending Machine meeting ENERGY STAR Version 4.0 Standards	One Refrigerated Vending Machine meeting ENERGY STARÂ® 1.0 Standards
ENERGY STAR Water Cooler	Miscellaneous	One Storage Type Hot/Cold Water Cooler Unit meeting	One Standard Storage Type Hot/Cold Water Cooler Unit

Measure	End-Use	Description	Baseline
		ENERGY STAR Version 3.0 Standards	
Energy Star windows	Space Cooling, Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Miscellaneous	Plug-in timer that activates engine block timer to reduce unnecessary run time	Engine block heater (typically used for backup generators) running continuously
Escalator Motor Efficiency Controller	Miscellaneous	Install Escalator Motor Efficiency Controller	Escalator without Motor Efficiency Controller
Facility Commissioning	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility commissioning to optimize building operations in new facilities	Standard new construction facility with no commissioning
Facility Energy Management System	Space Cooling, Space Heating, Ventilation and Circulation	Typical HVAC by Building Type Controlled by Energy Management System	Standard/manual facility equipment controls
Faucet Aerator	Domestic Hot Water	Low-flow lavatory faucet aerator, flow rate: 1.0 gpm	Federal lavatory flow rate standard, 1994, flow rate: 2.2 gpm
Floating Head Pressure Controls	Refrigeration	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Floor Insulation	Space Cooling, Space Heating	Increased Floor Insulation (R-19)	Market Average Existing Floor Insulation
Geothermal Heat Pump	Space Cooling, Space Heating	Geothermal Heat Pump	Code-Compliant Air Source Heat Pump
Green roof	Space Cooling, Space Heating	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
HE Air Cooled Chiller - All Compressor Types - 100 Tons	Space Cooling	HE Air Cooled Chiller - Air Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE DX 11.25-20.0 Tons Elec Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER

Measure	End-Use	Description	Baseline
HE DX 5.4-11.25 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
Heat Pump Pool Heater Commercial	Miscellaneous	High Efficiency Pool Heater Eff. >=84%	Standard Efficiency Pool Heater 78% Eff.
Heat Pump Water Heater	Domestic Hot Water	Efficient 50 Gallon Electric Heat Pump Water Heater	Code-Compliant 50 Gallon Electric Heat Pump Water Heater
High Efficiency Air Compressor	Miscellaneous	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Data Center Cooling	Space Cooling	High Efficiency CRAC (computer room air conditioner)	Standard Efficiency CRAC
High Efficiency PTAC	Space Cooling	High Efficiency PTAC	Code-Compliant PTAC
High Efficiency PTHP	Space Cooling, Space Heating	High Efficiency PTHP	Code-Compliant PTHP
High Efficiency Refrigeration Compressor_Discus	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor_Scroll	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Speed Fans	Ventilation and Circulation	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter

Measure	End-Use	Description	Baseline
Hot water pipe insulation	Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-4	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
Hotel Card Energy Control Systems	Space Cooling, Space Heating	Guest Room HVAC Unit Controlled by Hotel-Key-Card Activated Energy Control System	Guest Room HVAC Unit, Manually Controlled by Guest
Indoor daylight sensor	Interior Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Cooktops	Cooking	Efficient Induction Cooktop	One Standard Electric Cooktop
Infiltration Reduction - Air Sealing	Space Cooling, Space Heating	Reduced leakage through caulking, weather-stripping	Standard Heating and Cooling System with Moderate Infiltration
Instantaneous Hot Water System Commercial	Domestic Hot Water	Instantaneous Hot Water System	Code-Compliant Electric Storage Water Heater
LED - 14W_CFL Baseline	Interior Lighting	LED (assume 14W) replacing CFL	100W equivalent CFL
LED - 9W Flood_CFL Baseline	Exterior Lighting	LED (assume 9W) replacing CFL	14W CFL
LED Canopy Lighting (Exterior)	Exterior Lighting	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Exit Sign	Interior Lighting	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting	2x4 LED Troffer	Lumen-Equivalent 32-Watt T8 Lamp
LED Linear - Lamp Replacement	Interior Lighting	Linear LED (16W)	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	Space Cooling, Space Heating	LEED New Construction Whole Building	Comparable facility, code-compliance construction

Measure	End-Use	Description	Baseline
Light Tube	Interior Lighting	One 14" Light Tube, Delivering light to 250 S.F. of Commercial Space	250 S.F. of Commercial Space Lit by Typical Lighting Strategies
Low Flow Shower Head	Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.50 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
Low-Flow Pre-Rinse Sprayers	Domestic Hot Water	Low-Flow Pre-Rinse Sprayer with Flow Rate of 1.6 gpm	Pre-Rinse Sprayer with Federal Standard Flow Rate of 2.25 gpm
Network PC Power Management	Office Equipment	One computer and monitor attached to centralized energy management system that controls when desktop computers and monitors plugged into a n	One computer and monitor, manually controlled
Networked Lighting Controls	Interior Lighting	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Night Covers for Display Cases	Refrigeration	One Open Vertical Case with Night Covers	One Existing Open Vertical Case, No Night Covers
Occupancy Sensors, Ceiling Mounted	Interior Lighting	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy Sensors, Switch Mounted	Interior Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ozone Laundry Commercial	Miscellaneous	Add a new ozone laundry system onto a commercial clothes washer	One commercial clothes washer without ozone laundry system
Programmable thermostat	Space Cooling, Space Heating	Pre-set programmable thermostat that replaces manual thermostat	Standard Heating and Cooling System with Manual Thermostat
PSC to ECM Evaporator Fan Motor (Reach-In)	Refrigeration	Medium Temperature Reach-In Case with equivalent size Electronically Commutated Evaporator Fan Motor	Medium Temperature Reach-In Case with Permanent Split Capacitor Evaporator Fan Motor
PSC to ECM Evaporator Fan Motor (Walk-In, Refrigerator)	Refrigeration	Medium Temperature Walk-In Case with Electronically Commutated Evaporator Fan Motor	Medium Temperature Walk-In Case with Permanent Split Capacitor Evaporator Fan Motor

Measure	End-Use	Description	Baseline
Q-Sync Evaporator Fan Motor	Refrigeration	Medium Temperature Reach-In Case with equivalent size Q-Sync Evaporator Fan Motor	Medium Temperature Reach-In Case with 20W Permanent Split Capacitor Fan Motor
Reflective Roof Treatment	Space Cooling	Reflective Roof Treatment	Standard Black Roof
Refrigerated Display Case LED Lighting	Refrigeration	60" Refrigerated Case LED Strip	Lumen-Equivalent 32-Watt T8 Fixture
Refrigerated Display Case Lighting Controls	Refrigeration	Occupancy Sensors for Refrigerated Case Lighting to reduce run time	Market-Share Weighted Existing Linear Fluorescent Fixture
Refrigeration Commissioning	Refrigeration	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Refrigeration Economizer	Refrigeration	Walk-in refrigerator with economizer	Walk-in refrigerator without economizer
Regenerative Drive Elevator Motor	Miscellaneous	Regenerative drive produced energy when motor in overhaul condition	Standard motor
Retro-Commissioning (Existing Construction)	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	
Roof Insulation	Space Cooling, Space Heating	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Server Virtualization	Office Equipment	2 Virtual Host Server	20 Single Application Servers
Smart Strip Plug Outlet	Office Equipment	One Smart Strip Plug Outlet	One Standard plug strip/outlet
Smart thermostat	Space Cooling, Space Heating	Thermostats that include "smart" features such as occupancy sensors, geo-fencing, multi-zone sensors	Standard Heating and Cooling System with Manual Thermostat
Solar Pool Heater Commercial	Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pump	Miscellaneous	Solar Powered Pool Pump Motor	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System Commercial	Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Strip Curtains - Freezers	Refrigeration	Walk-in freezer with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in freezer without strip curtains

Measure	End-Use	Description	Baseline
Strip Curtains - Refrigerators	Refrigeration	Walk-in cooler with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in cooler without strip curtains
Suction Pipe Insulation - Freezers	Refrigeration	Suction Pipe Insulation - Freezers	Uninsulated freezer suction lines
Suction Pipe Insulation - Refrigerators	Refrigeration	Suction Pipe Insulation - Refrigerators	Uninsulated refrigeration suction lines
Thermal Energy Storage	Space Cooling	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Thermostatic Shower Restriction Valve Commercial	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Pressure Balance Shower Valves	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater and Standard Shower Valves
Time Clock Control	Interior Lighting	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Variable Refrigerant Flow (VRF) HVAC Systems	Space Cooling, Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant PTHP
VAV System	Ventilation and Circulation	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Cooling Tower Fans	Space Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Pump	Space Cooling, Space Heating	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VSD Controlled Compressor	Refrigeration	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Wall Insulation	Space Cooling, Space Heating	Increased Exterior Above-Grade Wall Insulation	Market Average Existing Exterior Above-Grade Wall Insulation
Warehouse Loading Dock Seals	Space Cooling, Space Heating	Seals to reduce infiltration losses at loading dock	Loading dock with no seals
Water Cooled Refrigeration Heat Recovery	Domestic Hot Water	The heat reclaim system transfers waste heat from refrigeration system to space heating or hot water	No heat recovery
Water Heater Setback	Domestic Hot Water	A 50 gallon electric hot water tank with a thermostat setting reduced to no lower than 120 degrees.	A 50 gallon electric hot water tank with a thermostat setting that is higher than 120 degrees, typically hot water tanks with settings of 130 degrees or higher.
Water source heat pump	Space Cooling, Space Heating	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP

Measure	End-Use	Description	Baseline
Waterside Economizer	Space Cooling	Waterside Economizer	No economizer
Window shade film	Space Cooling	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC
Zero Energy Doors	Refrigeration	Install zero energy doors for a reach-in refrigerated cooler or freezer	Standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors

Table 14: Industrial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
3-phase High Frequency Battery Charger - 1 shift	Other	3-phase High Frequency Battery Charger	Standard Charger
Advanced Rooftop Controller	HVAC	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Compressed Air	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air curtains	HVAC	Air Curtain across door opening	Door opening with no air curtain
Airside economizer	HVAC	Airside Economizer	No economizer
Auto Closer on Refrigerator Door	Process Cooling	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Auto Off Time Switch	Interior Lighting High Bay	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Exterior)	Exterior Lighting Industrial	Install Exterior Bi-Level Lighting Control, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting

Measure	End-Use	Description	Baseline
Bi-Level Lighting Control (Interior)	Interior Lighting High Bay	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Chilled Water Reset	HVAC	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Cogged Belt on 15hp ODP Motor	Motors Pumps	15HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	15HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Cogged Belt on 40hp ODP Motor	Motors Pumps	40HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	40HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Compressed Air Desiccant Dryer	Process Specific	heated regenerative desiccant dryer without dew point demand controls	heatless regenerative desiccant dryer without dew point demand controls
Compressed Air No-Loss Condensate Drains	Process Specific	Install no-loss condensate drains	Install standard condensate drains
Compressed Air Storage Tank	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Receiver Tank	20 HP Inlet Modulation Fixed-Speed Compressor, No Receiver Tank
Custom Measure - Non-Lighting	HVAC	Custom Improvement to Facility's Operations	Baseline Technology/Process
Dairy Refrigeration Heat Recovery	Other	refrigeration equipment with refrigeration heat recovery tank installed	existing dairy farm with refrigeration equipment and a water heater unit without an RHR unit
Dedicated Outside Air System (DOAS)	HVAC	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Ventilation	HVAC	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Process Cooling	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Dew Point Sensor Control for Dessicant CA Dryer	Compressed Air	1000 CFM Heated Desicant Air Dryer with Dew Point Controls	1000 CFM Modulating Heated Desicant Air Dryer
Drip Irrigation Nozzles	Other	Flow Control Nozzles	Standard Irrigation Nozzles
Dual Enthalpy Economizer	Process Cooling	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
DX Coil Cleaning	HVAC	DX Coil Cleaning	DX Coil Not Cleaned
Efficient Compressed Air Nozzles	Compressed Air	1/4" Engineered Air Nozzle	1/4" Open-End Air Nozzle

Measure	End-Use	Description	Baseline
Efficient New Construction Lighting	Interior Lighting High Bay	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Electric Actuators	Other	Electric Actuator	Pneumatic Actuator
Energy Efficient Laboratory Fume Hood	HVAC	Variable Air Volume High Performance Fume Hood	Constant Volume Conventional Bypass Fume Hood
Energy Efficient Transformers	Other	Energy Efficient Dry Type Transformer (CSL-3)	Standard Transformer (TP-1)
Energy Recovery Ventilation System	HVAC	Unitary Cooling Equipment that Incorporates Energy Recovery	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11.2 EER
Energy Star LED Directional Lamp	Interior Lighting Other	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star room ac	HVAC	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star windows	HVAC	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Other	An engine block heater operated by an outdoor plug-in timer	An engine block heater that is manually plugged in
Facility Commissioning	HVAC	Perform facility commissioning	Comparable facility, no commissioning
Facility Energy Management System	HVAC	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Fan Thermostat Controller	HVAC	Typical HVAC by Building Type with Fan Thermostat Controller Installed	Typical HVAC by Building Type with Programmable Thermostat
Floating Head Pressure Controller	Process Cooling	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Grain Bin Aeration Control System	Process Specific	Grain Storage Fan System with Automatic Controls	Grain Storage Fan System with Manual Controls
HE Air Cooled Chiller - All Compressor Types - 100 Tons	HVAC	HE Air Cooled Chiller - All Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE Air Cooled Chiller - All Compressor Types - 300 Tons	HVAC	Air Cooled Positive Displacement Chiller with Integral VFD, 300 Tons, 13.7 EER	Code-Compliant Air Cooled Positive Displacement Chiller, 300 Tons, 12.5 EER

Measure	End-Use	Description	Baseline
HE DX 11.25-20.0 Tons Elec Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
High Bay Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 800 Watts Controlled	800 Watts of Lighting, Manually Controlled
High Efficiency Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Refrigeration Compressor - Discus	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor - Scroll	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor

Measure	End-Use	Description	Baseline
High Efficiency Welder	Process Specific	High Efficiency Welder	Standard Welding Practices
High Speed Fans	HVAC	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
High Volume Low Speed Fan (HVLS)	Motors Fans Blowers	20' High Volume Low Speed Fan	Conventional Circulating Fan
Indoor Agriculture - LED Grow Lights	Interior Lighting High Bay	LED grow light	1000W High Pressure Sodium
Indoor daylight sensor	Interior Lighting High Bay	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Industrial Duct Sealing	HVAC	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Injection Mold and Extruder Barrel Wraps	Other	2' Diameter, 20' Long Machine Barrel with 1" Insulation	2' Diameter, 20' Long Machine Barrel with no Insulation
Insulated Pellet Dryer Tanks and Ducts	Process Heating	Insulation for Pellet Tank and Duct	Uninsulated Pellet Tank and Duct
LED - 14W_CFL Baseline	Interior Lighting Other	LED (assume 14W) replacing CFL	100W equivalent CFL
LED Canopy Lighting (Exterior)	Exterior Lighting Industrial	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting Industrial	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting Other	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED exit sign	Interior Lighting Other	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting Industrial	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting Linear Fluorescent	2x4 LED Troffer Fixture	Lumen-Equivalent 32-Watt T8 Fixture
LED Linear - Lamp Replacement	Interior Lighting Linear Fluorescent	Linear LED	Lumen-Equivalent 32-Watt T8 Lamp

Measure	End-Use	Description	Baseline
LED Parking Lighting	Exterior Lighting Industrial	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	HVAC	LEED Qualifying New Construction	Comparable facility, code-compliance construction
Light Tube	Interior Lighting Other	One 14" Light Tube, Delivering light to 250 S.F. of Industrial Space	250 S.F. of Industrial Space Lit by Typical Lighting Strategies
Low Energy Livestock Waterer	Motors Pumps	Install Thermostatically Controlled Livestock Watering System	Standard Livestock Watering System
Low Pressure Sprinkler Nozzles	Motors Pumps	Low Pressure Irrigation Nozzles operate at 35 psi or lower	Standard high pressure irrigation nozzles that operate at 50 psi or greater
Low Pressure-drop Filters	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Low Pressure Drop Filter	20 HP Inlet Modulation Fixed-Speed Compressor, No Particulate Removal
Milk Pre-Cooler	Other	Installed pre-cooler heat exchanger	no pre-cooler heat exchanger installed
Networked Lighting Controls	Interior Lighting Linear Fluorescent	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy sensors, switch mounted	Interior Lighting Linear Fluorescent	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting Industrial	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting Industrial	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Packaged Terminal AC	HVAC	High Efficiency Packaged Terminal AC	Code-Compliant PTAC, 10.9 EER
Process Cooling Ventilation Reduction	Process Cooling	Standard Process Cooling with Reduced Ventilation	Standard Process Cooling
Programmable thermostat	HVAC	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Reflective Roof Treatment	HVAC	Reflective Roof Treatment	Standard Black Roof

Measure	End-Use	Description	Baseline
Refrigeration Commissioning	Process Cooling	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Retro-Commissioning (Existing Construction)	HVAC	Perform Facility Retro-commissioning	
Roof insulation	HVAC	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Smart thermostat	HVAC	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Strategic Energy Management	HVAC	SEM goal setting and tracking	No active energy management
Synchronous Belt on 15hp ODP Motor	Motors Pumps	15 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	15 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 5hp ODP Motor	Motors Pumps	5 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	5 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 75hp ODP Motor	Motors Pumps	75 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	75 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Thermal energy storage	HVAC	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Time Clock Control	Interior Lighting High Bay	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
VAV System	HVAC	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
VFD on Cooling Tower Fans	Process Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Fan	Motors Fans Blowers	5 HP HVAC Fan Motor, with VFD Control	5 HP HVAC Fan Motor, no VFD Control
VFD on HVAC Pump	Motors Pumps	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VFD on process pump	Motors Pumps	20 HP Process Pump Equipped with VFD Control	20 HP Process Pump, Constant Speed
VSD Controlled Compressor	Process Cooling	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System

Measure	End-Use	Description	Baseline
Water source heat pump	HVAC	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside economizer	HVAC	Waterside Economizer	No economizer
Window shade film	HVAC	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

The following EE measures from the 2019 Technical Potential Study were eliminated from the current study[8]:

Table 15: 2019 EE Measures Eliminated from Current Study

Sector	Measure	End-Use	Reason for Removal
Residential	CFL – 15W Flood	Lighting	Better technology (LED) available
Residential	CFL – 15W Flood (Exterior)	Lighting	Better technology (LED) available
Residential	CFL – 13W	Lighting	Better technology (LED) available
Residential	CFL – 23W	Lighting	Better technology (LED) available
Residential	Low Wattage T8 Fixture	Lighting	Better technology (LED) available
Residential	15 SEER Central AC	Space Cooling	Updated Federal Standard
Residential	15 SEER Air Source Heat Pump	Space Cooling, Space Heating	Updated Federal Standard
Residential	14 SEER ASHP from base electric resistance heating	Space Cooling, Space Heating	Updated Federal Standard
Residential	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Storm Door	Space Cooling, Space Heating	Minimal/uncertain energy savings
Commercial	CFL – 15W Flood	Exterior Lighting	Better technology (LED) available
Commercial	High Efficiency HID Lighting	Exterior Lighting	Better technology (LED) available

[8] Additional measures from the 2019 study were updated to reflect current vintage/technology for the current study.

Sector	Measure	End-Use	Reason for Removal
Commercial	LED Street Lights	Exterior Lighting	Market standard
Commercial	LED Traffic and Crosswalk Lighting	Exterior Lighting	Market standard
Commercial	CFL-23W	Interior Lighting	Better technology (LED) available
Commercial	High Bay Fluorescent (T5)	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Fixture Replacement	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Lamp Replacement	Interior Lighting	Better technology (LED) available
Commercial	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Tank Wrap on Water Heater	Domestic Hot Water	Limited applicability
Commercial	Ceiling Insulation (R12 to R38)	Space Cooling, Space Heating	Consolidated measure baseline assumptions
Commercial	Ceiling Insulation (R30 to R38)	Miscellaneous	Consolidated measure baseline assumptions

Appendix B DR Measure List

Table 16: Residential DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Water heater control	Direct load control	Summer and Winter	Load control installed on a water heater (integrated or external switch)
Pool pump switches	Direct load control	Summer and Winter	Load control program with switch installed on pool pump
Room AC	Direct load control	Summer	Load control program that is focused on room AC units rather than central AC
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 17: Small C&I DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 18: Large C&I DR Measures

Measure	Type	Season	Description
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of

Measure	Type	Season	Description
			CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Auto DR	Utility-controlled loads	Summer and Winter	Custom load control of specific end-uses/processes that is triggered by utility signal to building management system; customer can sometimes opt-out of specific events
Firm Service Level	Contractual	Summer and Winter	Customer commits to a maximum usage level during peak periods and, when notified by the utility, agrees to cut usage to that level.
Guaranteed Load Drop	Contractual	Summer and Winter	Customer agrees to reduce usage by an agreed upon amount when notified

No DR measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix C DSRE Measure List

Table 19: Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation

Table 20: Non-Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation
CHP – Fuel Cell	An electrochemical cell-based generator that reacts hydrogen fuel with oxygen
CHP – Micro Turbine	Small combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Gas Turbine	A combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Reciprocating Engine	An engine that uses one or more pistons to convert pressure into rotational motion
CHP - Steam Turbine	A turbine that extracts thermal energy from pressured steam to drive a generator

No DSRE measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix D External Measure Suggestions

Table 21: External Measure Suggestions and Actions

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Efficient Electrification Measures	All measures that can produce substantial site energy savings by converting from natural gas or other fossil fuels should be included in the Florida electric utilities' next efficiency potential study. Key examples include efficient heat pumps to displace gas furnaces and efficient heat pump water heaters to displace gas water heaters. It is important to note that these electrification measures provide not only heating energy savings and water heating energy savings, but can also potentially provide cooling efficiency benefits as well. In the case of heat pumps, that can occur because efficient heat pumps can operate in cooling mode more efficiently than standard central air conditioners. In the case of heat pump water heaters, cooling and dehumidification benefits can occur when/if the water heater is in conditioned space because they transfer heat (particularly latent heat) from the air around them to the water they are heating. A growing number of jurisdictions – including Illinois, Minnesota and some northeastern states – have begun to include efficient electrification measures in their efficiency programs portfolios.	Fuel-switching and electrification are outside the scope of this study
Networked Lighting Controls	LED lighting technology has become increasingly accepted and installed in commercial buildings. The next big efficiency opportunity in commercial lighting efficiency is in sophisticated controls integrated into the light fixtures themselves – both luminaire level lighting controls and networked lighting controls. For example, a 2017 report for both the Northwest Energy Efficiency Alliance and the Design Lights Consortium, a non-profit that works with utilities and manufacturers of lighting products (and which many utilities across the country reference for determination of eligibility of lighting products for efficiency program rebates), found that networked lighting controls can provide on the order of 50% additional savings after LED conversion. Other studies have also found the national savings potential from such products to be enormous. Moreover, these products can be designed to provide not only lighting energy savings but also a number of other non-energy benefits (e.g., asset tracking, such as the ability of hospitals to know the location of all wheel chairs). Numerous utilities across the country now actively promote this technology through their efficiency programs. For example, Commonwealth Edison, the utility serving Chicago and other parts of northern Illinois, is currently getting a significant portion of its commercial lighting savings from promotion of networked lighting controls	Added to measure list for 2024 study

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Ductless mini-split heat pumps to displace inefficient electric baseboard heating	While most Florida residential buildings with electric heat provide that heat with heat pumps, at least some (perhaps most likely being older multi-family rental buildings) still use inefficient electric resistance heat. Ductless mini- split heat pump retrofits can very efficiently displace such inefficient electric heat and should be added to the residential measure list.	Added to measure list for 2024 study
Air Source Heat Pump baseline assumptions	There are seven air source heat pump (ASHP) measures included in the residential measure list. Two of them – one at SEER 14 and a second at SEER 21 – are listed as relative to an electric resistance baseline. Five of them – SEER 15, SEER 16, SEER 17, SEER 18 and SEER 21 – appear to be relative to a baseline of a standard new ASHP. Are we interpreting this correctly? If so, we have a couple of comments/questions/suggestions: • The efficiency standards assessed need to be modified to be consistent with new federal standards, including new testing procedures. • For cases where the baseline is "electric resistance", why only assessing two efficiency tiers (i.e., fewer than for standard ASHP baselines)? The same number of efficiency tiers should be assessed for both baselines.	Incorporated suggestions into 2024 study, including updated baseline standard and assessing same efficiency tiers for both baselines
Heat Pump Water Heater Efficiency	The Res EE tab of the utilities draft measure list suggests that the efficiency of a heat pump water heater is an EF of 2.50. That is unrealistically low. In fact, of the 222 products listed on the Energy Star website, none had UEFs less than 2.80 and only 29 (13%) had UEFs that were less than 3.4; the average was 3.57. Indeed, the first product listed on a search of heat pump water heaters on Home Depot's website is a 50 gallon, Rheem (Pro Terra) product with a UEF of 3.75 and a cost of $1699.	Incorporated suggestion into 2024 study
New Construction Measure Packages	The measures lists did not appear to include packages of measures for building new residential and/or new commercial buildings to levels of efficiency beyond those required by code. Utilities in many jurisdictions run new construction efficiency programs supporting such measure packages. In the residential sector, many base their programs on the long-standing Federal Energy Star standard. However, increasingly utility programs are promoting additional efficiency tiers – often as part of all-electric new construction program offerings – that go well beyond the Energy Star standard. For example, Consumers Energy (Michigan) offers $1000 rebates to builders who construct Energy Star single family homes	Incorporated suggestion into 2024 study with 2 tiers of residential new construction whole-home improvement measures.

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
	with a Home Energy Rating (HERS) score of 57 or less, but offer higher rebates for more efficient buildings – up to $4000 for all electric homes with a HERS score of 40 or less. The Florida utilities potential study should assess savings potential for both the Energy Star level and a tier or two of additional efficiency beyond that level. Similar assessments of new commercial building savings potential should also be assessed.	
Custom Industrial Measures	The utilities' list of industrial efficiency measures addresses common industrial efficiency opportunities. However, it does not address efficiency opportunities that may be unique to individual industries or even to individual industrial facilities. That can include such things as changes in types of materials used in manufacturing, reductions in waste streams, improved use of water delivered by agricultural irrigation systems, and/or other things that are not directly related to energy using equipment or controls of such equipment. It is obviously not possible to list all such measures. However, a potential study will understate savings potential if it does not include a way of capturing such potential in its estimates. One potential way to get a sense of such potential is to review results of comprehensive industrial efficiency programs run by other utilities to identify the portion of actual program savings from such unique custom measures – and then assume that portion of custom savings could be added to the savings estimated in the study for named measures.	Added to measure list for 2024 study
Electric Vehicle measures	Some EV chargers are more efficient than others. The Federal Energy Star program has a standard for them. Savings potential may not be huge, but should be considered in the study. With a growing number of EV sales, the study should also consider the potential savings from promoting the most efficient EVs within different size/style categories	Added to measure list for 2024 study
Removing screw-based LEDs	The screw-based LEDs on both the Residential and Commercial measure lists should now be considered baseline due to federal efficiency standards adopted earlier this year. Utility load forecasts for IRPs should reflect resulting improvements in end use efficiency.	Screw-based LEDs were included in the study but with limited applicability to reflect current market
Removing Commercial fluorescent lighting	LED technology – for both fixtures and lamps – has advanced significantly in recent years, to the point where it should be the only technology considered for commercial lighting. Measures such as high performance T-8 fluorescent fixtures and high bay T-5 fluorescent fixtures should be replaced with LED alternatives in the study.	Updated measure list for 2024 study to only include LED-based lamps for linear fluorescent replacements

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Removing fossil-gas fueled CHP	Fossil-fuel fired CHP systems should not be considered "renewable" and have questionable benefits if electric generation is expected to get increasingly more renewable and clean. Biogas-fueled CHP – such as systems installed in wastewater treatment facilities that use methane byproducts of processing waste – should be included in the study.	2024 study will continue to assess all CHP options
Adding livestock methane power generation to renewables list	For example, see the "cow power" program currently being run by Green Mountain Power, Vermont's largest electric utility	2024 study will continue to assess DSRE options consistent with prior study, including customer-sited solar, solar plus storage, and CHP
Adding EV managed charging to DR list	With national market shares for EVs growing, it is important that utilities consider programs for managing when charging occurs. Numerous utilities are currently running managed charging programs. This does not currently appear to be on the measure list and should be added to the Florida utilities' potential study.	Added to measure list for 2024 study
Residential "smart thermostat" measure can provide both efficiency savings and demand response potential	This is recognized in the inclusion of smart thermostats in both the Res EE and DR tabs of the measure list spreadsheet. We simply want to flag that it is important when assessing cost-effectiveness of this measure that these two potential benefits are considered together. In other words, the cost should be considered compared to the combined efficiency and DR potential rather than separately considered relative to just EE savings and then separately again compared to just DR potential	2024 study will include interactive impacts of EE and DR opportunities
Emerging Technologies	The efficiency potential study measure list appears to be somewhat outdated. It does not include a number of new and emerging technologies. The potential list of such technologies is long. We suggest reviewing the attached list of emerging technologies developed almost two years ago by Consumers Energy (Michigan) and including them in the study.	Consumers Energy study was reviewed and commercially available measures were added to measure list for 2024 study, including heat pump water heaters - CEE advanced tier, heat pump clothes dryers, ozone laundry systems, and 21+ SEER HVAC units

Technical Potential Study of Demand Side Management

Florida Public Utilities Company

Date: 03.07.2024

Table of Contents

Executive Summary

In October 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems.

The main objective of the study was to assess the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of Florida Public Utilities Company's (FPUC) service territory.

1.1 Methodology

Resource Innovations estimates DSM savings potential by applying an analytical framework that aligns baseline market conditions for energy consumption and demand with DSM opportunities. After describing the baseline condition, Resource Innovations applies estimated measure savings to disaggregated consumption and demand data. The approach varies slightly according to the type of DSM resources and available data; the specific approaches used for each type of DSM are described below.

1.1.1 EE Potential

This study utilized Resource Innovations' proprietary EE modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual program savings. The methodology for the EE potential assessment was based on a hybrid "top-down/bottom-up" approach, which started with the current utility load forecast, then disaggregated it into its constituent customer-class and end-use components. Our assessment examined the effect of the range of EE measures and practices on each end-use, taking into account current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the end-use, customer class, and system levels for FPUC.

1.1.2 DR Potential

The assessment of DR potential in FPUC's service territory was an analysis of mass market direct load control programs for residential and small commercial and industrial (C&I) customers, and an analysis of DR programs for large C&I customers. The direct load control program assessment focused on the potential for demand reduction through heating, ventilation, and air conditioning (HVAC), water heater, managed electric vehicle charging, and pool pump load control. These end-uses were of particular interest because of their large contribution to peak period system load. For this analysis, a range of direct load control measures were examined for each customer segment to highlight the range of potential. The assessment further accounted for existing DR programs for FPUC when calculating the total DR potential.

1.1.3 DSRE Potential

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from customers' PV systems, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

1.2 Savings Potential

Technical potential for EE, DR, and DSRE are as follows:

1.2.1 EE Potential

EE technical potential describes the savings potential when all technically feasible EE measures are fully implemented, ignoring all non-technical constraints on electricity savings, such as cost-effectiveness and customer willingness to adopt EE.

The estimated EE technical potential results are summarized in Table 1.

Table 1. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	26	15	97
Non-Residential[1]	14	12	71
Total	40	27	168

1.2.2 DR Potential

DR technical potential describes the magnitude of loads that can be managed during conditions when grid operators need peak capacity. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale such as heating, cooling, water heaters, managed electric vehicle charging, and pool pumps. For large C&I customers, this included their entire electric demand during a utility's system peak, as many of these types of customers will forego virtually all electric demand temporarily if the financial incentive is large enough.

The estimated DR technical potential results are summarized in Table 2.

Table 2. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	41	65
Non-Residential	27	24
Total	68	89

[1] Non-Residential results include all commercial and industrial customer segments.

1.2.3 DSRE Potential

DSRE technical potential estimates quantify all technically feasible distributed generation opportunities from PV systems, battery storage systems charged from PV, and CHP technologies based on the customer characteristics of FPUC's customer base.

The estimated DSRE technical potential results are summarized in Table 3.

Table 3. DSRE Technical Potential[2]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	17	10	152
Non-Residential	9	3	70
Total	26	13	222
Battery Storage charged from PV Systems			
Residential	5	2	0
Non-Residential	0	1	0
Total	5	3	0
CHP Systems			
Total	23	13	108

[2] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

2 Introduction

In October, 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems. The main objective of the study was:

- Assessing the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of FPUC's service territory.

The following deliverables were developed by Resource Innovations as part of the project and are addressed in this report:

- DSM measure list and detailed assumption workbooks
- Disaggregated baseline demand and energy use by year, sector, and end-use
- Baseline technology saturations, energy consumption, and demand
- Technical potential demand and energy savings
- Supporting calculation spreadsheets

2.1 Technical Potential Study Approach

Resource Innovations estimates technical potential according to the industry standard categorization, as follows:

> Technical Potential is the theoretical maximum amount of energy and capacity that could be displaced by DSM, regardless of cost and other barriers that may prevent the installation or adoption of a DSM measure.

For this study, technical potential included full application of commercially available DSM technologies to all residential, commercial, and industrial customers in the utility's service territory.

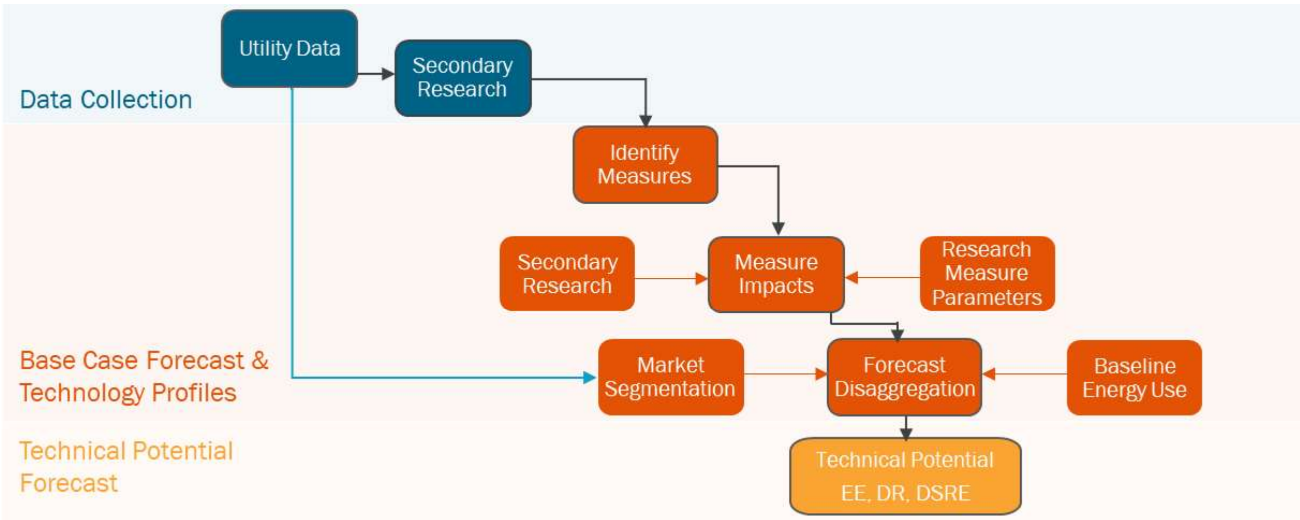
Quantifying DSM technical potential is the result of an analytical process that refines DSM opportunities that align with FPUC's customers' electric consumption patterns. Resource Innovations' general methodology for estimating technical potential is a hybrid "top-

down/bottom-up" approach, which is described in detail in Sections 3 through 5 of this report and includes the following steps:

- Develop a baseline forecast: the study began with a disaggregation of the utility's official electric energy forecast to create a baseline electric energy forecast. This forecast does not include any utility-specific assumptions around DSM performance. Resource Innovations applied customer segmentation and consumption data from each utility and data from secondary sources to describe baseline customer-class and end-use components. Additional details on the forecast disaggregation are included in Section 3.
- Identify DSM opportunities: A comprehensive set of DSM opportunities applicable to FPUC's climate and customers were analyzed to best depict DSM technical potential. Effects for a range of DSM technologies for each end-use could then be examined while accounting for current market saturations, technical feasibility, and impacts.
- Collect cost and impact data for measures: For those measures applicable to FPUC's customers, Resource Innovations conducted primary and secondary research and estimated costs, energy savings, measure life, and demand savings. We differentiated between the type of cost (capital, installation labor, maintenance, etc.) to separately evaluate different implementation modes: retrofit (capital plus installation labor plus incremental maintenance); new construction (incremental capital and incremental maintenance); and burnout costs (incremental capital and incremental maintenance costs for replacement of appliances and equipment that has reached the end of its useful life). Additional details on measure development are included in Section 4.

Figure 1 provides an illustration of the technical potential modeling process conducted for FPUC, with the assessment starting with the current utility load forecast, disaggregated into its constituent customer-class and end-use components, and calibrated to ensure consistency with the overall forecast. Resource Innovations considered the range of DSM measures and practices application to each end-use, accounting for current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the technology, end-use, customer class, and system levels.

Figure 1. Approach to Technical Potential Modeling



Resource Innovations estimated DSM technical potential based on a combination of market research, utility load forecasts and customer data, and measure impact analysis, all in coordination with FPUC. Resource Innovations examined the technical potential for EE, DR, and DSRE opportunities; this report is organized to offer detail on each DSM category, with additional details on technical potential methodology presented in Section 5.

2.2 EE Potential Overview

To estimate EE potential, this study utilized Resource Innovations' modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual utility program savings, as described in Section 5.1.1 below. While the analysis estimates the impacts of individual EE measures, the model accounts for interactions and overlap of individual measure impacts within an end-use or equipment type. The model provides transparency into the assumptions and calculations for estimating EE potential.

2.3 DR Potential Overview

To estimate DR market potential, Resource Innovations considered customer demand during utility peaking conditions and projected customer response to DR measures. Customer demand was determined by looking at account-level interval data for each customer segment. For each segment, Resource Innovations determined the portion of a customer's load that could be curtailed during the system peak. FPUC customer interval data was unavailable and therefore, a sample of FPL customers' load data was used as proxy to estimate peak load profiles and demand response potential.

2.4 DSRE Potential Overview

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from PV, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

3 Baseline Forecast Development

3.1 Market Characterization

The FPUC base year energy use and sales forecast provided the reference point to determine potential savings. The end-use market characterization of the base year energy use and reference case forecast included customer segmentation and load forecast disaggregation. The characterization is described in this section, while the subsequent section addresses the measures and market potential energy and demand savings scenarios.

3.1.1 Customer Segmentation

In order to estimate EE, DR, and DSRE potential, the sales forecast and peak load forecasts were segmented by customer characteristics. As electricity consumption patterns vary by customer type, Resource Innovations segmented customers into homogenous groups to identify which customer groups are eligible to adopt specific DSM technologies, have similar building characteristics and load profiles, or are able to provide DSM grid services.

Resource Innovations segmented customers according to the following:

1) By Sector – how much of FPUC's energy sales, summer and winter peak demand forecast is attributable to the residential, commercial, and industrial sectors?
2) By Customer – how much electricity does each customer typically consume annually and during system peaking conditions?
3) By End-Use – within a home or business, what equipment is using electricity during the system peak? How much energy does this end-use consume over the course of a year?

Table 4 summarizes the segmentation within each sector. In addition to the segmentation described here for the EE and DSRE analyses, the residential customer segments were further segmented by heating type (electric heat, gas heat, or unknown) and by annual consumption bins within each sub-segment for the DR analysis.

Table 4. Customer Segmentation

Residential	Commercial		Industrial	
Single Family	Assembly	Miscellaneous	Agriculture and Assembly	Primary Resources Industries
Multi-Family	College and University	Offices	Chemicals and Plastics	Stone/Glass/ Clay/Concrete
Manufactured Homes	Grocery	Restaurant	Construction	Textiles and Leather
	Healthcare	Retail	Electrical and Electronic Equipment	Transportation Equipment
	Hospitals	Schools K-12	Lumber/Furniture/ Pulp/Paper	Water and Wastewater
	Institutional	Warehouse	Metal Products and Machinery	Other
	Lodging/ Hospitality		Miscellaneous Manufacturing	

From an equipment and energy use perspective, each segment has variation within each building type or sub-sector. For example, the energy consuming equipment in a convenience store will vary significantly from the equipment found in a supermarket. To account for this variation, the selected end-uses describe energy consumption patterns that are consistent with those typically studied in national or regional surveys, such as the U.S. Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS), Commercial Building Energy Consumption Survey (CBECS) and Manufacturing Energy Consumption Survey (MECS), among others. The end-uses selected for this study are listed in Table 5.

Table 5. End-Uses

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Space heating[3]	Space heating[3]	Process heating
Space cooling[3]	Space cooling[3]	Process cooling
Domestic hot water	Domestic hot water	Compressed air
Ventilation and circulation	Ventilation and circulation	Motors/pumps

[3] Includes the contribution of building envelope measures and efficiencies.

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Lighting	Interior lighting	Fan, blower motors
Cooking	Exterior lighting	Process-specific
Appliances	Cooking	Industrial lighting
Electronics	Refrigeration	Exterior lighting
Miscellaneous	Office equipment	HVAC[3]
	Miscellaneous	Other

For DR, the end-uses targeted were those with controllable load for residential customers (i.e., HVAC, water heaters, pool pumps, and electric vehicles) and small C&I customers (HVAC and electric vehicles). For large C&I customers, all load during peak hours was included assuming these customers would potentially be willing to reduce electricity consumption for a limited time if offered a large enough incentive during temporary system peak demand conditions.

3.1.2 Forecast Disaggregation

A common understanding of the assumptions and granularity in the baseline load forecast was developed with input from FPUC. Key discussion topics reviewed included:

- How current DSM offerings are reflected in the energy and demand forecast.
- Assumed weather conditions and hour(s) of the day when the system is projected to peak.
- Are there portions of the load forecast attributable to customers or equipment not eligible for DSM programs?
- How are projections of population increase, changes in appliance efficiency, and evolving distribution of end-use load shares accounted for in the peak demand forecast?

3.1.2.1 Electricity Consumption (kWh) Forecast

Resource Innovations segmented FPUC's electricity consumption forecast into electricity consumption load shares by customer class and end-use. The baseline customer segmentation represents the electricity market by describing how electricity was consumed within the service territory. Resource Innovations developed the forecast for the year 2025, and based it on data provided by FPUC, primarily their 2022 Long-Term Projections of Electricity Energy and Demand, which was the most recent plan available at the time the studies were initiated. The data addressed current baseline consumption, system load, and sales forecasts.

3.1.2.2 Peak Demand (kW) Forecast

A fundamental component of DR potential was establishing a baseline forecast of what loads or operational requirements would be absent due to existing dispatchable DR or time varying rates. This baseline was necessary to assess how DR can assist in meeting specific planning and operational requirements. We utilized FPUC's summer and winter peak demand forecast, which was developed for system planning purposes.

3.1.2.3 Estimating Consumption by End-Use Technology

As part of the forecast disaggregation, Resource Innovations developed a list of electricity end-uses by sector (Table 5). To develop this list, Resource Innovations began with FPUC's estimates of average end-use consumption by customer and sector. Resource Innovations combined these data with other information, such as utility residential appliance saturation surveys, as available, to develop estimates of customers' baseline consumption. Resource Innovations calibrated the utility-provided data with data available from public sources, such as the EIA's recurring data-collection efforts that describe energy end-use consumption for the residential, commercial, and manufacturing sectors.

To develop estimates of end-use electricity consumption by customer segment and end-use, Resource Innovations applied estimates of end-use and equipment-type saturation to the average energy consumption for each sector. The following data sources and adjustments were used in developing the base year 2025 sales by end-use:

Residential Sector:

- The disaggregation was based on FPUC's rate class load shares and intensities.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - FPUC rate class load share is based on average per customer.
    - Resource Innovations made conversions to usage estimates generated by applying EIA RECS data, residential end-use study data from other FEECA utilities and EIA's Annual Energy Outlook (AEO) 2023.

Commercial Sector:

- The disaggregation was based on FPUC's rate class load shares, intensities, and EIA CBECS data.

- Segment data from EIA and FPUC.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
  - Rate class load share based on EIA CBECS and end-use forecasts from FPUC.

Industrial Sector:

- The disaggregation was based on rate class load shares, intensities, and EIA MECS data.
- Segment data from EIA and FPUC.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
  - Rate class load share based on EIA MECS and end-use forecasts from FPUC.

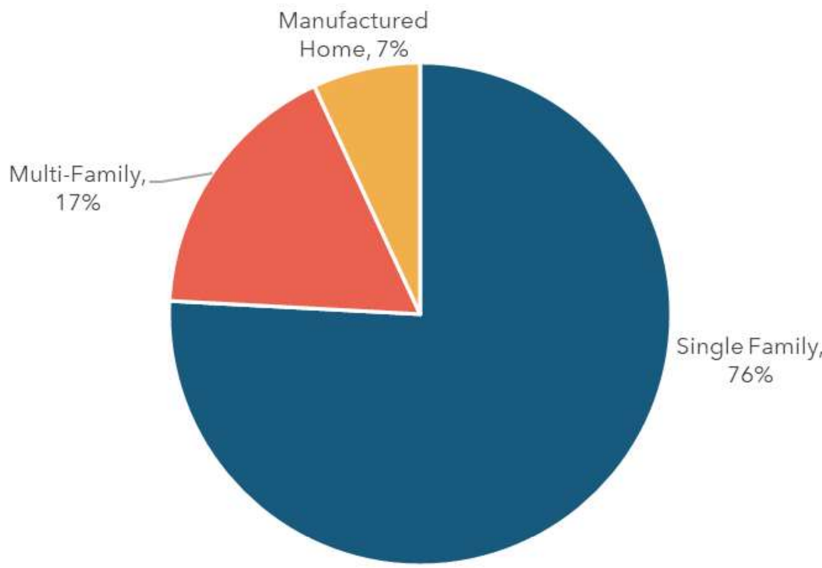
3.2 Analysis of Customer Segmentation

Customer segmentation is important to ensuring that a MPS examines DSM measure savings potential in a manner that reflects the diversity of energy savings opportunities existing across the utility's customer base. FPUC provided Resource Innovations with data concerning the premise type and loads characteristics for all customers for the MPS analysis. Resource Innovations examined the provided data from multiple perspectives to identify customer segments. Resource Innovations' approach to segmentation varied slightly for non-residential and residential accounts, but the overall logic was consistent with the concept of expressing the accounts in terms that were relevant to DSM opportunities.

3.2.1 Residential Customers (EE, DR, and DSRE Analysis)

Segmentation of residential customer accounts enabled Resource Innovations to align DSM opportunities with appropriate DSM measures. Resource Innovations used utility customer data, supplemented with EIA data, to segment the residential sector by customer dwelling type (single family, multi-family, or manufactured home). The resulting distribution of customers according to dwelling unit type is presented in Figure 2.

Figure 2. Residential Customer Segmentation



3.2.2 Non-Residential (Commercial and Industrial) Customers (EE and DSRE Analysis)

For the EE and DSRE analysis, Resource Innovations segmented C&I accounts using the utility's North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes, supplemented by data produced by the EIA's CBECS and MECS. Resource Innovations classified the customers in this group as either commercial or industrial, on the basis of DSM measure information available and applicable to each. For example, agriculture and forestry DSM measures are commonly considered industrial savings opportunities. Resource Innovations based this classification on the types of DSM measures applicable by segment, rather than on the annual energy consumption or maximum instantaneous demand from the segment as a whole. The estimated energy sales distributions Resource Innovations applied are shown below in Figure 3 and Figure 4.

Figure 3. Commercial Customer Segmentation

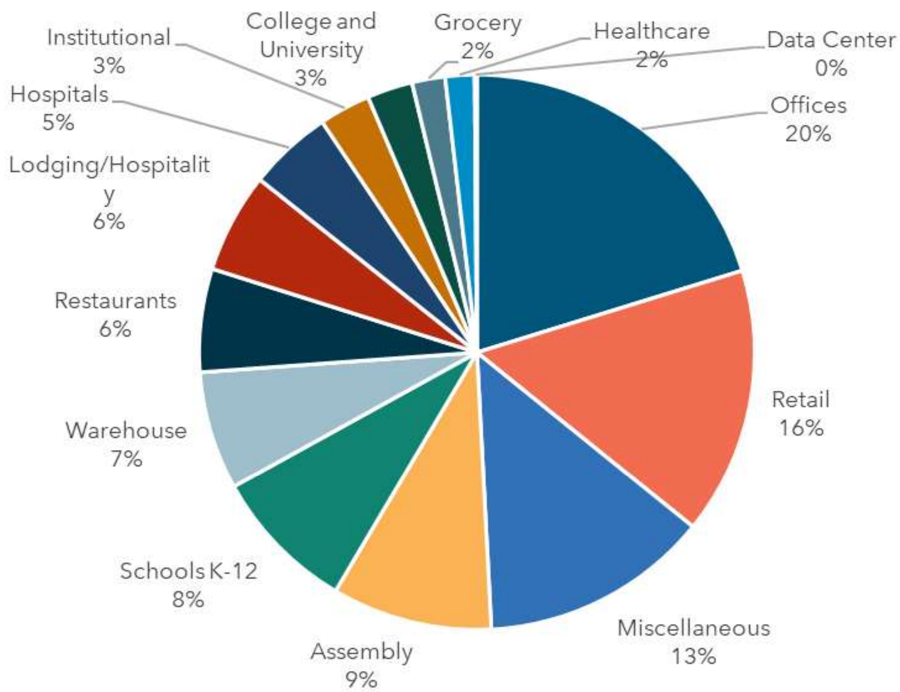
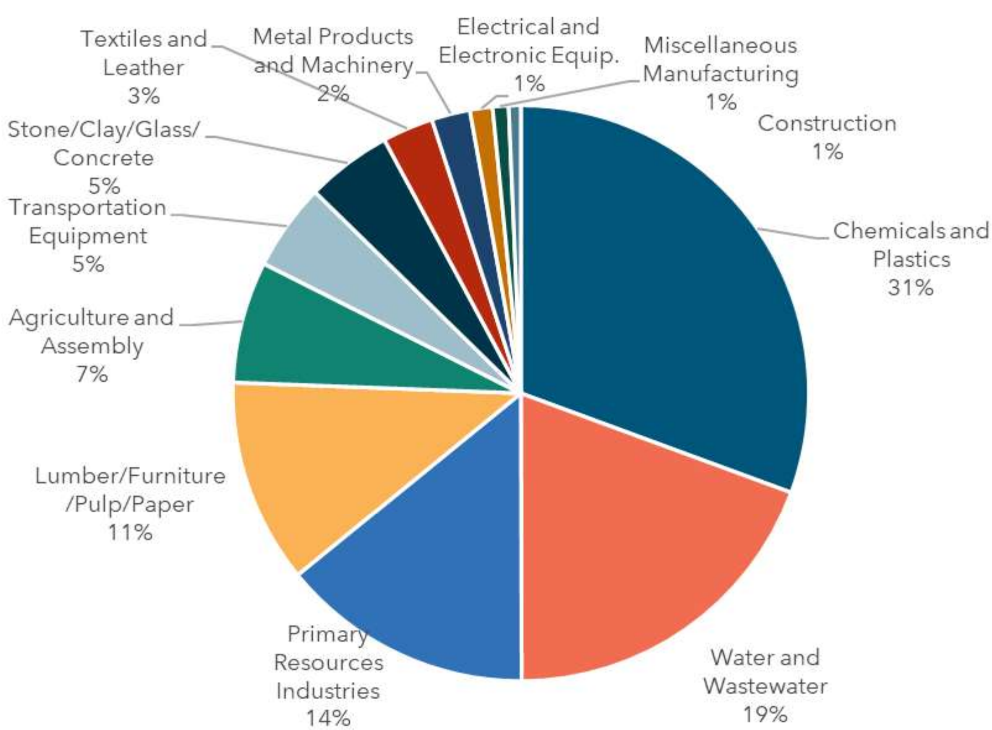


Figure 4. Industrial Customer Segmentation



3.2.3 Commercial and Industrial Accounts (DR Analysis)

For the DR analysis, Resource Innovations divided the non-residential customers into the two customer classes of small C&I and large C&I using rate class and annual consumption. For the purposes of this analysis, small C&I customers are those on the General Service (GS) tariff. Large C&I customers are all customers on the General Service Demand (GSD) tariff or on the General Service Large Demand (GSLD) tariff. Resource Innovations further segmented these two groups based on customer size. For small C&I, segmentation was determined using annual customer consumption and for large C&I the customer's maximum demand was used. Both customer maximum demand and customer annual consumption were calculated using billing data provided by FPUC.

Table 6 shows the account breakout between small C&I and large C&I.

Table 6. Summary of Customer Classes for DR Analysis

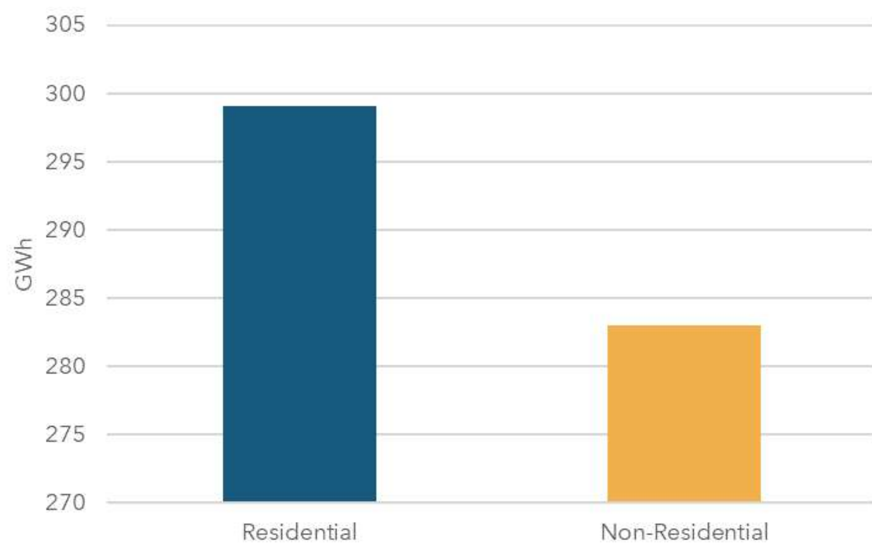
Customer Class	Annual kWh	Estimated Number of Accounts
Small C&I	0-15,000 kWh	2,559
	15,001-25,000 kWh	566
	25,001-50,000 kWh	457
	50,001 kWh +	246
	Total	3,828
Large C&I	0-50 kW	269
	51-300 kW	327
	301-500 kW	14
	501 kW +	8
	Total	618

3.3 Analysis of System Load

3.3.1 System Energy Sales

Technical potential is based on FPUC's load forecast for the year 2025 from their 2022 Long-Term Projections of Electricity Energy and Demand, which is illustrated in Figure 5.

Figure 5. 2025 Electricity Sales Forecast by Sector



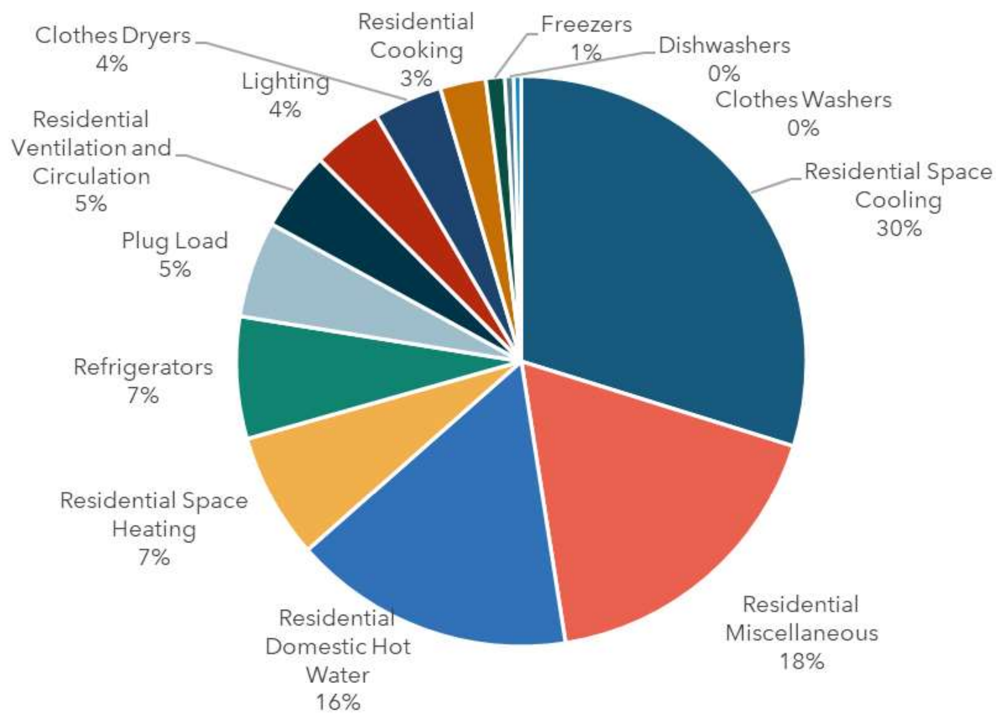
3.3.2 System Demand

To determine the technical potential for DR, Resource Innovations first established peaking conditions for each utility by looking at when each utility historically experienced its maximum demand. The primary data source used to determine when maximum DR impact was the historical system load for FPUC. The data provided contained the system loads for all 8,760 hours of the most recent five years leading up to the study (2016-2021). The utility summer and winter peaks were then identified within the utility-defined peaking conditions. For FPUC the summer peaking conditions were defined as August from 4:00-5:00 PM and the winter peaking conditions were defined as January from 7:00-8:00 AM. The seasonal peaks were then selected as the maximum demand during utility peaking conditions.

3.3.3 Load Disaggregation

The disaggregated annual electric loads[4] for the base year 2025 by sector and end-use are summarized in Figure 6, Figure 7, and Figure 8.

Figure 6. Residential Baseline (2025) Energy Sales by End-Use



[4] Full disaggregation of system demand by end-use was not conducted, as DR potential for residential and small C&I customers focused on specific end-uses of particular interest because of their large contribution to peak period system load, and was not end-use specific for large C&I customers. A description of the end-use analysis for residential and small C&I customers is included in Section 5.1.2

Figure 7. Commercial Baseline (2025) Energy Sales by End-Use

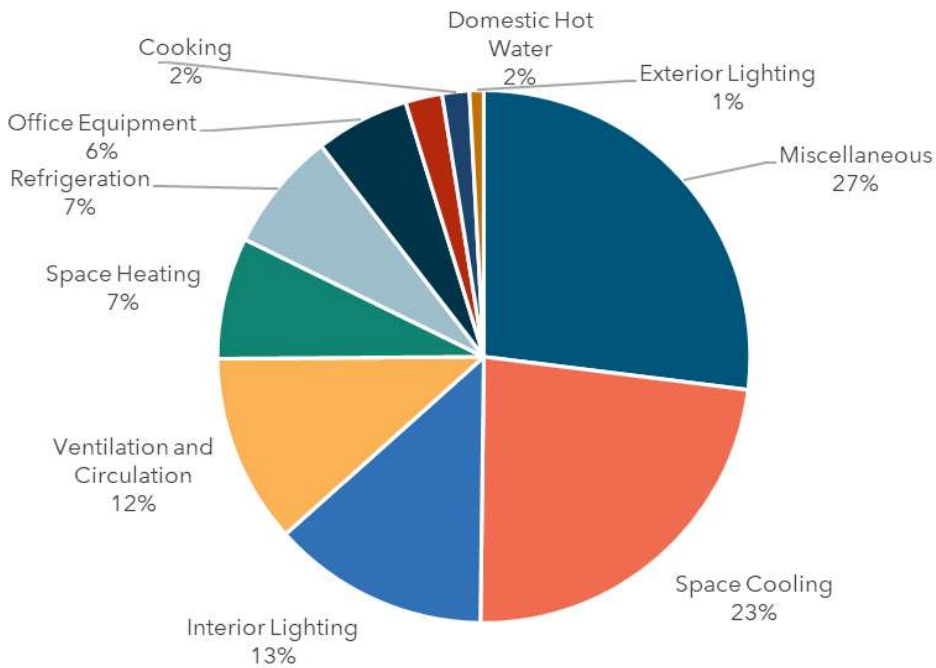
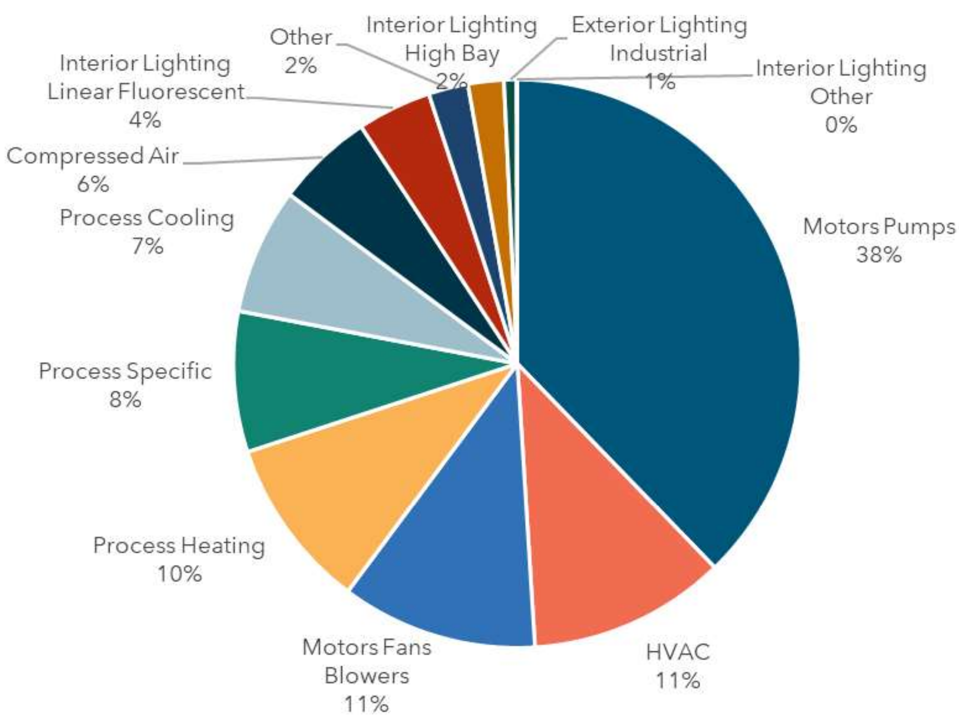


Figure 8. Industrial Baseline (2025) Energy Sales by End-Use



4 DSM Measure Development

DSM potential is described by comparing baseline market consumption with opportunities for savings. Describing these individual savings opportunities results in a list of DSM measures to analyze. This section presents the methodology to develop the EE, DR, and DSRE measure lists.

4.1 Methodology

Resource Innovations identified a comprehensive catalog of DSM measures for the study. The measure list is the same for all FEECA Utilities. The iterative vetting process with the utilities to develop the measure list began by initially examining the list of measures included in the 2019 Goals docket. This list was then adjusted based on proposed measure additions and revisions provided by the FEECA Utilities. Resource Innovations further refined the measure list based on reviews of Resource Innovations' DSM measure library, compiled from similar market potential studies conducted in recent years throughout the United States, as well as measures included in other utility programs where Resource Innovations is involved with program design, implementation, or evaluation. The FEECA Utilities also reached out to interested parties and received input with recommendations on measure additions to the 2019 measure list. Their measure suggestions were reviewed and incorporated into the study as appropriate. External measure suggestions and actions are summarized in Appendix D. The extensive, iterative review process involving multiple parties has ensured that the study included a robust and comprehensive set of DSM measures.

See Appendix A for the list of EE measures, Appendix B for the list of DR measures, and Appendix C for the list of DSRE measures analyzed in the study.

4.2 EE Measures

EE measures represent technologies applicable to the residential, commercial, and industrial customers in the FEECA Utilities' service territories. The development of EE measures included consideration of:

- EE technologies that are applicable to Florida and commercially available: Measures that are not applicable due to climate or customer characteristics were excluded, as were "emerging" technologies that are not currently commercially available to FEECA utility customers.
- Current and planned Florida Building Codes and Federal equipment standards (Codes & Standards) for baseline equipment: Measures included from prior studies

were adjusted to reflect current Codes & Standards as well as updated efficiency tiers, as appropriate.

- Eligibility for utility DSM offerings in Florida: For example, behavioral measures were excluded from consideration, as they historically have not been allowed to count towards utility DSM goals. Behavioral measures are intended to motivate customers to operate in a more energy-efficient manner (e.g., setting an air-conditioner thermostat to a higher temperature) without accompanying: a) physical changes to more efficient end-use equipment or to their building envelope, b) utility-provided products and tools to facilitate the efficiency improvements, or c) permanent operational changes that improve efficiency which are not easily revertible to prior conditions. These types of behavioral measures were excluded because of the variability in forecasting the magnitude and persistence of energy and demand savings from the utility's perspective. Additionally, decoupling behavioral measure savings from the installation of certain EE technologies like smart thermostats can be challenging and could result in overlapping potential with other EE measures included in the study.

Upon development of the final EE measure list, utility-specific measure details were developed. RI maintains a proprietary online database of energy efficiency measures for MPS studies, which was used as a starting point for measure development for this study. Measures are added or updated at the request of project stakeholders or because of changes to the EE marketplace (for example, new codes and standards, or current practice in the market). Measure data are refined as new data or algorithms are developed for estimating measure impacts, and updated for each study to incorporate inputs parameters specific to the service territory being analyzed. The database contains the following information for each of the measures:

- Measure description: measure classification by type, end-use, and subsector, and description of the base-case and the efficient-case scenarios.
- kWh savings: Energy savings associated with each measure were developed through engineering algorithms or building simulation modeling, taking climate data and customer segments into consideration as appropriate. Reference sources used for developing residential, commercial, and industrial measure savings included a variety of Florida-specific, as well as regional and national sources, such as utility-specific measurement & verification (M&V) data, technical reference manuals (TRM) from other jurisdictions, ENERGY STAR calculators, and manufacturer or retailer specifications for particular products.
- Energy savings were applied in RI's TEA-POT model as a percentage of total baseline consumption. Peak demand savings were determined using utility-specific load shapes or coincidence factors.

- Measure Expected Useful Lifetime: Sources included the Database for Energy Efficient Resources (DEER), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, TRMs, and other regional and national measure databases and EE program evaluations.
- Measure Costs: Per-unit costs (full or incremental, depending on the application) associated with measure installations. Sources included: TRMs, ENERGY STAR calculator, online market research, FEECA utility program data, and other secondary sources.

The measure details from the online measure library are exported for use in RI's TEA-POT model, accompanied by utility-specific estimates of measure applicability. Measure applicability is a general term encompassing an array of factors, including technical feasibility of installation, and the measure's current saturation as well as factors to allocate savings associated with competing measures. Information used was primarily derived from data in current regional and national databases, as well as FPUC's program tracking data. These factors are described in Table 7.

Table 7. Measure Applicability Factors

Measure Impact	Explanation	Sources
Technical Feasibility	The percentage of buildings that can have the measure physically installed. Various factors may affect this, including, but not limited to, whether the building already has the baseline measure (e.g., dishwasher), and limitations on installation (e.g., size of unit and space available to install the unit).	Various secondary sources and engineering experience.
Measure Incomplete Factor	The percentage of buildings without the specific measure currently installed.	Utility RASS; EIA RECS, CBECS; MECS; ENERGY STAR sales figures; and engineering experience.
Measure Share	Used to distribute the percentage of market shares for competing measures (e.g., only blown-in ceiling insulation or spray foam insulation, not both would be installed in an attic).	Utility customer data, Various secondary sources and engineering experience.

As shown in Table 8, the measure list includes 395 unique energy-efficiency measures. Expanding the measures to account for all appropriate installation scenarios resulted in

9,535 measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (i.e., a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed).

Table 8. EE Measure Counts by Sector

Sector	Unique Measures	Permutations
Residential	119	1,173
Commercial	164	5,798
Industrial	112	2,564

4.3 DR Measures

The DR measures included in the measure list utilize the following DR strategies:

- **Direct Load Control.** Utility control of selected equipment at the customer's home or business, such as HVAC or water heaters.
- **Critical Peak Pricing (CPP) with Technology.** Electricity rate structures that vary based on time of day. Includes CPP when the rate is substantially higher for a limited number of hours or days per year (customers receive advance notification of CPP event) coupled with technology that enables customer to lower their usage in a specific end-use in response to the event (e.g., HVAC via smart thermostat).
- **Contractual DR.** Customers receive incentive payments or a rate discount for committing to reduce load by a pre-determined amount or to a pre-determined firm service level upon utility request.
- **Automated DR.** Utility dispatched control of specific end-uses at a customer facility.

DR initiatives that do not rely on the installation of a specific device or technology to implement (such as a voluntary curtailment program or time of use rates) were not included.

A workbook was developed for each measure which included the same measure inputs as previously described for the EE measures. In addition, the DR workbook included expected load reduction from the measure, based on utility technical potential, existing utility DR programs, and other nationwide DR programs if needed.

For technical potential, Resource Innovations did not break out results by specific measure or control technology because all of the developed measures target the end-uses estimated

for technical potential (i.e., potential is reported for space cooling end-use and not allocated to switches, smart thermostats, etc.).

4.4 DSRE Measures

The DSRE measure list includes rooftop PV systems, battery storage systems charged from PV systems, and CHP systems.

PV Systems

PV systems utilize solar panels (a packaged collection of PV cells) to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter, a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted systems that face south-west, south, and/or, south-east. The potential associated with roof-mounted systems installed on residential and commercial buildings was analyzed.

Battery Storage Systems Charged from PV Systems

Distributed battery storage systems included in this study consist of behind-the-meter battery systems installed in conjunction with an appropriately-sized PV system at residential and commercial customer facilities. These battery systems typically consist of a DC-charged battery, a DC/AC inverter, and electrical system interconnections to a PV system. On their own battery storage systems do not generate or conserve energy, but can collect and store excess PV generation to provide power during particular time periods, which for DSM purposes would be to offset customer demand during the utility's system peak.

CHP Systems

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide other on-site needs. Common prime mover technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Internal combustion engines

A workbook was developed for each measure which included the inputs previously described for EE measures and prime mover operating parameters.

5 Technical Potential

In the previous sections, the approach for DSM measure development was summarized, and the 2025 base year load shares and reference-case load forecast were described. The outputs from these tasks provided the input for estimating the technical potential scenario, which is discussed in this section.

The technical potential scenario estimates the potential energy and demand savings when all technically feasible and commercially available DSM measures are implemented without regard for cost-effectiveness and customer willingness to adopt the most impactful EE, DR, or DSRE technologies. Since the technical potential does not consider the costs or time required to achieve these savings, the estimates provide a theoretical upper limit on electricity savings potential. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. For this study, technical potential included full application of the commercially available DSM measures to all residential, commercial, and industrial customers in the utility's service territory.

5.1 Methodology

5.1.1 EE Technical Potential

EE technical potential refers to delivering less electricity to the same end-uses. In other words, technical potential might be summarized as "doing the same thing with less energy, regardless of the cost."

DSM measures were applied to the disaggregated utility electricity sales forecasts to estimate technical potential. This involved applying estimated energy savings from equipment and non-equipment measures to all electricity end-uses and customers. Technical potential consists of the total energy and demand that can be saved in the market which Resource Innovations reported as single numerical values for each utility's service territory.

The core equation used in the residential sector EE technical potential analysis for each individual efficiency measure is shown in Equation 1 below, while the core equation used in the nonresidential sector technical potential analysis for each individual efficiency measure is shown in Equation 2.

Equation 1: Core Equation for Residential Sector EE Technical Potential

$$\text{Technical Potential of Efficient Measures} = \text{Total Number of Households} \times \text{Base Case Equipment Energy Use Intensity (kWh/unit)} \times \text{Saturation Shares} \times \text{Percent Incomplete} \times \text{Feasibility Factor} \times \text{Savings Factor}$$

Where:

- **Baseline Equipment Energy Use Intensity** = the electricity used per customer per year by each baseline technology in each market segment. In other words, the baseline equipment energy-use intensity is the consumption of the electrical energy using equipment that the efficient technology replaces or affects.
- **Saturation Share** = the fraction of the end-use electrical energy that is applicable for the efficient technology in a given market segment. For example, for residential cooling, the saturation share would be the fraction of all residential electric customers that have central air conditioners in their household.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of central air conditioners that is not already energy efficient.
- **Feasibility Factor** = the fraction of units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (i.e., it may not be possible to install LEDs in all light sockets in a home because the available styles may not fit in every socket).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

Equation 2: Core Equation for Non-Residential Sector EE Technical Potential

$$\text{Technical Potential of Efficient Measures} = \text{Total Stock Sq. Footage by Building Type by EDC} \times \text{Base Case Equipment Energy Use Intensity (kWh/unit)} \times \text{Saturation Shares} \times \text{Percent Incomplete} \times \text{Feasibility Factor} \times \text{Savings Factor}$$

Where:

- **Total Stock Square Footage by Segment** = the forecasted square footage level for a given building type (e.g., square feet of office buildings).
- **Baseline Equipment Energy Use Intensity** = the electricity used per square foot per year by each baseline equipment type in each market segment.

- **Saturation Shares** = the fraction of total end-use energy consumption associated with the efficient technology in a given market segment. For example, for packaged terminal air-conditioner (PTAC), the saturation share would be the fraction of all space cooling kWh in a given market segment that is associated with PTAC equipment.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient.
- **Feasibility Factor** = the fraction of the equipment or practice that is technically feasible for conversion to the efficient technology from an engineering perspective (i.e., it may not be possible to install Variable Frequency Drives (VFD) on all motors in a given market segment).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

It is important to note that the technical potential estimate represents electricity savings potential at a specific point in time. In other words, the technical potential estimate is based on data describing status quo customer electricity use and technologies known to exist today. As technology and electricity consumption patterns evolve over time, the baseline electricity consumption will also change accordingly. For this reason, technical potential is a discrete estimate of a dynamic market. Resource Innovations reported the technical potential for 2025, based on currently known DSM measures and observed electricity consumption patterns.

Measure Interaction and Competition (Overlap)

While the technical potential equations listed above focus on the technical potential of a single measure or technology, Resource Innovations' modeling approach does recognize the overlap of individual measure impacts within an end-use or equipment type, and accounts for the following interactive effects:

- Measure interaction: Installing high-efficiency equipment could reduce energy savings in absolute terms (kWh) associated with non-equipment measures that impact the same end-use. For example, installing a high-efficiency heat pump will reduce heating and cooling consumption which will reduce the baseline against which attic insulation would be applied, thus reducing savings associated with installing insulation. To account for this interaction, Resource Innovations' TEA-POT model ranks measures that interact with one another and reduces the baseline consumption for the subsequent measure based on the savings achieved by the preceding measure. For technical potential, interactive measures are ranked based on total end-use energy savings percentage.
- Measure competition (overlap): The "measure share"—as defined above—accounted for competing measures, ensuring savings were not double-counted. This interaction

occurred when two or more measures "competed" for the same end-use. For example, a T-12 lamp could be replaced with a T-8 or linear LED lamp.

Addressing Naturally-Occurring EE

Naturally occurring energy efficiency includes actions taken by customers to improve the efficiency of their homes and businesses in the absence of utility program intervention. For the analysis of technical potential, Resource Innovations verified with FPUC's forecasting group that the baseline sales forecasts incorporated two known sources of naturally-occurring efficiency:

- Codes and Standards: The sales forecasts already incorporated the impacts of known Code & standards changes.
- Baseline Measure Adoption: The sales forecast excluded the projected impacts of future DSM efforts but included already implemented DSM penetration.

By properly accounting for these factors, the technical potential analysis estimated the additional EE opportunities beyond what is already included in the utility sales forecast.

5.1.2 DR Technical Potential

The concept of technical potential applies differently to DR than for EE. Technical potential for DR is effectively the magnitude of loads that can be curtailed during conditions when utilities need peak capacity reductions. In evaluating this potential at peak capacity, the following were considered: which customers are consuming electricity at those times? What end-uses are in play? Can those end-use loads be managed? Large C&I accounts generally do not provide the utility with direct control over particular end-uses. Instead, many of these customers will forego electric demand temporarily if the financial incentive is large enough. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale.

This framework makes end-use disaggregation an important element for understanding DR potential, particularly in the residential and small C&I sectors. When done properly, end-use disaggregation not only provides insights into which loads are on and off when specific grid services are needed, it also provides insight concerning how key loads and end-uses, such as air conditioning use, vary across customers. Resource Innovations' approach used for load disaggregation is more advanced than what is used for most potential studies. Instead of disaggregating annual consumption or peak demand, Resource Innovations produced end-use load disaggregation for all 8,760 hours. This was needed because the loads available at times when different grid applications are needed can vary substantially. Instead

of producing disaggregated loads for the average customer, the study was produced for several customer segments. Because customer-level load data was not available for FPUC, this process relied on interval load data from FPL's load research samples for each customer segment as best proxy. Using FPL's load data, Resource Innovations examined three residential segments based on customer housing type, four different small C&I segments based on customer size, and four different large C&I segments based on customer size, for a total of 11 different customer segments.

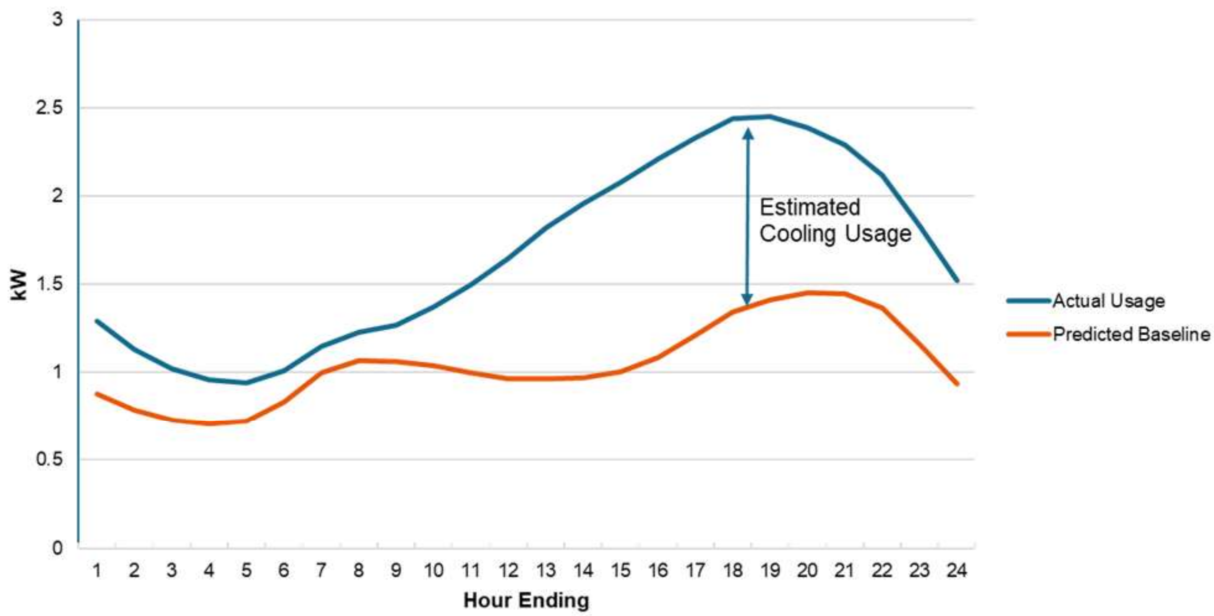
Technical potential, in the context of DR, is defined as the total amount of load available for reduction that is coincident with the period of interest; in this case, the system peak hour for the summer and winter seasons. Thus, two sets of capacity values are estimated: a summer capacity and a winter capacity.

As previously mentioned, for technical potential purposes, all coincident large C&I load is considered dispatchable, while residential and small C&I DR capacity is based on specific end-uses. Summer DR capacity for residential customers was comprised of air-conditioning (AC), pool pumps, water heaters, and managed electric vehicle charging. For small C&I customers, summer capacity was based on AC load. For winter DR capacity, residential was based on electric heating, pool pumps, and water heaters. For small C&I customers, winter capacity was based on electric heating.

AC and heating load profiles were generated for residential and small C&I customers using a sample customer interval data provided by FPL. This sample included a customer breakout based on housing type for residential customers and size for small C&I customers. Resource Innovations then used the interval data from these customers to create an average load profile for each customer segment.

The average load profile for each customer segment was combined with historical weather data, and used to estimate hourly load as a function of weather conditions. AC and heating loads were estimated by first calculating the baseline load on days when cooling degree days (CDD) and heating degree days (HDD) were equal to zero, and then subtracting this baseline load. This methodology is illustrated by Figure 9 (a similar methodology was used to predict heating loads).

Figure 9: Methodology for Estimating Cooling Loads



This method was able to produce estimates for average AC/heating load profiles for the seven different customer segments within the residential and small C&I sectors.

Profiles for residential water heater and pool pump loads were estimated by utilizing end-use load data from NREL's residential end-use load profile database.

For all eligible loads, the technical potential was defined as the amount that was coincident with system peak hours for each season, which are August from 4:00-5:00 PM for summer, and January from 7:00-8:00 AM for winter. As mentioned in Section 4, for technical potential there was also no measure breakout needed, because all measures will target the end-uses' estimated total loads.

5.1.3 DSRE Technical Potential

5.1.3.1 PV Systems

To determine technical potential for PV systems, RI estimated the percentage of rooftop square footage in Florida that is suitable for hosting PV technology. Our estimate of technical potential for PV systems in this report is based in part on the available roof area and consisted of the following steps:

- Step 1: Outcomes from the forecast disaggregation analysis were used to characterize the existing and new residential, commercial, and industrial building stocks.
    - To calculate the total roof area for residential buildings, the average roof area per household is multiplied by the number of households.
    - For commercial and industrial buildings, RI calculated the total roof area by first dividing the load forecast by the energy usage intensity, which provides an estimate of the total building square footage. This result is then divided by the average number of floors to derive the total roof area.
- Step 2: The total available roof area feasible for installing PV systems was calculated. Relevant parameters included unusable area due to other rooftop equipment and setback requirements, in addition to possible shading from trees and limitations of roof orientation (factored into a "technical suitability" multiplier).
- Step 3: Estimated the expected power density (kW per square foot of roof area).
- Step 4: Estimated the hourly PV generation profile using NREL's PV Watts Calculator
- Step 5: Calculated total energy and coincident peak demand potential by applying RI's Spatial Penetration and Integration of Distributed Energy Resources (SPIDER) Model.

The methodology presented in this report uses the following formula to estimate overall technical potential of PVs:

Equation 3: Core Equation for Solar DSRE Technical Energy Potential

$$\text{PV Technical Energy Potential} = \text{Suitable Rooftop PV Area (Sq Ft)} \times \text{PV Power Density (kW-DC/Sq Ft)} \times \text{Generation Factor (kWh/kW-DC)}$$

Where:

- **Suitable Rooftop PV Area for Residential [Square Feet]:** Number of Residential Buildings x Average Roof Area Per Building x Technical Suitability Factor
- **Suitable Rooftop PV Area for Commercial [Square Feet] :** Energy Consumption [kWh] / Energy Intensity [kWh / Square Feet] / Average No. of Stories Per Building x Technical Suitability Factor
- **PV Power Density [kW-DC/Square Feet]:** Maximum power generated in Watts per square foot of solar panel.
- **Generation Factor:** Annual Energy Generation Factor for PV, from PV Watts (dependent on local solar irradiance)

5.1.3.2 Battery Storage Systems Charged from PV Systems

Battery storage systems on their own do not generate power or create efficiency improvements, but store power for use at different times. Therefore, in analyzing the technical potential for battery storage systems, the source of the stored power and overlap with technical potential identified in other categories was considered.

Battery storage systems that are powered directly from the grid do not produce annual energy savings but may be used to shift or curtail load during particular time periods. As the DR technical potential analyzes curtailment opportunities for the summer and winter peak period, and battery storage systems can be used as a DR technology, the study concluded that no additional technical potential should be claimed for grid-powered battery systems beyond that already attributed to DR.

Battery storage systems that are connected to on-site PV systems also do not produce additional energy savings beyond the energy produced from the PV system[5]. However, PV-connected battery systems do create the opportunity to store energy during period when the PV system is generating more than the home or business is consuming and use that stored power during utility system peak periods.

To determine the additional technical potential peak demand savings for "solar plus storage" systems, our methodology consisted of the following steps:

- Assume that every PV system included in PV Technical Potential is installed with a paired storage system.
- Size the storage system assuming peak storage power is equal to peak PV generation and energy storage duration is three hours.
- Apply RI's hourly dispatch optimization module in SPIDER to create an hourly storage dispatch profile that flattens the individual customer's load profile to the greatest extent possible accounting for a) customer hourly load profile, b) hourly PV generation profile, and c) battery peak demand, energy capacity, and roundtrip charge/discharge efficiency.
- Calculate the effective hourly impact for the utility using the above storage dispatch profile, aligned with the utility's peak hour (calculated separately for summer and winter)
- Report the output storage kW impact on utility coincident peak demand in summer and winter.

[5] PV-connected battery systems experience some efficiency loss due to storage, charging, and discharging. However, for this study, these losses were not quantified.

5.1.3.3 CHP Systems

The CHP analysis created a series of unique distributed generation potential models for each primary market sector (commercial and industrial).

Only non-residential customer segments whose electric and thermal load profiles allow for the application of CHP were considered. The technical potential analysis followed a three-step process. First, minimum facilities size thresholds were determined for each non-residential customer segment. Next, the full population of non-residential customers were segmented and screened based on the size threshold established for that segment. Finally, the facilities that were of sufficient size were matched with the appropriately sized CHP technology.

To determine the minimum threshold for CHP suitability, a thermal factor was applied to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load in order to achieve improved efficiencies.

The study collected electric and thermal intensity data from other recent CHP studies. For industrial customers, Resource Innovations assumed that the thermal load would primarily be used for process operations and was not modified from the secondary data sources for Florida climate conditions. For commercial customers, the thermal load is more commonly made up of water heating, space heating, and space cooling (through the use of an absorption chiller). Therefore, to account for the hot and humid climate in Florida, which traditionally limits weather-dependent internal heating loads, commercial customers' thermal loads were adjusted to incorporate a higher proportion of space cooling to space heating as available opportunities for waste heat recovery.

Resource Innovations worked with the utility-provided customer data, focusing on annual consumption due to the absence of NAICS or SIC codes for this utility data. Non-residential customers were subsequently classified based on annual consumption and size. Since NAICS or SIC codes were unavailable, no formal segmentation occurred. Instead, the analysis focused exclusively on annual utility usage. Facilities with annual loads below the kWh thresholds were deemed unlikely to possess the consistent electric and thermal loads necessary to support CHP and were consequently excluded from consideration. Conversely, those meeting the size criteria were aligned with the corresponding CHP technology.

In general, internal combustion engines are the prime mover for systems under 500kW with gas turbines becoming progressively more popular as system size increases above that. Based on the available load by customer, adjusted by the estimated thermal factor for each

segment, CHP technologies were assigned to utility customers in a top-down fashion (i.e., starting with the largest CHP generators).

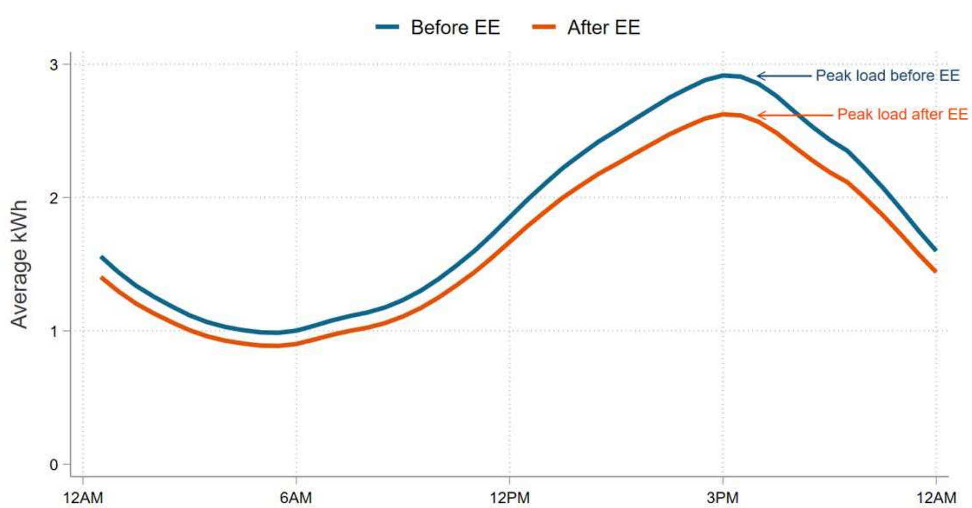
Measure Interaction

PV systems and battery storage charged from PV systems were analyzed collectively due to their common power generation source; and therefore, the identified technical potential for these systems is additive. However, CHP systems were independently analyzed for technical potential without consideration of the competition between DSRE technologies or customer preference for a particular DSRE system. Therefore, results for CHP technical potential should not be combined with PV systems or battery storage systems for overall DSRE potential but used as independent estimates.

5.1.4 Interaction of Technical Potential Impacts

As described above, the technical potential was estimated using separate models for EE, DR, and DSRE systems. However, there is interaction between these technologies; for example, a more efficient HVAC system would result in a reduced peak demand available for DR curtailment, as illustrated in Figure 10.

Figure 10: Illustration of EE Impacts on HVAC System Load Shape



Therefore, after development of the independent models, the interaction between EE, DR, and DSRE was incorporated as follows:

- The EE technical potential was assumed to be implemented first, followed by DR technical potential and DSRE technical potential.

- To account for the impact of EE technical potential on DR, the baseline load forecast for the applicable end-uses was adjusted by the EE technical potential, resulting in a reduction in baseline load available for curtailment.
- For DSRE systems, the EE and DR technical potential was incorporated in a similar fashion, adjusting the baseline load used to estimate DSRE potential.
    - For the PV analysis, this did not impact the results as the EE and DR technical potential did not affect the amount of PV that could be installed on available rooftops.
    - For the battery storage charged from PV systems, the reduced baseline load from EE resulted in additional PV-generated energy being available for the battery systems and for use during peak periods. The impact of DR events during the assumed curtailment hours was incorporated into the modeling of available battery storage and discharge loads.
- For CHP systems, the reduced baseline load from EE resulted in a reduction in the number of facilities that met the annual energy threshold needed for CHP installations. Installed DR capacity was assumed to not impact CHP potential as the CHP system feasibility was determined based on energy and thermal consumption at the facility. It should be noted that CHP systems not connected to the grid could impact the amount of load available for curtailment with utility-sponsored DR. Therefore, CHP technical potential should not be combined with DR potential but used as independent estimates.

5.2 EE Technical Potential

5.2.1 Summary

Table 9 summarizes the EE technical potential by sector:

Table 9. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	26	15	97
Non-Residential[6]	14	12	71
Total	40	27	168

[6] Non-Residential results include all commercial and industrial customer segments.

5.2.2 Residential

Figure 11, Figure 12, and Figure 13 summarize the residential sector EE technical potential by end-use.

Figure 11: Residential EE Technical Potential by End-Use (Summer Peak Savings)

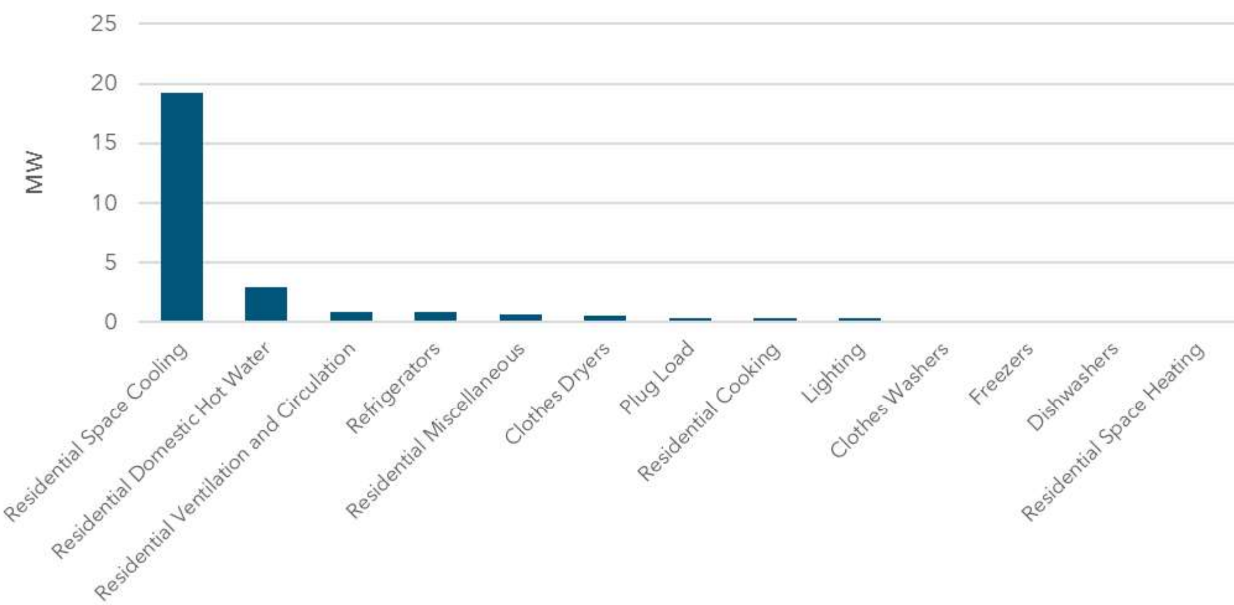


Figure 12: Residential EE Technical Potential by End-Use (Winter Peak Savings)

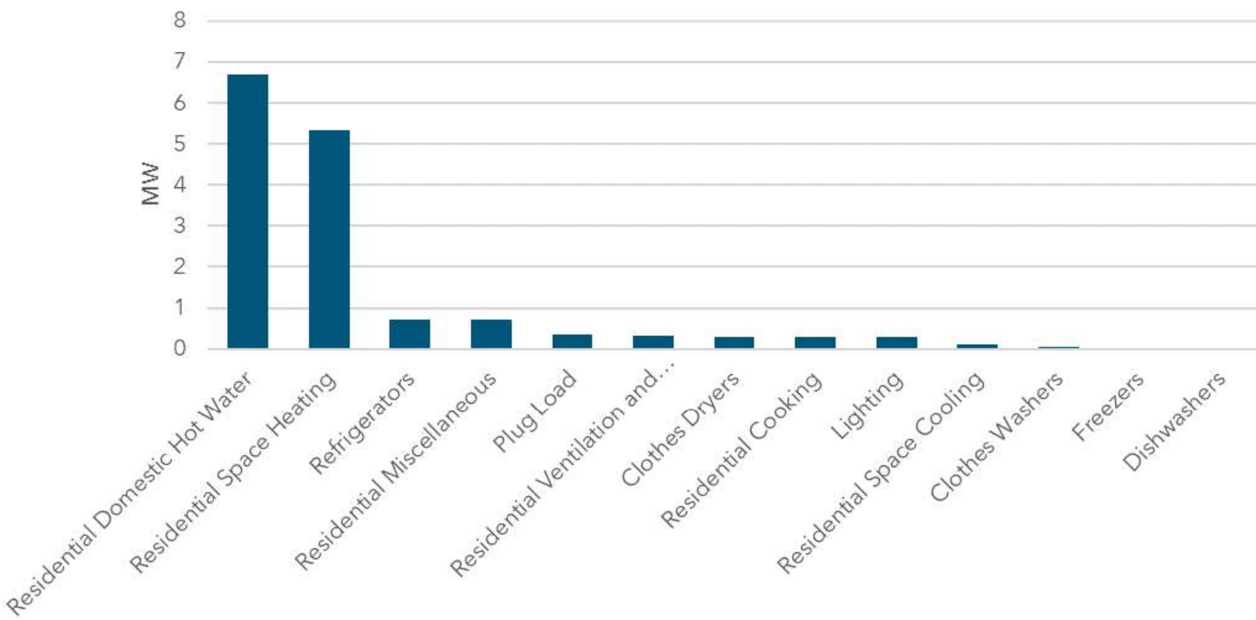
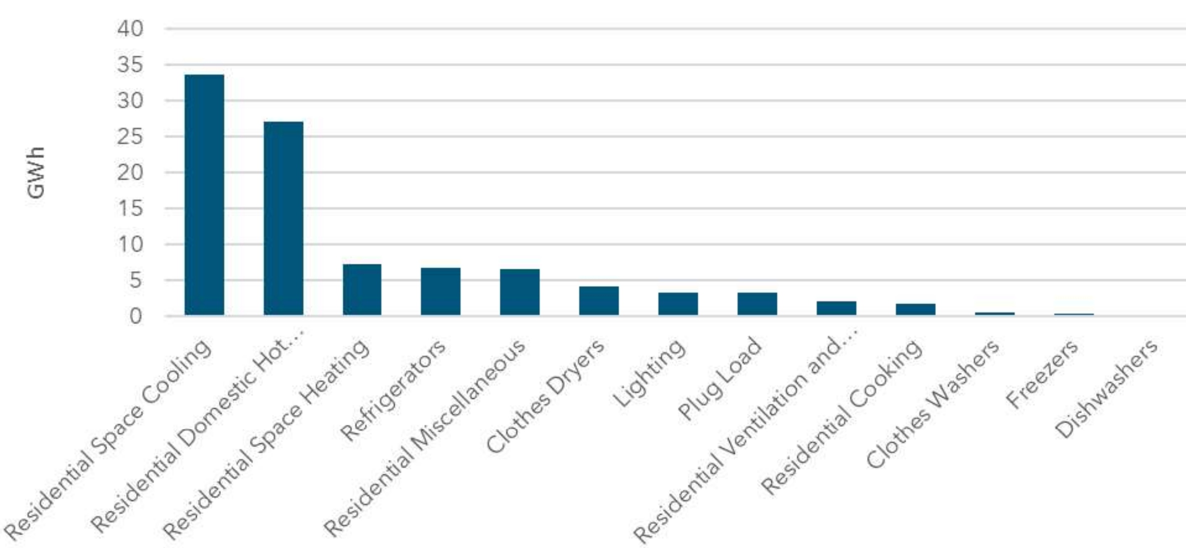


Figure 13: Residential EE Technical Potential by End-Use (Energy Savings)



5.2.3 Non-Residential

5.2.3.1 Commercial Segments

Figure 14, Figure 15, and Figure 16 summarize the commercial sector EE technical potential by end-use.

Figure 14: Commercial EE Technical Potential by End-Use (Summer Peak Savings)

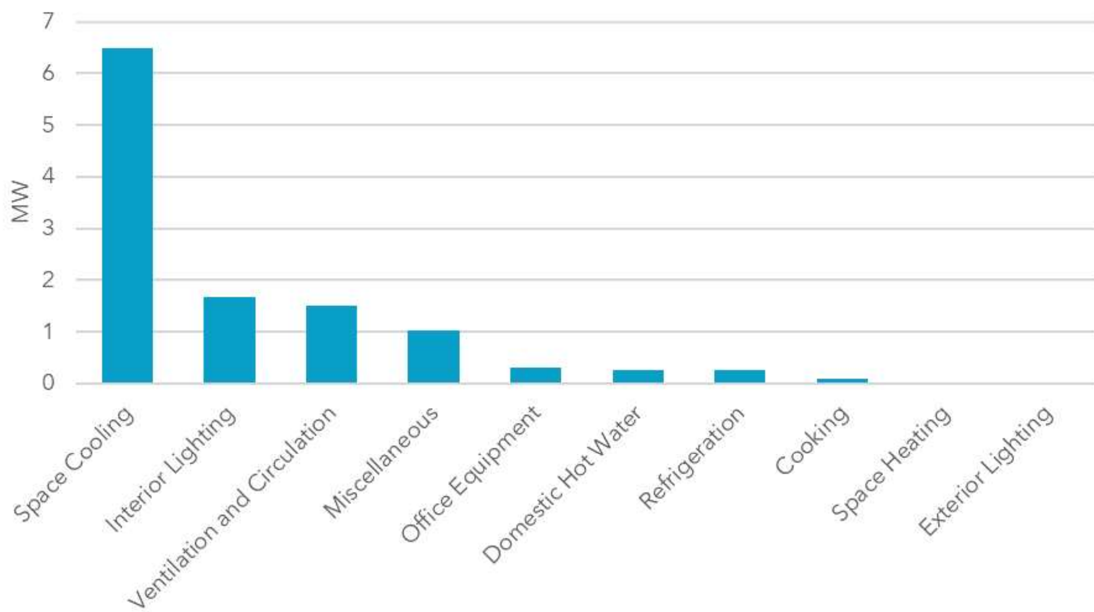


Figure 15: Commercial EE Technical Potential by End-Use (Winter Peak Savings)

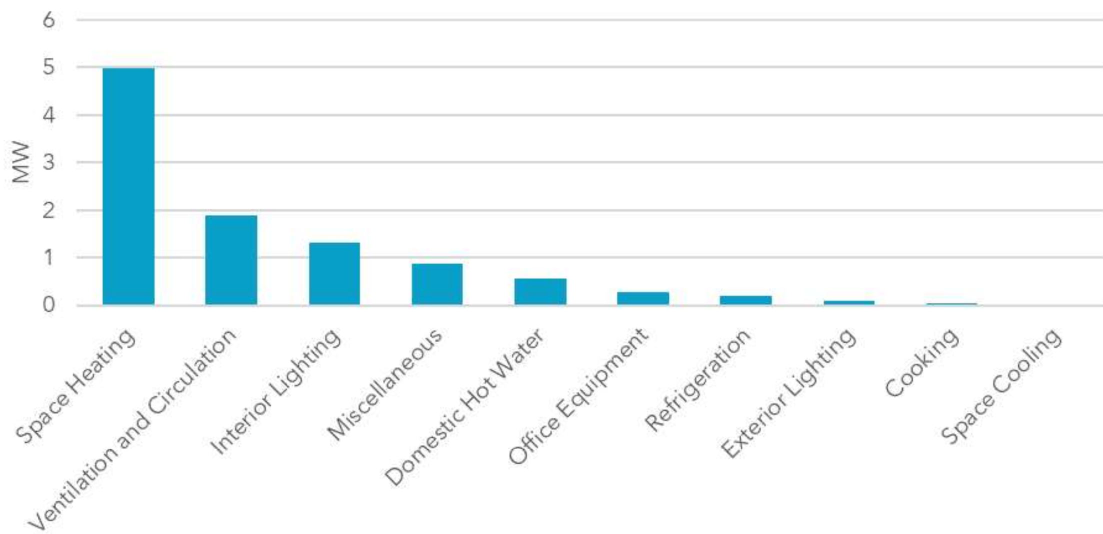
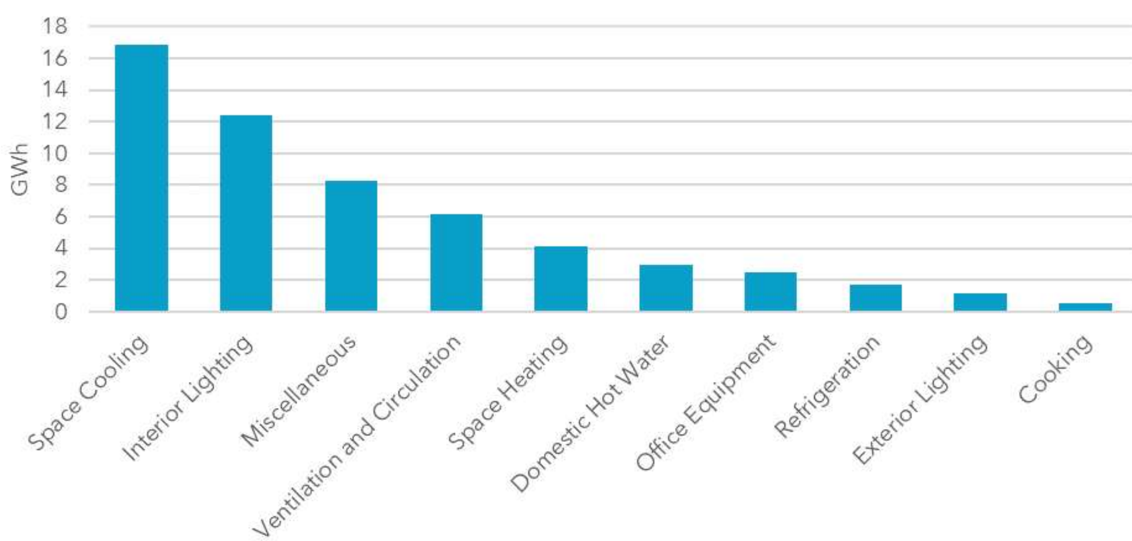


Figure 16: Commercial EE Technical Potential by End-Use (Energy Savings)



5.2.3.2 Industrial Segments

Figure 17, Figure 18, and Figure 19 summarize the industrial sector EE technical potential by end-use.

Figure 17: Industrial EE Technical Potential by End-Use (Summer Peak Savings)

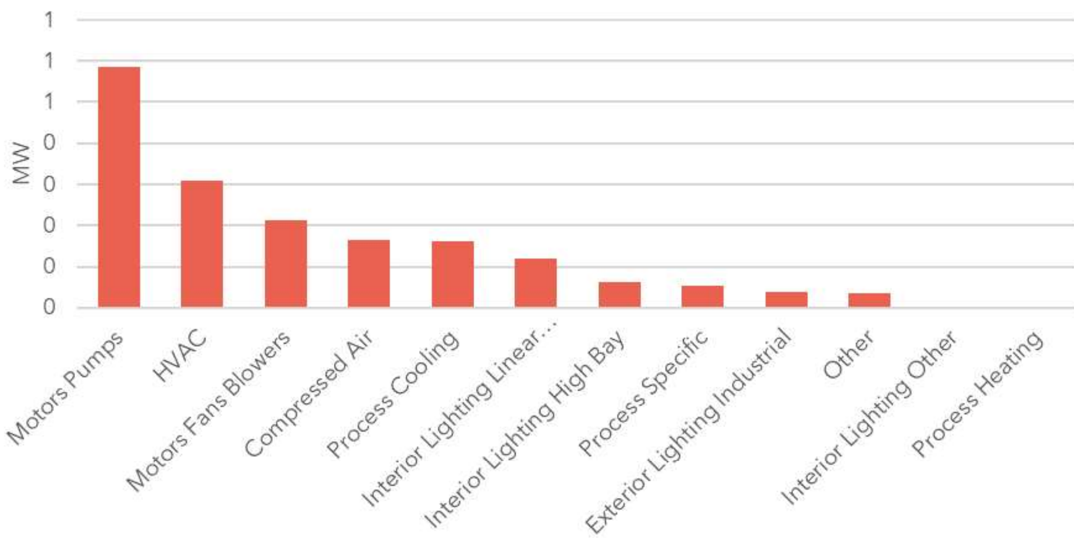


Figure 18: Industrial EE Technical Potential by End-Use (Winter Peak Savings)

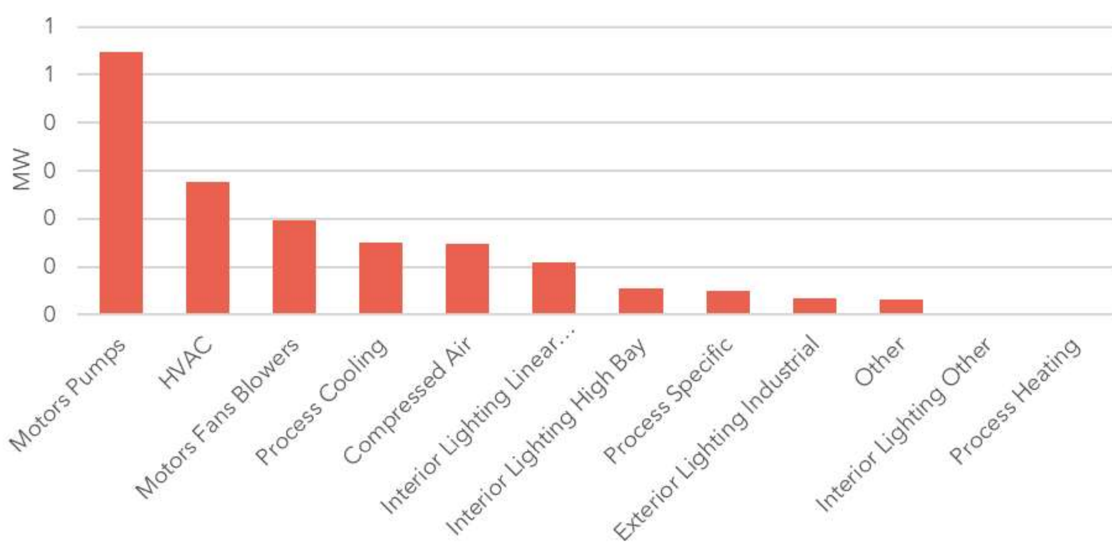
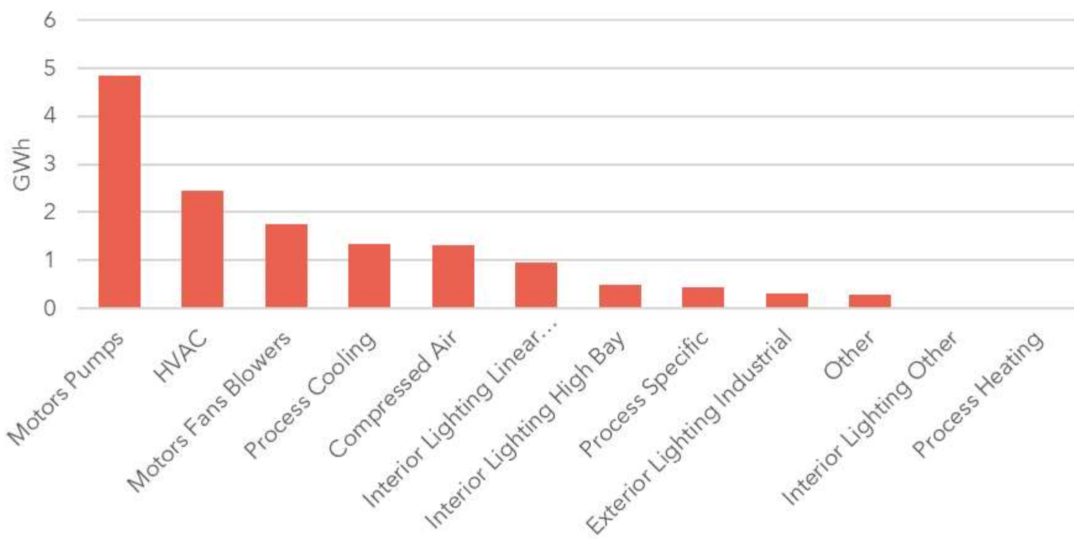


Figure 19: Industrial EE Technical Potential by End-Use (Energy Savings)



5.3 DR Technical Potential

Technical potential for DR is defined for each class of customers as follows:

- Residential & Small C&I customers – Technical potential is equal to the aggregate load for all end-uses that can participate in FPUC's current programs plus DR measures not currently offered in which the utility uses specialized devices to control loads (i.e., direct load control programs). This includes cooling and heating loads for residential and small C&I customers and water heater and pool pump loads for residential customers. Not all demand reductions are delivered via direct load control of end-uses. The magnitude of demand reductions from non-direct load control such as time varying pricing, peak time rebates and targeted notifications is linked to cooling and heating loads.
- Large C&I customers – Technical potential is equal to the total amount of load for each customer segment (i.e., that customers reduce their total load to zero when called upon).

Table 10 summarizes the seasonal DR technical potential by sector:

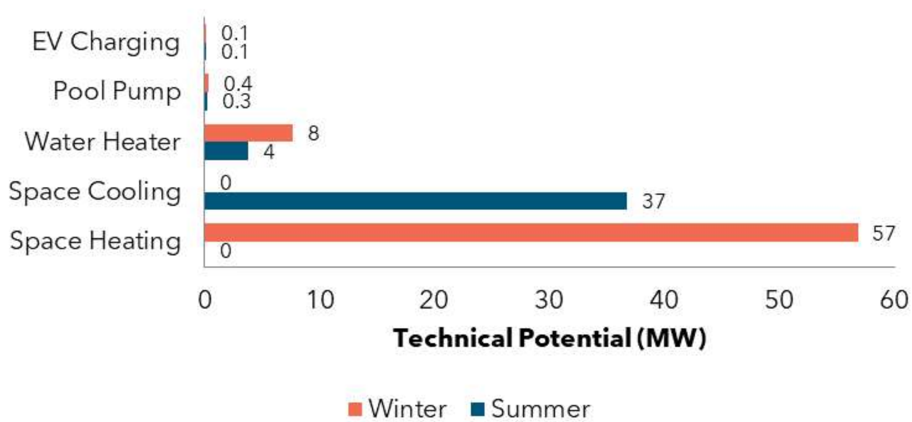
Table 10. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	41	65
Non-Residential	27	24
Total	68	89

5.3.1 Residential

Residential technical potential is summarized in Figure 20.

Figure 20: Residential DR Technical Potential by End-Use

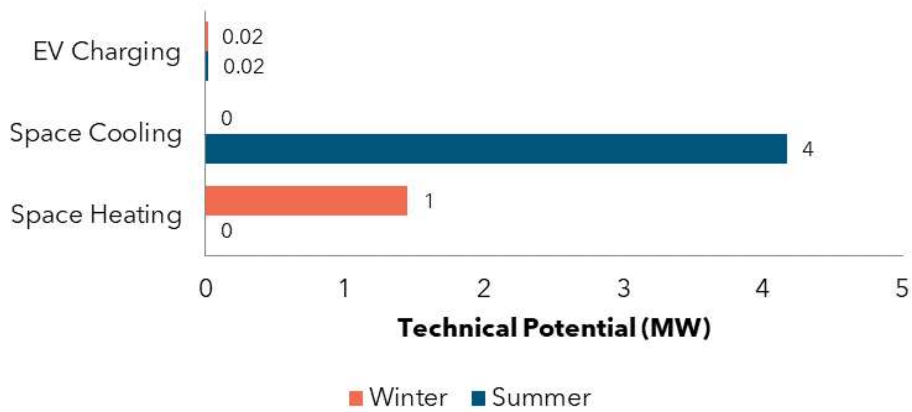


5.3.2 Non-Residential

5.3.2.1 Small C&I Customers

For small C&I technical potential, Resource Innovations looked at cooling and heating loads only. Small C&I technical potential is provided in Figure 21.

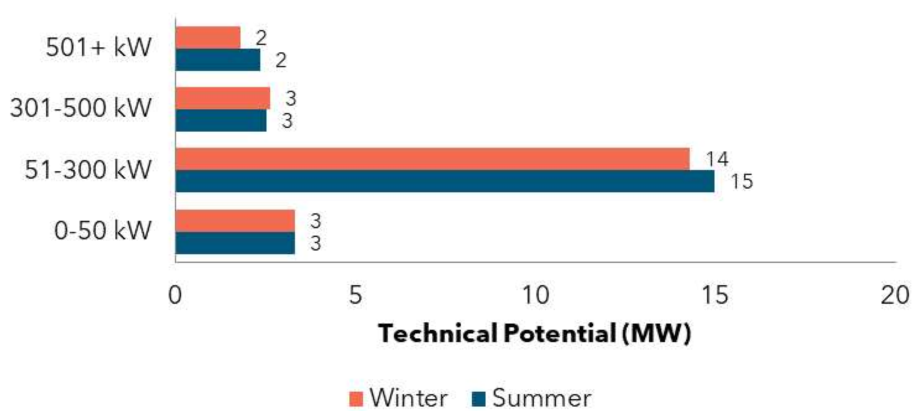
Figure 21: Small C&I DR Technical Potential by End-Use



5.3.2.2 Large C&I Customers

Figure 22 provides the technical potential for large C&I customers, broken down by customer size.

Figure 22: Large C&I DR Technical Potential by Segment



5.4 DSRE Technical Potential

Table 11 provides the results of the DSRE technical potential for each customer segment:

Table 11. DSRE Technical Potential[7]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	17	10	152
Non-Residential	9	3	70
Total	26	13	222
Battery Storage charged from PV Systems			
Residential	5	2	0
Non-Residential	0	1	0
Total	5	3	0
CHP Systems			
Total	23	13	108

[7] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

Appendix A EE Measure List

For information on how Resource Innovations developed this list, please see Section 4.

Table 12: Residential EE Measures

Measure	End-Use	Description	Baseline
120v Heat Pump Water Heater 50 Gallons	Residential Domestic Hot Water	120v Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Air Sealing-Infiltration Control	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Improved Infiltration Control	Standard Heating and Cooling System with Standard Infiltration Control
Air-to-Water Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star Air-to-Water Heat Pump, 25 SEER, 13 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - 15 SEER/14.3 SEER2 from base electric resistance	Residential Space Cooling, Residential Space Heating	ASHP 15 SEER from base electric resistance	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2 (from elec resistance)	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2, 10.5 HSPF	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating

Measure	End-Use	Description	Baseline
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2 (from elect resistance)	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
Basement or Crawlspace Wall Insulation R-15	Residential Space Cooling, Residential Space Heating	Increased Basement or Crawlspace Wall Insulation (R-15)	Code-Compliant Exterior Below-Grade Wall Insulation (R-10)
Bathroom Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
CEE Advanced Tier Clothes Dryer	Clothes Dryers	CEE Advanced Tier Clothes Dryer	One Clothes Dryer meeting Federal Standard
CEE Advanced Tier Clothes Washer	Clothes Washers	Tier 3 CEE Clothes washer	One Clothes Washer meeting Federal Standard
CEE Tier 3 Refrigerator	Refrigerators	Residential Tier 3 Refrigerator	One Refrigerator meeting Federal Standard
Ceiling Insulation (R11 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Ceiling Insulation (R38 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Residential Space Cooling	Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - 24 SEER/22.9 SEER2	Residential Space Cooling	Central AC - 24 SEER/22.9 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Residential Space Cooling	Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling	Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC Tune Up	Residential Space Cooling	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Existing Typical Central AC without Regular Maintenance/tune-up
Dehumidifier Recycling	Plug Load	No dehumidifier	One Dehumidifier meeting Federal Standard
Drain Water Heat Recovery	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Duct Insulation	Residential Space Cooling, Residential Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork	Standard Electric Heating and Central AC with Uninsulated Ductwork
Duct Repair	Residential Space Cooling, Residential Space Heating	Duct Repair to eliminate/minimize leaks, includes testing and sealing	Standard Electric Heating and Central AC with typical duct leakage
ECM Circulator Pump	Residential Miscellaneous	Install ECM Circulator Pump	Install Standard Circulator Pump
Energy Star Air Purifier	Plug Load	One Air Purifier meeting ENERGY STAR 2.0 Standards	One Standard Conventional Air Purifier
Energy Star Audio-Video Equipment	Plug Load	One DVD/Blu-Ray Player meeting current ENERGY STAR Standards	One Market Average DVD/Blu-Ray Player
Energy Star Bathroom Ventilating Fan	Residential Ventilation and Circulation	Bathroom Exhaust Fan meeting current ENERGY STAR Standards	Bathroom Exhaust Fan meeting Federal Standard
Energy Star Ceiling Fan	Residential Miscellaneous	60" Ceiling Fan Meeting ENERGY STAR 3.1 Standards	Standard 60" Ceiling Fan
Energy Star Clothes Dryer	Clothes Dryers	One Electric Resistance Clothes Dryer meeting ENERGY STAR 1.1 Standards	One Clothes Dryer meeting Federal Standard
Energy Star Clothes Washer	Clothes Washers	One Clothes Washer meeting ENERGY STAR 8.1 Standards	One Clothes Washer meeting Federal Standard

Measure	End-Use	Description	Baseline
Energy Star Dehumidifier	Plug Load	One Dehumidifier meeting ENERGY STAR 5.0 Standards	One Dehumidifier meeting Federal Standard
Energy Star Dishwasher	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements (effective on July 19, 2023), electric water heating	One Dishwasher meeting Federal Standard
Energy Star Dishwasher (Gas Water Heating)	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements, gas water heating	One Dishwasher meeting Federal Standard; gas water heating
Energy Star Door	Residential Space Cooling, Residential Space Heating	100ft2 of Opaque Door meeting Energy Star Version 6.0 Requirements (U-Value: 0.17)	100ft2 of Opaque Door meeting current FL Code Requirements
ENERGY STAR EV supply equipment (level 2 charger)	Residential Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Freezer	Freezers	One Freezer meeting current ENERGY STAR 5.1 Standards	One Freezer meeting Federal Standard
Energy Star Ground Source Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star GSHP, 17.1 SEER, 12 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Energy Star Imaging Equipment	Plug Load	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star Monitor	Plug Load	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star Personal Computer	Plug Load	One Personal Computer meeting ENERGY STAR 8.0 Standards	One Personal Computer meeting ENERGY STARÂ® 3.0 Standards
Energy Star Refrigerator	Refrigerators	One Refrigerator/Freezer meeting ENERGY STAR 5.1 Standards	One Refrigerator/Freezer meeting Federal Standard
Energy Star Room AC	Residential Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star Set-Top Receiver	Plug Load	One Set-top Box meeting ENERGY STAR 4.1 Standards	One Market Average Set-top Box
Energy Star TV	Plug Load	One Television meeting ENERGY STAR 9.0 Standards	One non-ENERGY STAR Television
Energy Star Windows	Residential Space Cooling, Residential Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window current FL energy code requirements
Exterior Wall Insulation	Residential Space Cooling, Residential Space Heating	Increased Exterior Above-Grade Wall Insulation (R-13)	Market Average Existing Exterior Above-Grade Wall Insulation

Measure	End-Use	Description	Baseline
Filter Whistle	Residential Ventilation and Circulation	Install the Furnace Filter Alarm	No Furnace Filter Alarm on a Central Forced-Air Furnace
Floor Insulation	Residential Space Heating	Increased Floor Insulation (R-30)	Code-Compliant Floor Insulation
Freezer Recycling	Freezers	No Freezer	Current Market Freezer
Green Roof	Residential Space Cooling	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
Heat Pump Clothes Dryer	Clothes Dryers	One Heat Pump Clothes Dryer	One Clothes Dryer meeting Federal Standard
Heat Pump Pool Heater	Residential Miscellaneous	Heat Pump Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Heat Pump Tune Up	Residential Space Cooling, Residential Space Heating	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Standard Heating and Cooling System without Regular Maintenance/tune-up
Heat Pump Water Heater 50 Gallons-CEE Advanced Tier	Residential Domestic Hot Water	CEE Advanced Tier Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 50 Gallons-ENERGY STAR	Residential Domestic Hot Water	Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 80 Gallons-ENERGY STAR	Residential Domestic Hot Water	Energy Star Heat Pump Water Heater 80 Gallons	Code-Compliant 80 Gallon Electric Resistance Water Heater
Heat Trap	Residential Domestic Hot Water	Heat Trap	Existing Water Heater without heat trap
High Efficiency Convection Oven	Residential Cooking	One Full-Size Convection Oven meeting ENERGY STAR 3.0 Standards	One Standard Economy-Grade Full-Size Oven
High Efficiency Induction Cooktop	Residential Cooking	One residential induction cooktop	One standard residential electric cooktop
Home Energy Management System	Lighting, Plug Load, Residential Space Cooling, Residential Space Heating	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Hot Water Pipe Insulation	Residential Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-5	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
HVAC ECM Motor	Residential Ventilation and Circulation	A brushless permanent magnet (ECM) blower motor for electric furnace	Permanent Split Capacitor Motor for Electric Furnace
HVAC Economizer	Residential Space Cooling	Install residential economizer	No economizer
HVAC Zoning System	Residential Space Cooling, Residential Space Heating	Install dampers in the ducts, dividing home into multiple	Single zone HVAC system

Measure	End-Use	Description	Baseline
		zones, each controlled by its own thermostat	
Indoor Daylight Sensor	Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Range	Residential Cooking	Residential induction range	Electric range
Instantaneous Hot Water System	Residential Domestic Hot Water	Instantaneous Hot Water System	Standard Efficiency Storage Tank Water Heater
Kitchen Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
LED - 9W_CFL Baseline	Lighting	LED (assume 9W) replacing CFL baseline lamp	14W CFL (60W equivalent)
LED - 9W_Halogen Baseline	Lighting	LED (assume 9W) replacing EISA-2020 compliant baseline lamp	EISA-2020 compliant baseline lamp (60W equivalent)
LED Specialty Lamps-5W Chandelier	Lighting	5 W Chandelier LED	Standard incandescent chandelier lamp
Linear LED	Lighting	Linear LED Lamps in Linear Fluorescent Fixture	Standard (32w) T8 lamps in Linear Fluorescent Fixture
Low Flow Showerhead	Residential Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
New Construction - Whole Home Improvements - Tier 1	Whole Home	Performance-based improvements in new homes - 20% savings	Residential New Construction (Baseline Efficiency)
New Construction - Whole Home Improvements - Tier 2	Whole Home	Performance-based improvements in new homes - 35% savings	Residential New Construction (Baseline Efficiency)
Occupancy Sensors Switch Mounted	Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Timer	Lighting	Timer on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Outdoor Motion Sensor	Lighting	Motion Sensor on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Ozone Laundry	Clothes Washers	Add a New, Single-Unit Ozone Laundry System to the Clothes Washer	One Clothes Washer meeting Federal Standard
Programmable Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Properly Sized CAC	Residential Space Cooling	Properly Sized Central Air Conditioning	Standard Central Air Conditioning, Oversized

Measure	End-Use	Description	Baseline
Radiant Barrier	Residential Space Cooling	Radiant Barrier	No radiant barrier
Reflective Roof	Residential Space Cooling	Reflective Roof Treatment	Standard dark shingle
Refrigerator Coil Cleaning	Refrigerators	Refrigerator Coil Cleaning	
Refrigerator Recycling	Refrigerators	No Refrigerator	Current Market Average Refrigerator
Residential Whole House Fan	Residential Space Cooling	Standard Central Air Conditioning with Whole House Fan	Standard Central Air Conditioning, No Whole House Fan
Sealed crawlspace	Residential Space Cooling, Residential Space Heating	Encapsulated and semi-conditioned crawlspace	Naturally vented, unconditioned crawlspace
Smart Breaker	Whole Home	Smart Breaker	standard electric breakers
Smart Panel	Whole Home	Multi-channel device that attaches to customer's circuit breaker to enable monitoring and control of major end-use appliances by customer	standard electric panel
Smart Power Strip	Plug Load	Smart plug strips for entertainment centers and home office	Standard entertainment center or home office usage, no smart strip controls
Smart Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Solar Attic Fan	Residential Space Cooling	Standard Central Air Conditioning with Solar Attic Fan	Standard Central Air Conditioning, No Solar Attic Fan
Solar Pool Heater	Residential Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pumps	Residential Miscellaneous	Solar Powered Pool Pump	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System	Residential Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Spray Foam Insulation(Base R11)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation(Base R19)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation(Base R2)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Spray Foam Insulation(Base R30)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Thermostatic Shower Restriction Valve	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Thermostatic Shower Valves	50 Gallon Electric Resistance Heater and Standard Shower Valves
Variable Refrigerant Flow (VRF) HVAC Systems	Residential Space Cooling, Residential Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Water Heater Blanket	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Insulated Tank Wrap	Code-Compliant 50 Gallon Electric Resistance Water Heater, No Tank Wrap
Water Heater Thermostat Setback	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Temperature Setpoint of 119°F	Code-Compliant 50 Gallon Electric Resistance Water Heater (Temp. Setpoint = 130Â°F)
Water Heater Timeclock	Residential Domestic Hot Water	Water Heater Timeclock	Existing Water Heater without time clock
Weather stripping	Residential Space Cooling, Residential Space Heating	Specific quantity of weather stripping to seal	
Window Caulking	Residential Space Cooling, Residential Space Heating	Window caulking	
Window Sun Protection	Residential Space Cooling	Window Film Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

Table 13: Commercial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
Advanced Rooftop Controller	Ventilation and Circulation	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Miscellaneous	Performing Routine Maintenance on 20HP Inlet	20 HP Inlet Modulation Fixed-Speed Compressor

Measure	End-Use	Description	Baseline
		Modulation Fixed-Speed Compressor	
Air Curtains	Space Cooling, Space Heating	Air Curtain across door opening	Door opening with no air curtain
Airside Economizer	Space Cooling	Airside Economizer	No economizer
Anti-Sweat Controls	Refrigeration	One Medium Temperature Reach-In Case with Anti-Sweat Heater Controls	One Medium Temperature Reach-In Case without Anti-Sweat Heater Controls
Auto Off Time Switch	Interior Lighting	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Automatic Door Closer for Walk-in Coolers and Freezers	Refrigeration	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Beverage Vending Machine Controls	Refrigeration	One non-ENERGY STAR beverage vending machine equipped with infrared occupancy sensing controls	One non-ENERGY STAR beverage vending machine, no controls
Bi-Level Lighting Control (Exterior)	Exterior Lighting	Bi-Level Controls on Exterior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Interior)	Interior Lighting	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ceiling Insulation (R19 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Chilled Water Reset	Space Cooling	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Chiller maintenance	Space Cooling	O&M improvements to restore chiller performance	
CO Sensors for Parking Garage Exhaust	Miscellaneous	Enclosed Parking Garage Exhaust with CO Control	Constant Volume Enclosed Parking Garage Exhaust

Measure	End-Use	Description	Baseline
Commercial Duct Sealing	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Commercial Strategic Energy Management	Whole Building	Commercial Strategic Energy Management	No active energy management
Custom measure - Non-lighting	Space Cooling, Space Heating	Custom Improvement to Facility's Operations	Baseline Technology/Process
Data Center Hot Cold Aisle	Office Equipment	Equipment configuration that saves HVAC	No hot, cold aisle containment
Dedicated Outside Air System (DOAS)	Space Cooling, Space Heating	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Circulating Systems	Domestic Hot Water	Recirculation Pump with Demand Control Mechanism	Uncontrolled Recirculation Pump
Demand Controlled Ventilation	Ventilation and Circulation	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Refrigeration	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Destratification Fans	Space Heating	Destratification Fans improve temperature distribution by circulating warmer air from the ceiling back down to the floor level	No destratification fan
Door Gasket (Cooler)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Door Gasket (Freezer)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Drain water heat recovery	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Dual Enthalpy Economizer	Ventilation and Circulation	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
Duct Insulation	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork (R-8)	Standard Electric Heating and Central AC with Uninsulated Ductwork (R-4)
Ductless Mini-Split AC	Space Cooling	Ductless Mini-Split AC, 4 Ton, 16 SEER	Code-Compliant AC Unit, 4 Ton, 15 SEER
Ductless Mini-Split HP	Space Cooling, Space Heating	Ductless Mini-Split HP, 17 SEER, 9.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
DX Coil Cleaning	Space Cooling	DX Coil Cleaning	DX Coil Not Cleaned

Measure	End-Use	Description	Baseline
ECM Motors on Furnaces	Space Heating	Variable Speed Electronically Commutated Motor for an Electric Furnace	Permanent Split Capacitor Motor for Electric Furnace
Efficient Battery Charger	Miscellaneous	Efficient Battery Charger	FR or SCR charging stations with power conversion efficiency < 89% or > 10 W
Efficient Exhaust Hood	Cooking	Kitchen ventilation with automatically adjusting fan controls	Kitchen ventilation with constant speed ventilation motor
Efficient Motor Belts	Miscellaneous	Synchronous belt, 98% efficiency	Standard V-belt drive
Efficient New Construction Lighting	Interior Lighting	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Energy Recovery Ventilation System (ERV)	Space Cooling	Unitary Cooling Equipment that Incorporates Energy Recovery	Current Market Packaged or Split DX Unit
Energy Star Combination Oven	Cooking	Energy Star Combination Oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade 10-Pan Combination Oven
Energy Star Commercial Clothes Washer	Miscellaneous	One Commercial Clothes Washer meeting current ENERGY STAR Version 8.1 Standards	One Commercial Clothes Washer meeting Federal Standard
Energy Star Commercial Dishwasher	Domestic Hot Water	One Commercial Dishwasher meeting ENERGY STAR Version 3.0 Standards	One Dishwasher meeting Federal Standard
Energy Star Commercial Glass Door Freezer	Refrigeration	One Glass Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Glass Door Freezer meeting Federal Standards
Energy Star Commercial Glass Door Refrigerator	Refrigeration	One Glass Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Glass Door Refrigerator meeting Federal Standards
Energy Star Commercial Solid Door Freezer	Refrigeration	One Solid Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Solid Door Freezer meeting Federal Standards
Energy Star Commercial Solid Door Refrigerator	Refrigeration	One Solid Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Solid Door Refrigerator meeting Federal Standards
Energy Star convection oven	Cooking	Energy Star convection oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Full-Size Convection Oven
Energy Star EV Chargers	Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Fryer	Cooking	One Standard Vat Electric Fryer meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Standard Vat Electric Fryer

Measure	End-Use	Description	Baseline
Energy Star Griddle	Cooking	One Griddle meeting current ENERGY STAR Version 1.2 Standards	One Conventional Griddle
Energy Star Hot Food Holding Cabinet	Cooking	One Hot Food Holding Cabinet meeting current ENERGY STAR Version 2.0 Standards	One Standard Hot Food Holding Cabinet
Energy Star Ice Maker	Refrigeration	One Continuous Self-Contained Ice Maker meeting ENERGY STAR Version 3.0 Standards	One Continuous Self-Contained Ice Maker meeting Federal Standard
ENERGY STAR Imaging Equipment	Office Equipment	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star LED Directional Lamp	Interior Lighting	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star Monitors	Office Equipment	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star PCs	Office Equipment	One Personal Computer (desktop or laptop) meeting current ENERGY STARÂ® Standards	One non-ENERGY STARÂ® Personal Computer
Energy Star room AC	Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC, 1 Ton, 10.9 CEER
Energy Star Servers	Office Equipment	One Server meeting ENERGY STAR 2.0 Standards	One Standard Server
Energy Star Steamer	Cooking	One 4-Pan Electric Steamer meeting ENERGY STARÂ® 2.0 Standards	One Standard Economy-Grade 4-Pan Steamer
Energy Star Uninterruptable Power Supply	Office Equipment	Standard Desktop Plugged into Energy Star Uninterruptable Power Supply at 25% Load	Standard Desktop Plugged into Average Rotary Uninterruptable Power Supply at 25% Load
Energy Star Vending Machine	Refrigeration	One Refrigerated Vending Machine meeting ENERGY STAR Version 4.0 Standards	One Refrigerated Vending Machine meeting ENERGY STARÂ® 1.0 Standards
ENERGY STAR Water Cooler	Miscellaneous	One Storage Type Hot/Cold Water Cooler Unit meeting ENERGY STAR Version 3.0 Standards	One Standard Storage Type Hot/Cold Water Cooler Unit
Energy Star windows	Space Cooling, Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Miscellaneous	Plug-in timer that activates engine block timer to reduce unnecessary run time	Engine block heater (typically used for backup generators) running continuously

Measure	End-Use	Description	Baseline
Escalator Motor Efficiency Controller	Miscellaneous	Install Escalator Motor Efficiency Controller	Escalator without Motor Efficiency Controller
Facility Commissioning	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility commissioning to optimize building operations in new facilities	Standard new construction facility with no commissioning
Facility Energy Management System	Space Cooling, Space Heating, Ventilation and Circulation	Typical HVAC by Building Type Controlled by Energy Management System	Standard/manual facility equipment controls
Faucet Aerator	Domestic Hot Water	Low-flow lavatory faucet aerator, flow rate: 1.0 gpm	Federal lavatory flow rate standard, 1994, flow rate: 2.2 gpm
Floating Head Pressure Controls	Refrigeration	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Floor Insulation	Space Cooling, Space Heating	Increased Floor Insulation (R-19)	Market Average Existing Floor Insulation
Geothermal Heat Pump	Space Cooling, Space Heating	Geothermal Heat Pump	Code-Compliant Air Source Heat Pump
Green roof	Space Cooling, Space Heating	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
HE Air Cooled Chiller - All Compressor Types - 100 Tons	Space Cooling	HE Air Cooled Chiller - Air Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE DX 11.25-20.0 Tons Elec Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER

Measure	End-Use	Description	Baseline
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
Heat Pump Pool Heater Commercial	Miscellaneous	High Efficiency Pool Heater Eff. >=84%	Standard Efficiency Pool Heater 78% Eff.
Heat Pump Water Heater	Domestic Hot Water	Efficient 50 Gallon Electric Heat Pump Water Heater	Code-Compliant 50 Gallon Electric Heat Pump Water Heater
High Efficiency Air Compressor	Miscellaneous	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Data Center Cooling	Space Cooling	High Efficiency CRAC (computer room air conditioner)	Standard Efficiency CRAC
High Efficiency PTAC	Space Cooling	High Efficiency PTAC	Code-Compliant PTAC
High Efficiency PTHP	Space Cooling, Space Heating	High Efficiency PTHP	Code-Compliant PTHP
High Efficiency Refrigeration Compressor_Discus	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor_Scroll	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Speed Fans	Ventilation and Circulation	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
Hot water pipe insulation	Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-4	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
Hotel Card Energy Control Systems	Space Cooling, Space Heating	Guest Room HVAC Unit Controlled by Hotel-Key-Card Activated Energy Control System	Guest Room HVAC Unit, Manually Controlled by Guest
Indoor daylight sensor	Interior Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Cooktops	Cooking	Efficient Induction Cooktop	One Standard Electric Cooktop

Measure	End-Use	Description	Baseline
Infiltration Reduction - Air Sealing	Space Cooling, Space Heating	Reduced leakage through caulking, weather-stripping	Standard Heating and Cooling System with Moderate Infiltration
Instantaneous Hot Water System Commercial	Domestic Hot Water	Instantaneous Hot Water System	Code-Compliant Electric Storage Water Heater
LED - 14W_CFL Baseline	Interior Lighting	LED (assume 14W) replacing CFL	100W equivalent CFL
LED - 9W Flood_CFL Baseline	Exterior Lighting	LED (assume 9W) replacing CFL	14W CFL
LED Canopy Lighting (Exterior)	Exterior Lighting	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Exit Sign	Interior Lighting	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting	2x4 LED Troffer	Lumen-Equivalent 32-Watt T8 Lamp
LED Linear - Lamp Replacement	Interior Lighting	Linear LED (16W)	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	Space Cooling, Space Heating	LEED New Construction Whole Building	Comparable facility, code-compliance construction
Light Tube	Interior Lighting	One 14" Light Tube, Delivering light to 250 S.F. of Commercial Space	250 S.F. of Commercial Space Lit by Typical Lighting Strategies
Low Flow Shower Head	Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.50 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
Low-Flow Pre-Rinse Sprayers	Domestic Hot Water	Low-Flow Pre-Rinse Sprayer with Flow Rate of 1.6 gpm	Pre-Rinse Sprayer with Federal Standard Flow Rate of 2.25 gpm
Network PC Power Management	Office Equipment	One computer and monitor attached to centralized energy management system that controls when desktop	One computer and monitor, manually controlled

Measure	End-Use	Description	Baseline
		computers and monitors plugged into a n	
Networked Lighting Controls	Interior Lighting	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Night Covers for Display Cases	Refrigeration	One Open Vertical Case with Night Covers	One Existing Open Vertical Case, No Night Covers
Occupancy Sensors, Ceiling Mounted	Interior Lighting	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy Sensors, Switch Mounted	Interior Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ozone Laundry Commercial	Miscellaneous	Add a new ozone laundry system onto a commercial clothes washer	One commercial clothes washer without ozone laundry system
Programmable thermostat	Space Cooling, Space Heating	Pre-set programmable thermostat that replaces manual thermostat	Standard Heating and Cooling System with Manual Thermostat
PSC to ECM Evaporator Fan Motor (Reach-In)	Refrigeration	Medium Temperature Reach-In Case with equivalent size Electronically Commutated Evaporator Fan Motor	Medium Temperature Reach-In Case with Permanent Split Capacitor Evaporator Fan Motor
PSC to ECM Evaporator Fan Motor (Walk-In, Refrigerator)	Refrigeration	Medium Temperature Walk-In Case with Electronically Commutated Evaporator Fan Motor	Medium Temperature Walk-In Case with Permanent Split Capacitor Evaporator Fan Motor
Q-Sync Evaporator Fan Motor	Refrigeration	Medium Temperature Reach-In Case with equivalent size Q-Sync Evaporator Fan Motor	Medium Temperature Reach-In Case with 20W Permanent Split Capacitor Fan Motor
Reflective Roof Treatment	Space Cooling	Reflective Roof Treatment	Standard Black Roof
Refrigerated Display Case LED Lighting	Refrigeration	60" Refrigerated Case LED Strip	Lumen-Equivalent 32-Watt T8 Fixture
Refrigerated Display Case Lighting Controls	Refrigeration	Occupancy Sensors for Refrigerated Case Lighting to reduce run time	Market-Share Weighted Existing Linear Fluorescent Fixture
Refrigeration Commissioning	Refrigeration	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Refrigeration Economizer	Refrigeration	Walk-in refrigerator with economizer	Walk-in refrigerator without economizer

Measure	End-Use	Description	Baseline
Regenerative Drive Elevator Motor	Miscellaneous	Regenerative drive produced energy when motor in overhaul condition	Standard motor
Retro-Commissioning (Existing Construction)	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	
Roof Insulation	Space Cooling, Space Heating	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Server Virtualization	Office Equipment	2 Virtual Host Server	20 Single Application Servers
Smart Strip Plug Outlet	Office Equipment	One Smart Strip Plug Outlet	One Standard plug strip/outlet
Smart thermostat	Space Cooling, Space Heating	Thermostats that include "smart" features such as occupancy sensors, geo-fencing, multi-zone sensors	Standard Heating and Cooling System with Manual Thermostat
Solar Pool Heater Commercial	Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pump	Miscellaneous	Solar Powered Pool Pump Motor	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System Commercial	Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Strip Curtains - Freezers	Refrigeration	Walk-in freezer with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in freezer without strip curtains
Strip Curtains - Refrigerators	Refrigeration	Walk-in cooler with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in cooler without strip curtains
Suction Pipe Insulation - Freezers	Refrigeration	Suction Pipe Insulation - Freezers	Uninsulated freezer suction lines
Suction Pipe Insulation - Refrigerators	Refrigeration	Suction Pipe Insulation - Refrigerators	Uninsulated refrigeration suction lines
Thermal Energy Storage	Space Cooling	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Thermostatic Shower Restriction Valve Commercial	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater and Standard Shower Valves

Measure	End-Use	Description	Baseline
		Pressure Balance Shower Valves	
Time Clock Control	Interior Lighting	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Variable Refrigerant Flow (VRF) HVAC Systems	Space Cooling, Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant PTHP
VAV System	Ventilation and Circulation	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Cooling Tower Fans	Space Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Pump	Space Cooling, Space Heating	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VSD Controlled Compressor	Refrigeration	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Wall Insulation	Space Cooling, Space Heating	Increased Exterior Above-Grade Wall Insulation	Market Average Existing Exterior Above-Grade Wall Insulation
Warehouse Loading Dock Seals	Space Cooling, Space Heating	Seals to reduce infiltration losses at loading dock	Loading dock with no seals
Water Cooled Refrigeration Heat Recovery	Domestic Hot Water	The heat reclaim system transfers waste heat from refrigeration system to space heating or hot water	No heat recovery
Water Heater Setback	Domestic Hot Water	A 50 gallon electric hot water tank with a thermostat setting reduced to no lower than 120 degrees.	A 50 gallon electric hot water tank with a thermostat setting that is higher than 120 degrees, typically hot water tanks with settings of 130 degrees or higher.
Water source heat pump	Space Cooling, Space Heating	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside Economizer	Space Cooling	Waterside Economizer	No economizer
Window shade film	Space Cooling	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC
Zero Energy Doors	Refrigeration	Install zero energy doors for a reach-in refrigerated cooler or freezer	Standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors

Table 14: Industrial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
3-phase High Frequency Battery Charger - 1 shift	Other	3-phase High Frequency Battery Charger	Standard Charger
Advanced Rooftop Controller	HVAC	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Compressed Air	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air curtains	HVAC	Air Curtain across door opening	Door opening with no air curtain
Airside economizer	HVAC	Airside Economizer	No economizer
Auto Closer on Refrigerator Door	Process Cooling	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Auto Off Time Switch	Interior Lighting High Bay	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Exterior)	Exterior Lighting Industrial	Install Exterior Bi-Level Lighting Control, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Bi-Level Lighting Control (Interior)	Interior Lighting High Bay	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Chilled Water Reset	HVAC	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Cogged Belt on 15hp ODP Motor	Motors Pumps	15HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	15HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Cogged Belt on 40hp ODP Motor	Motors Pumps	40HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	40HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans

Measure	End-Use	Description	Baseline
Compressed Air Desiccant Dryer	Process Specific	heated regenerative desiccant dryer without dew point demand controls	heatless regenerative desiccant dryer without dew point demand controls
Compressed Air No-Loss Condensate Drains	Process Specific	Install no-loss condensate drains	Install standard condensate drains
Compressed Air Storage Tank	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Receiver Tank	20 HP Inlet Modulation Fixed-Speed Compressor, No Receiver Tank
Custom Measure - Non-Lighting	HVAC	Custom Improvement to Facility's Operations	Baseline Technology/Process
Dairy Refrigeration Heat Recovery	Other	refrigeration equipment with refrigeration heat recovery tank installed	existing dairy farm with refrigeration equipment and a water heater unit without an RHR unit
Dedicated Outside Air System (DOAS)	HVAC	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Ventilation	HVAC	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Process Cooling	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Dew Point Sensor Control for Dessicant CA Dryer	Compressed Air	1000 CFM Heated Desicant Air Dryer with Dew Point Controls	1000 CFM Modulating Heated Desicant Air Dryer
Drip Irrigation Nozzles	Other	Flow Control Nozzles	Standard Irrigation Nozzles
Dual Enthalpy Economizer	Process Cooling	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
DX Coil Cleaning	HVAC	DX Coil Cleaning	DX Coil Not Cleaned
Efficient Compressed Air Nozzles	Compressed Air	1/4" Engineered Air Nozzle	1/4" Open-End Air Nozzle
Efficient New Construction Lighting	Interior Lighting High Bay	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Electric Actuators	Other	Electric Actuator	Pneumatic Actuator
Energy Efficient Laboratory Fume Hood	HVAC	Variable Air Volume High Performance Fume Hood	Constant Volume Conventional Bypass Fume Hood
Energy Efficient Transformers	Other	Energy Efficient Dry Type Transformer (CSL-3)	Standard Transformer (TP-1)

Measure	End-Use	Description	Baseline
Energy Recovery Ventilation System	HVAC	Unitary Cooling Equipment that Incorporates Energy Recovery	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11.2 EER
Energy Star LED Directional Lamp	Interior Lighting Other	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star room ac	HVAC	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star windows	HVAC	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Other	An engine block heater operated by an outdoor plug-in timer	An engine block heater that is manually plugged in
Facility Commissioning	HVAC	Perform facility commissioning	Comparable facility, no commissioning
Facility Energy Management System	HVAC	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Fan Thermostat Controller	HVAC	Typical HVAC by Building Type with Fan Thermostat Controller Installed	Typical HVAC by Building Type with Programmable Thermostat
Floating Head Pressure Controller	Process Cooling	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Grain Bin Aeration Control System	Process Specific	Grain Storage Fan System with Automatic Controls	Grain Storage Fan System with Manual Controls
HE Air Cooled Chiller - All Compressor Types - 100 Tons	HVAC	HE Air Cooled Chiller - All Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE Air Cooled Chiller - All Compressor Types - 300 Tons	HVAC	Air Cooled Positive Displacement Chiller with Integral VFD, 300 Tons, 13.7 EER	Code-Compliant Air Cooled Positive Displacement Chiller, 300 Tons, 12.5 EER
HE DX 11.25-20.0 Tons Elec Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER

Measure	End-Use	Description	Baseline
HE DX 5.4-11.25 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
High Bay Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 800 Watts Controlled	800 Watts of Lighting, Manually Controlled
High Efficiency Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Refrigeration Compressor - Discus	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor - Scroll	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Welder	Process Specific	High Efficiency Welder	Standard Welding Practices
High Speed Fans	HVAC	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
High Volume Low Speed Fan (HVLS)	Motors Fans Blowers	20' High Volume Low Speed Fan	Conventional Circulating Fan

Measure	End-Use	Description	Baseline
Indoor Agriculture - LED Grow Lights	Interior Lighting High Bay	LED grow light	1000W High Pressure Sodium
Indoor daylight sensor	Interior Lighting High Bay	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Industrial Duct Sealing	HVAC	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Injection Mold and Extruder Barrel Wraps	Other	2' Diameter, 20' Long Machine Barrel with 1" Insulation	2' Diameter, 20' Long Machine Barrel with no Insulation
Insulated Pellet Dryer Tanks and Ducts	Process Heating	Insulation for Pellet Tank and Duct	Uninsulated Pellet Tank and Duct
LED - 14W_CFL Baseline	Interior Lighting Other	LED (assume 14W) replacing CFL	100W equivalent CFL
LED Canopy Lighting (Exterior)	Exterior Lighting Industrial	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting Industrial	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting Other	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED exit sign	Interior Lighting Other	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting Industrial	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting Linear Fluorescent	2x4 LED Troffer Fixture	Lumen-Equivalent 32-Watt T8 Fixture
LED Linear - Lamp Replacement	Interior Lighting Linear Fluorescent	Linear LED	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting Industrial	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting

Measure	End-Use	Description	Baseline
LEED New Construction Whole Building	HVAC	LEED Qualifying New Construction	Comparable facility, code-compliance construction
Light Tube	Interior Lighting Other	One 14" Light Tube, Delivering light to 250 S.F. of Industrial Space	250 S.F. of Industrial Space Lit by Typical Lighting Strategies
Low Energy Livestock Waterer	Motors Pumps	Install Thermostatically Controlled Livestock Watering System	Standard Livestock Watering System
Low Pressure Sprinkler Nozzles	Motors Pumps	Low Pressure Irrigation Nozzles operate at 35 psi or lower	Standard high pressure irrigation nozzles that operate at 50 psi or greater
Low Pressure-drop Filters	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Low Pressure Drop Filter	20 HP Inlet Modulation Fixed-Speed Compressor, No Particulate Removal
Milk Pre-Cooler	Other	Installed pre-cooler heat exchanger	no pre-cooler heat exchanger installed
Networked Lighting Controls	Interior Lighting Linear Fluorescent	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy sensors, switch mounted	Interior Lighting Linear Fluorescent	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting Industrial	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting Industrial	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Packaged Terminal AC	HVAC	High Efficiency Packaged Terminal AC	Code-Compliant PTAC, 10.9 EER
Process Cooling Ventilation Reduction	Process Cooling	Standard Process Cooling with Reduced Ventilation	Standard Process Cooling
Programmable thermostat	HVAC	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Reflective Roof Treatment	HVAC	Reflective Roof Treatment	Standard Black Roof
Refrigeration Commissioning	Process Cooling	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Retro-Commissioning	HVAC	Perform Facility Retro-commissioning	

Measure	End-Use	Description	Baseline
(Existing Construction)			
Roof insulation	HVAC	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Smart thermostat	HVAC	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Strategic Energy Management	HVAC	SEM goal setting and tracking	No active energy management
Synchronous Belt on 15hp ODP Motor	Motors Pumps	15 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	15 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 5hp ODP Motor	Motors Pumps	5 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	5 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 75hp ODP Motor	Motors Pumps	75 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	75 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Thermal energy storage	HVAC	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Time Clock Control	Interior Lighting High Bay	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
VAV System	HVAC	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
VFD on Cooling Tower Fans	Process Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Fan	Motors Fans Blowers	5 HP HVAC Fan Motor, with VFD Control	5 HP HVAC Fan Motor, no VFD Control
VFD on HVAC Pump	Motors Pumps	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VFD on process pump	Motors Pumps	20 HP Process Pump Equipped with VFD Control	20 HP Process Pump, Constant Speed
VSD Controlled Compressor	Process Cooling	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Water source heat pump	HVAC	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside economizer	HVAC	Waterside Economizer	No economizer

Measure	End-Use	Description	Baseline
Window shade film	HVAC	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

The following EE measures from the 2019 Technical Potential Study were eliminated from the current study[8]:

Table 15: 2019 EE Measures Eliminated from Current Study

Sector	Measure	End-Use	Reason for Removal
Residential	CFL – 15W Flood	Lighting	Better technology (LED) available
Residential	CFL – 15W Flood (Exterior)	Lighting	Better technology (LED) available
Residential	CFL – 13W	Lighting	Better technology (LED) available
Residential	CFL – 23W	Lighting	Better technology (LED) available
Residential	Low Wattage T8 Fixture	Lighting	Better technology (LED) available
Residential	15 SEER Central AC	Space Cooling	Updated Federal Standard
Residential	15 SEER Air Source Heat Pump	Space Cooling, Space Heating	Updated Federal Standard
Residential	14 SEER ASHP from base electric resistance heating	Space Cooling, Space Heating	Updated Federal Standard
Residential	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Storm Door	Space Cooling, Space Heating	Minimal/uncertain energy savings
Commercial	CFL – 15W Flood	Exterior Lighting	Better technology (LED) available
Commercial	High Efficiency HID Lighting	Exterior Lighting	Better technology (LED) available
Commercial	LED Street Lights	Exterior Lighting	Market standard
Commercial	LED Traffic and Crosswalk Lighting	Exterior Lighting	Market standard

[8] Additional measures from the 2019 study were updated to reflect current vintage/technology for the current study.

Sector	Measure	End-Use	Reason for Removal
Commercial	CFL-23W	Interior Lighting	Better technology (LED) available
Commercial	High Bay Fluorescent (T5)	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Fixture Replacement	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Lamp Replacement	Interior Lighting	Better technology (LED) available
Commercial	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Tank Wrap on Water Heater	Domestic Hot Water	Limited applicability
Commercial	Ceiling Insulation (R12 to R38)	Space Cooling, Space Heating	Consolidated measure baseline assumptions
Commercial	Ceiling Insulation (R30 to R38)	Miscellaneous	Consolidated measure baseline assumptions

Appendix B DR Measure List

Table 16: Residential DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Water heater control	Direct load control	Summer and Winter	Load control installed on a water heater (integrated or external switch)
Pool pump switches	Direct load control	Summer and Winter	Load control program with switch installed on pool pump
Room AC	Direct load control	Summer	Load control program that is focused on room AC units rather than central AC
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 17: Small C&I DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 18: Large C&I DR Measures

Measure	Type	Season	Description
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of

Measure	Type	Season	Description
			CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Auto DR	Utility-controlled loads	Summer and Winter	Custom load control of specific end-uses/processes that is triggered by utility signal to building management system; customer can sometimes opt-out of specific events
Firm Service Level	Contractual	Summer and Winter	Customer commits to a maximum usage level during peak periods and, when notified by the utility, agrees to cut usage to that level.
Guaranteed Load Drop	Contractual	Summer and Winter	Customer agrees to reduce usage by an agreed upon amount when notified

No DR measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix C DSRE Measure List

Table 19: Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation

Table 20: Non-Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation
CHP – Fuel Cell	An electrochemical cell-based generator that reacts hydrogen fuel with oxygen
CHP – Micro Turbine	Small combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Gas Turbine	A combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Reciprocating Engine	An engine that uses one or more pistons to convert pressure into rotational motion
CHP - Steam Turbine	A turbine that extracts thermal energy from pressured steam to drive a generator

No DSRE measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix D External Measure Suggestions

Table 21: External Measure Suggestions and Actions

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Efficient Electrification Measures	All measures that can produce substantial site energy savings by converting from natural gas or other fossil fuels should be included in the Florida electric utilities' next efficiency potential study. Key examples include efficient heat pumps to displace gas furnaces and efficient heat pump water heaters to displace gas water heaters. It is important to note that these electrification measures provide not only heating energy savings and water heating energy savings, but can also potentially provide cooling efficiency benefits as well. In the case of heat pumps, that can occur because efficient heat pumps can operate in cooling mode more efficiently than standard central air conditioners. In the case of heat pump water heaters, cooling and dehumidification benefits can occur when/if the water heater is in conditioned space because they transfer heat (particularly latent heat) from the air around them to the water they are heating. A growing number of jurisdictions – including Illinois, Minnesota and some northeastern states – have begun to include efficient electrification measures in their efficiency programs portfolios.	Fuel-switching and electrification are outside the scope of this study
Networked Lighting Controls	LED lighting technology has become increasingly accepted and installed in commercial buildings. The next big efficiency opportunity in commercial lighting efficiency is in sophisticated controls integrated into the light fixtures themselves – both luminaire level lighting controls and networked lighting controls. For example, a 2017 report for both the Northwest Energy Efficiency Alliance and the Design Lights Consortium, a non-profit that works with utilities and manufacturers of lighting products (and which many utilities across the country reference for determination of eligibility of lighting products for efficiency program rebates), found that networked lighting controls can provide on the order of 50% additional savings after LED conversion. Other studies have also found the national savings potential from such products to be enormous. Moreover, these products can be designed to provide not only lighting energy savings but also a number of other non-energy benefits (e.g., asset tracking, such as the ability of hospitals to know the location of all wheel chairs). Numerous utilities across the country now actively promote this technology through their efficiency programs. For example, Commonwealth Edison, the utility serving Chicago and other parts of northern Illinois, is currently getting a significant portion of its commercial lighting savings from promotion of networked lighting controls	Added to measure list for 2024 study

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Ductless mini-split heat pumps to displace inefficient electric baseboard heating	While most Florida residential buildings with electric heat provide that heat with heat pumps, at least some (perhaps most likely being older multi-family rental buildings) still use inefficient electric resistance heat. Ductless mini- split heat pump retrofits can very efficiently displace such inefficient electric heat and should be added to the residential measure list.	Added to measure list for 2024 study
Air Source Heat Pump baseline assumptions	There are seven air source heat pump (ASHP) measures included in the residential measure list. Two of them – one at SEER 14 and a second at SEER 21 – are listed as relative to an electric resistance baseline. Five of them – SEER 15, SEER 16, SEER 17, SEER 18 and SEER 21 – appear to be relative to a baseline of a standard new ASHP. Are we interpreting this correctly? If so, we have a couple of comments/questions/suggestions: • The efficiency standards assessed need to be modified to be consistent with new federal standards, including new testing procedures. • For cases where the baseline is "electric resistance", why only assessing two efficiency tiers (i.e., fewer than for standard ASHP baselines)? The same number of efficiency tiers should be assessed for both baselines.	Incorporated suggestions into 2024 study, including updated baseline standard and assessing same efficiency tiers for both baselines
Heat Pump Water Heater Efficiency	The Res EE tab of the utilities draft measure list suggests that the efficiency of a heat pump water heater is an EF of 2.50. That is unrealistically low. In fact, of the 222 products listed on the Energy Star website, none had UEFs less than 2.80 and only 29 (13%) had UEFs that were less than 3.4; the average was 3.57. Indeed, the first product listed on a search of heat pump water heaters on Home Depot's website is a 50 gallon, Rheem (Pro Terra) product with a UEF of 3.75 and a cost of $1699.	Incorporated suggestion into 2024 study
New Construction Measure Packages	The measures lists did not appear to include packages of measures for building new residential and/or new commercial buildings to levels of efficiency beyond those required by code. Utilities in many jurisdictions run new construction efficiency programs supporting such measure packages. In the residential sector, many base their programs on the long-standing Federal Energy Star standard. However, increasingly utility programs are promoting additional efficiency tiers – often as part of all-electric new construction program offerings – that go well beyond the Energy Star standard. For example, Consumers Energy (Michigan) offers $1000 rebates to builders who construct Energy Star single family homes	Incorporated suggestion into 2024 study with 2 tiers of residential new construction whole-home improvement measures.

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
	with a Home Energy Rating (HERS) score of 57 or less, but offer higher rebates for more efficient buildings – up to $4000 for all electric homes with a HERS score of 40 or less. The Florida utilities potential study should assess savings potential for both the Energy Star level and a tier or two of additional efficiency beyond that level. Similar assessments of new commercial building savings potential should also be assessed.	
Custom Industrial Measures	The utilities' list of industrial efficiency measures addresses common industrial efficiency opportunities. However, it does not address efficiency opportunities that may be unique to individual industries or even to individual industrial facilities. That can include such things as changes in types of materials used in manufacturing, reductions in waste streams, improved use of water delivered by agricultural irrigation systems, and/or other things that are not directly related to energy using equipment or controls of such equipment. It is obviously not possible to list all such measures. However, a potential study will understate savings potential if it does not include a way of capturing such potential in its estimates. One potential way to get a sense of such potential is to review results of comprehensive industrial efficiency programs run by other utilities to identify the portion of actual program savings from such unique custom measures – and then assume that portion of custom savings could be added to the savings estimated in the study for named measures.	Added to measure list for 2024 study
Electric Vehicle measures	Some EV chargers are more efficient than others. The Federal Energy Star program has a standard for them. Savings potential may not be huge, but should be considered in the study. With a growing number of EV sales, the study should also consider the potential savings from promoting the most efficient EVs within different size/style categories	Added to measure list for 2024 study
Removing screw-based LEDs	The screw-based LEDs on both the Residential and Commercial measure lists should now be considered baseline due to federal efficiency standards adopted earlier this year. Utility load forecasts for IRPs should reflect resulting improvements in end use efficiency.	Screw-based LEDs were included in the study but with limited applicability to reflect current market
Removing Commercial fluorescent lighting	LED technology – for both fixtures and lamps – has advanced significantly in recent years, to the point where it should be the only technology considered for commercial lighting. Measures such as high performance T-8 fluorescent fixtures and high bay T-5 fluorescent fixtures should be replaced with LED alternatives in the study.	Updated measure list for 2024 study to only include LED-based lamps for linear fluorescent replacements

Docket Nos. 20240012-EG to 20240017-EG
TPS for Florida Public Utilities Company
Exhibit JH-5, Page 82 of 84

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Removing fossil-gas fueled CHP	Fossil-fuel fired CHP systems should not be considered "renewable" and have questionable benefits if electric generation is expected to get increasingly more renewable and clean. Biogas-fueled CHP – such as systems installed in wastewater treatment facilities that use methane byproducts of processing waste – should be included in the study.	2024 study will continue to assess all CHP options
Adding livestock methane power generation to renewables list	For example, see the "cow power" program currently being run by Green Mountain Power, Vermont's largest electric utility	2024 study will continue to assess DSRE options consistent with prior study, including customer-sited solar, solar plus storage, and CHP
Adding EV managed charging to DR list	With national market shares for EVs growing, it is important that utilities consider programs for managing when charging occurs. Numerous utilities are currently running managed charging programs. This does not currently appear to be on the measure list and should be added to the Florida utilities' potential study.	Added to measure list for 2024 study
Residential "smart thermostat" measure can provide both efficiency savings and demand response potential	This is recognized in the inclusion of smart thermostats in both the Res EE and DR tabs of the measure list spreadsheet. We simply want to flag that it is important when assessing cost-effectiveness of this measure that these two potential benefits are considered together. In other words, the cost should be considered compared to the combined efficiency and DR potential rather than separately considered relative to just EE savings and then separately again compared to just DR potential	2024 study will include interactive impacts of EE and DR opportunities
Emerging Technologies	The efficiency potential study measure list appears to be somewhat outdated. It does not include a number of new and emerging technologies. The potential list of such technologies is long. We suggest reviewing the attached list of emerging technologies developed almost two years ago by Consumers Energy (Michigan) and including them in the study.	Consumers Energy study was reviewed and commercially available measures were added to measure list for 2024 study, including heat pump water heaters - CEE advanced tier, heat pump clothes dryers, ozone laundry systems, and 21+ SEER HVAC units

Docket Nos. 20240012-EG to 20240017-EG
TPS for Florida Public Utilities Company
Exhibit JH-5, Page 84 of 84

resource innovations

Technical Potential Study of Demand Side Management

JEA

Date: 03.07.2024

Table of Contents

Executive Summary

In October 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems.

The main objective of the study was to assess the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of JEA's service territory.

1.1 Methodology

Resource Innovations estimates DSM savings potential by applying an analytical framework that aligns baseline market conditions for energy consumption and demand with DSM opportunities. After describing the baseline condition, Resource Innovations applies estimated measure savings to disaggregated consumption and demand data. The approach varies slightly according to the type of DSM resources and available data; the specific approaches used for each type of DSM are described below.

1.1.1 EE Potential

This study utilized Resource Innovations' proprietary EE modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual program savings. The methodology for the EE potential assessment was based on a hybrid "top-down/bottom-up" approach, which started with the current utility load forecast, then disaggregated it into its constituent customer-class and end-use components. Our assessment examined the effect of the range of EE measures and practices on each end-use, taking into account current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the end-use, customer class, and system levels for JEA.

1.1.2 DR Potential

The assessment of DR potential in JEA's service territory was an analysis of mass market direct load control programs for residential and small commercial and industrial (C&I) customers, and an analysis of DR programs for large C&I customers. The direct load control program assessment focused on the potential for demand reduction through heating, ventilation, and air conditioning (HVAC), water heater, managed electric vehicle charging, and pool pump load control. These end-uses were of particular interest because of their large contribution to peak period system load. For this analysis, a range of direct load control measures were examined for each customer segment to highlight the range of potential. The assessment further accounted for existing DR programs for JEA when calculating the total DR potential.

1.1.3 DSRE Potential

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from customers' PV systems, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

1.2 Savings Potential

Technical potential for EE, DR, and DSRE are as follows:

1.2.1 EE Potential

EE technical potential describes the savings potential when all technically feasible EE measures are fully implemented, ignoring all non-technical constraints on electricity savings, such as cost-effectiveness and customer willingness to adopt EE.

The estimated EE technical potential results are summarized in Table 1.

Table 1. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	517	297	1,887
Non-Residential[1]	280	251	1,690
Total	797	548	3,577

1.2.2 DR Potential

DR technical potential describes the magnitude of loads that can be managed during conditions when grid operators need peak capacity. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale such as heating, cooling, water heaters, managed electric vehicle charging, and pool pumps. For large C&I customers, this included their entire electric demand during a utility's system peak, as many of these types of customers will forego virtually all electric demand temporarily if the financial incentive is large enough.

The estimated DR technical potential results are summarized in Table 2.

Table 2. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	443	1,451
Non-Residential	673	578
Total	1,116	2,029

[1] Non-Residential results include all commercial and industrial customer segments.

1.2.3 DSRE Potential

DSRE technical potential estimates quantify all technically feasible distributed generation opportunities from PV systems, battery storage systems charged from PV, and CHP technologies based on the customer characteristics of JEA's customer base.

The estimated DSRE technical potential results are summarized in Table 3.

Table 3. DSRE Technical Potential[2]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	493	19	4,146
Non-Residential	214	3	1,617
Total	707	22	5,763
Battery Storage charged from PV Systems			
Residential	304	557	0
Non-Residential	0	158	0
Total	304	715	0
CHP Systems			
Total	397	359	1,811

[2] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

2 Introduction

In October, 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems. The main objective of the study was:

- Assessing the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of JEA's service territory.

The following deliverables were developed by Resource Innovations as part of the project and are addressed in this report:

- DSM measure list and detailed assumption workbooks
- Disaggregated baseline demand and energy use by year, sector, and end-use
- Baseline technology saturations, energy consumption, and demand
- Technical potential demand and energy savings
- Supporting calculation spreadsheets

2.1 Technical Potential Study Approach

Resource Innovations estimates technical potential according to the industry standard categorization, as follows:

> Technical Potential is the theoretical maximum amount of energy and capacity that could be displaced by DSM, regardless of cost and other barriers that may prevent the installation or adoption of a DSM measure.

For this study, technical potential included full application of commercially available DSM technologies to all residential, commercial, and industrial customers in the utility's service territory.

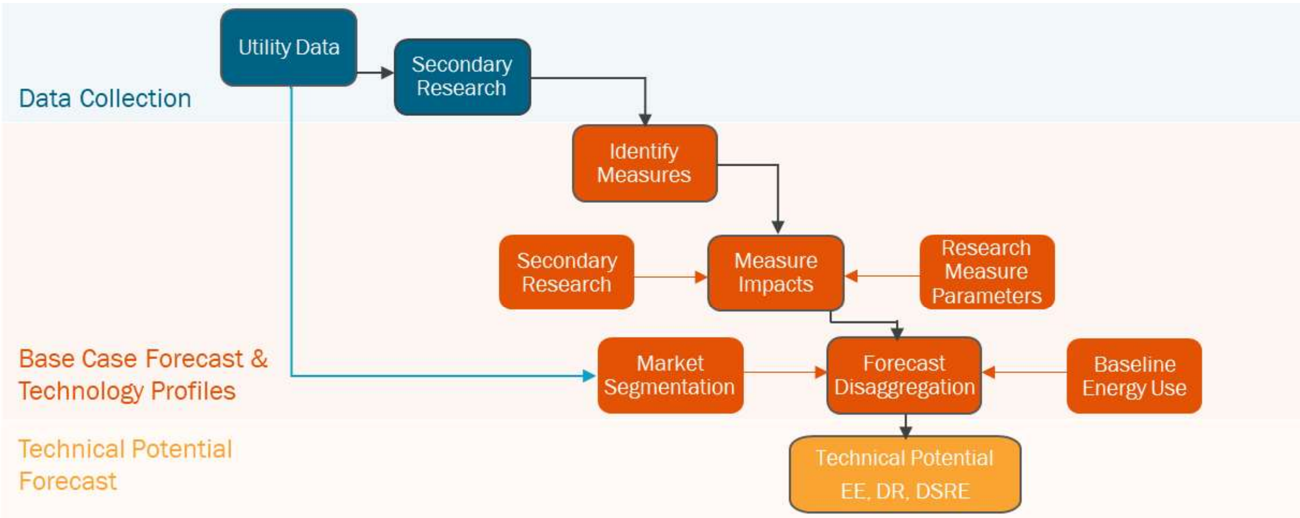
Quantifying DSM technical potential is the result of an analytical process that refines DSM opportunities that align with JEA's customers' electric consumption patterns. Resource Innovations' general methodology for estimating technical potential is a hybrid "top-

down/bottom-up" approach, which is described in detail in Sections 3 through 5 of this report and includes the following steps:

- Develop a baseline forecast: the study began with a disaggregation of the utility's official electric energy forecast to create a baseline electric energy forecast. This forecast does not include any utility-specific assumptions around DSM performance. Resource Innovations applied customer segmentation and consumption data from each utility and data from secondary sources to describe baseline customer-class and end-use components. Additional details on the forecast disaggregation are included in Section 3.
- Identify DSM opportunities: A comprehensive set of DSM opportunities applicable to JEA's climate and customers were analyzed to best depict DSM technical potential. Effects for a range of DSM technologies for each end-use could then be examined while accounting for current market saturations, technical feasibility, and impacts.
- Collect cost and impact data for measures: For those measures applicable to JEA's customers, Resource Innovations conducted primary and secondary research and estimated costs, energy savings, measure life, and demand savings. We differentiated between the type of cost (capital, installation labor, maintenance, etc.) to separately evaluate different implementation modes: retrofit (capital plus installation labor plus incremental maintenance); new construction (incremental capital and incremental maintenance); and burnout costs (incremental capital and incremental maintenance costs for replacement of appliances and equipment that has reached the end of its useful life). Additional details on measure development are included in Section 4.

Figure 1 provides an illustration of the technical potential modeling process conducted for JEA, with the assessment starting with the current utility load forecast, disaggregated into its constituent customer-class and end-use components, and calibrated to ensure consistency with the overall forecast. Resource Innovations considered the range of DSM measures and practices application to each end-use, accounting for current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the technology, end-use, customer class, and system levels.

Figure 1. Approach to Technical Potential Modeling



Resource Innovations estimated DSM technical potential based on a combination of market research, utility load forecasts and customer data, and measure impact analysis, all in coordination with JEA. Resource Innovations examined the technical potential for EE, DR, and DSRE opportunities; this report is organized to offer detail on each DSM category, with additional details on technical potential methodology presented in Section 5.

2.2 EE Potential Overview

To estimate EE potential, this study utilized Resource Innovations' modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual utility program savings, as described in Section 5.1.1 below. While the analysis estimates the impacts of individual EE measures, the model accounts for interactions and overlap of individual measure impacts within an end-use or equipment type. The model provides transparency into the assumptions and calculations for estimating EE potential.

2.3 DR Potential Overview

To estimate DR market potential, Resource Innovations considered customer demand during utility peaking conditions and projected customer response to DR measures. Customer demand was determined by looking at segment-level interval data for each customer segment. For each segment, Resource Innovations determined the portion of a customer's load that could be curtailed during the system peak.

2.4 DSRE Potential Overview

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from PV, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

3 Baseline Forecast Development

3.1 Market Characterization

The JEA base year energy use and sales forecast provided the reference point to determine potential savings. The end-use market characterization of the base year energy use and reference case forecast included customer segmentation and load forecast disaggregation. The characterization is described in this section, while the subsequent section addresses the measures and market potential energy and demand savings scenarios.

3.1.1 Customer Segmentation

In order to estimate EE, DR, and DSRE potential, the sales forecast and peak load forecasts were segmented by customer characteristics. As electricity consumption patterns vary by customer type, Resource Innovations segmented customers into homogenous groups to identify which customer groups are eligible to adopt specific DSM technologies, have similar building characteristics and load profiles, or are able to provide DSM grid services.

Resource Innovations segmented customers according to the following:

1) By Sector – how much of JEA's energy sales, summer and winter peak demand forecast is attributable to the residential, commercial, and industrial sectors?
2) By Customer – how much electricity does each customer typically consume annually and during system peaking conditions?
3) By End-Use – within a home or business, what equipment is using electricity during the system peak? How much energy does this end-use consume over the course of a year?

Table 4 summarizes the segmentation within each sector. In addition to the segmentation described here for the EE and DSRE analyses, the residential customer segments were further segmented by heating type (electric heat, gas heat, or unknown) and by annual consumption bins within each sub-segment for the DR analysis.

Table 4. Customer Segmentation

Residential	Commercial		Industrial	
Single Family	Assembly	Miscellaneous	Agriculture and Assembly	Primary Resources Industries
Multi-Family	College and University	Offices	Chemicals and Plastics	Stone/Glass/ Clay/Concrete
Manufactured Homes	Grocery	Restaurant	Construction	Textiles and Leather
	Healthcare	Retail	Electrical and Electronic Equipment	Transportation Equipment
	Hospitals	Schools K-12	Lumber/Furniture/ Pulp/Paper	Water and Wastewater
	Institutional	Warehouse	Metal Products and Machinery	Other
	Lodging/ Hospitality		Miscellaneous Manufacturing	

From an equipment and energy use perspective, each segment has variation within each building type or sub-sector. For example, the energy consuming equipment in a convenience store will vary significantly from the equipment found in a supermarket. To account for this variation, the selected end-uses describe energy consumption patterns that are consistent with those typically studied in national or regional surveys, such as the U.S. Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS), Commercial Building Energy Consumption Survey (CBECS) and Manufacturing Energy Consumption Survey (MECS), among others. The end-uses selected for this study are listed in Table 5.

Table 5. End-Uses

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Space heating[3]	Space heating[3]	Process heating
Space cooling[3]	Space cooling[3]	Process cooling
Domestic hot water	Domestic hot water	Compressed air
Ventilation and circulation	Ventilation and circulation	Motors/pumps

[3] Includes the contribution of building envelope measures and efficiencies.

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Lighting	Interior lighting	Fan, blower motors
Cooking	Exterior lighting	Process-specific
Appliances	Cooking	Industrial lighting
Electronics	Refrigeration	Exterior lighting
Miscellaneous	Office equipment	HVAC[3]
	Miscellaneous	Other

For DR, the end-uses targeted were those with controllable load for residential customers (i.e., HVAC, water heaters, pool pumps, and electric vehicles) and small C&I customers (HVAC and electric vehicles). For large C&I customers, all load during peak hours was included assuming these customers would potentially be willing to reduce electricity consumption for a limited time if offered a large enough incentive during temporary system peak demand conditions.

3.1.2 Forecast Disaggregation

A common understanding of the assumptions and granularity in the baseline load forecast was developed with input from JEA. Key discussion topics reviewed included:

- How current DSM offerings are reflected in the energy and demand forecast.
- Assumed weather conditions and hour(s) of the day when the system is projected to peak.
- Are there portions of the load forecast attributable to customers or equipment not eligible for DSM programs?
- How are projections of population increase, changes in appliance efficiency, and evolving distribution of end-use load shares accounted for in the peak demand forecast?

3.1.2.1 Electricity Consumption (kWh) Forecast

Resource Innovations segmented JEA's electricity consumption forecast into electricity consumption load shares by customer class and end-use. The baseline customer segmentation represents the electricity market by describing how electricity was consumed within the service territory. Resource Innovations developed the forecast for the year 2025, and based it on data provided by JEA, primarily their 2023 Ten-Year Site Plan, which was the most recent plan available at the time the studies were initiated. The data addressed current baseline consumption, system load, and sales forecasts.

3.1.2.2 Peak Demand (kW) Forecast

A fundamental component of DR potential was establishing a baseline forecast of what loads or operational requirements would be absent due to existing dispatchable DR or time varying rates. This baseline was necessary to assess how DR can assist in meeting specific planning and operational requirements. We utilized JEA's summer and winter peak demand forecast, which was developed for system planning purposes.

3.1.2.3 Estimating Consumption by End-Use Technology

As part of the forecast disaggregation, Resource Innovations developed a list of electricity end-uses by sector (Table 5). To develop this list, Resource Innovations began with JEA's estimates of average end-use consumption by customer and sector. Resource Innovations combined these data with other information, such as utility residential appliance saturation surveys, as available, to develop estimates of customers' baseline consumption. Resource Innovations calibrated the utility-provided data with data available from public sources, such as the EIA's recurring data-collection efforts that describe energy end-use consumption for the residential, commercial, and manufacturing sectors.

To develop estimates of end-use electricity consumption by customer segment and end-use, Resource Innovations applied estimates of end-use and equipment-type saturation to the average energy consumption for each sector. The following data sources and adjustments were used in developing the base year 2025 sales by end-use:

Residential Sector:

- The disaggregation was based on JEA's rate class load shares and intensities.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
  - JEA rate class load share is based on average per customer.
  - Resource Innovations made conversions to usage estimates generated by applying JEA's 2020 Appliance Saturation Study (APSS) report, EIA RECS data, residential end-use study data from other FEECA utilities, and EIA's Annual Energy Outlook (AEO) 2023.

Commercial Sector:

- The disaggregation was based on JEA's rate class load shares, intensities, and EIA CBECS data.
- Segment data from EIA and JEA.

- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - Rate class load share based on EIA CBECS and end-use forecasts from JEA.

Industrial Sector:

- The disaggregation was based on rate class load shares, intensities, and EIA MECS data.
- Segment data from EIA and JEA.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - Rate class load share based on EIA MECS and end-use forecasts from JEA.

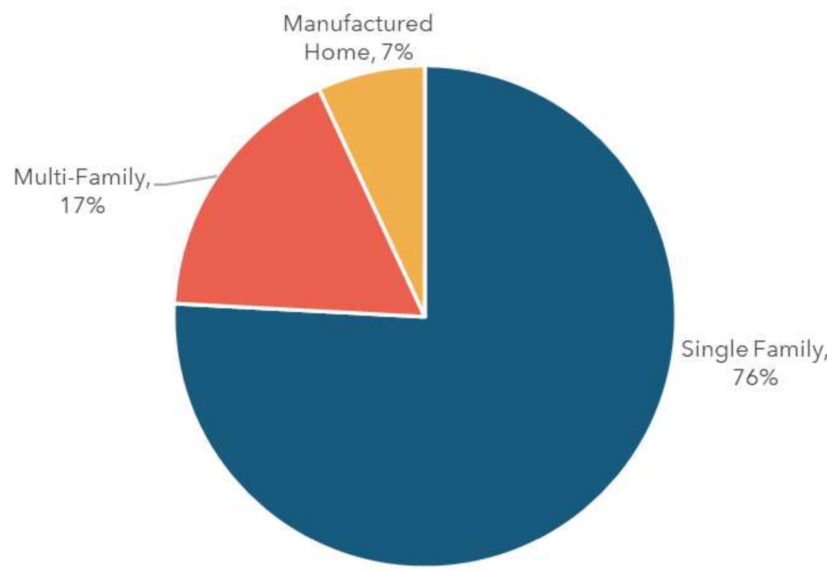
3.2 Analysis of Customer Segmentation

Customer segmentation is important to ensuring that a MPS examines DSM measure savings potential in a manner that reflects the diversity of energy savings opportunities existing across the utility's customer base. JEA provided Resource Innovations with data concerning the premise type and loads characteristics for all customers for the MPS analysis. Resource Innovations examined the provided data from multiple perspectives to identify customer segments. Resource Innovations' approach to segmentation varied slightly for non-residential and residential accounts, but the overall logic was consistent with the concept of expressing the accounts in terms that were relevant to DSM opportunities.

3.2.1 Residential Customers (EE, DR, and DSRE Analysis)

Segmentation of residential customer accounts enabled Resource Innovations to align DSM opportunities with appropriate DSM measures. Resource Innovations used utility customer data, supplemented with EIA data, to segment the residential sector by customer dwelling type (single family, multi-family, or manufactured home). The resulting distribution of customers according to dwelling unit type is presented in Figure 2.

Figure 2. Residential Customer Segmentation



3.2.2 Non-Residential (Commercial and Industrial) Customers (EE and DSRE Analysis)

For the EE and DSRE analysis, Resource Innovations segmented C&I accounts using the utility's North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes, supplemented by data produced by the EIA's CBECS and MECS. Resource Innovations classified the customers in this group as either commercial or industrial, on the basis of DSM measure information available and applicable to each. For example, agriculture and forestry DSM measures are commonly considered industrial savings opportunities. Resource Innovations based this classification on the types of DSM measures applicable by segment, rather than on the annual energy consumption or maximum instantaneous demand from the segment as a whole. The estimated energy sales distributions Resource Innovations applied are shown below in Figure 3 and Figure 4.

Figure 3. Commercial Customer Segmentation

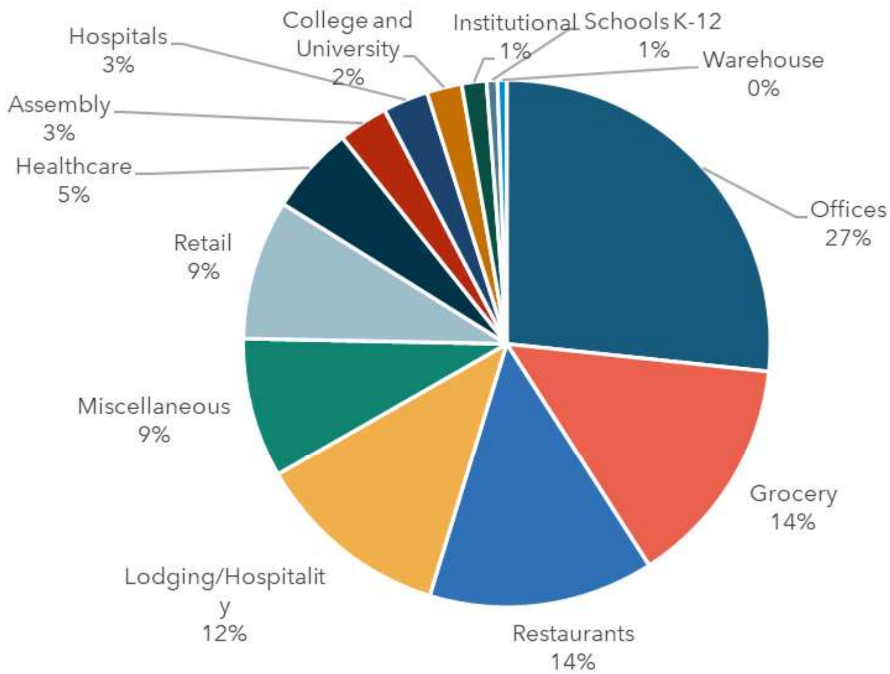
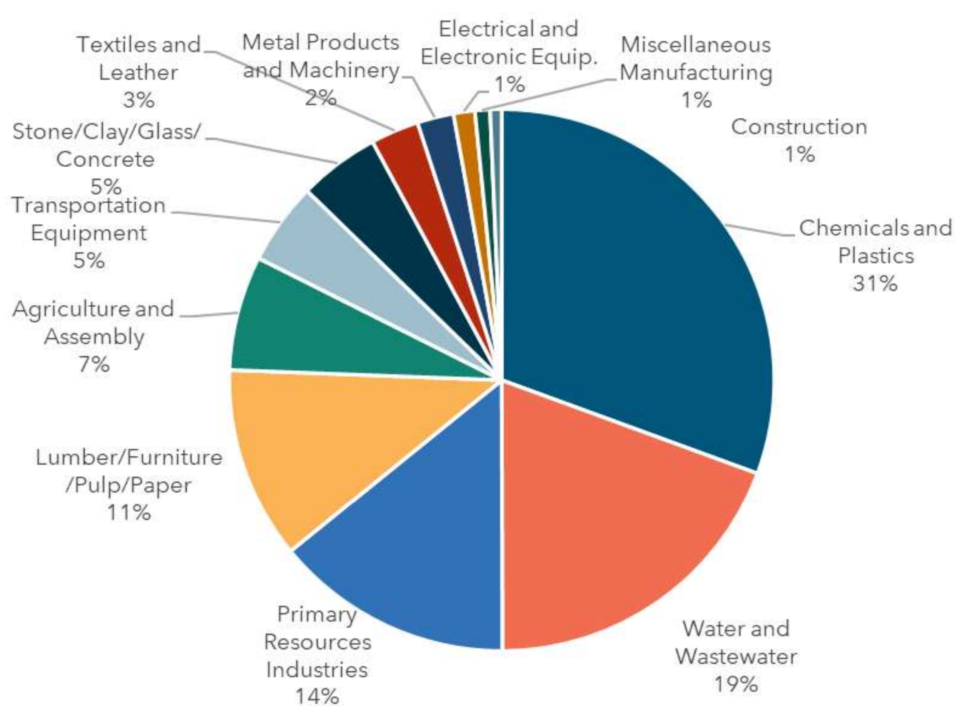


Figure 4. Industrial Customer Segmentation



3.2.3 Commercial and Industrial Accounts (DR Analysis)

For the DR analysis, Resource Innovations divided the non-residential customers into the two customer classes of small C&I and large C&I using rate class and annual consumption. For the purposes of this analysis, small C&I customers are those on the General Service (GS) tariff. Large C&I customers are all customers on the General Service Demand (GSD) tariff or on the General Service Large Demand (GSLD) tariff. Resource Innovations further segmented these two groups based on customer size. For small C&I, segmentation was determined using annual customer consumption and for large C&I the customer's maximum demand was used. Both customer maximum demand and customer annual consumption were calculated using billing data provided by JEA.

Table 6 shows the account breakout between small C&I and large C&I.

Table 6. Summary of Customer Classes for DR Analysis

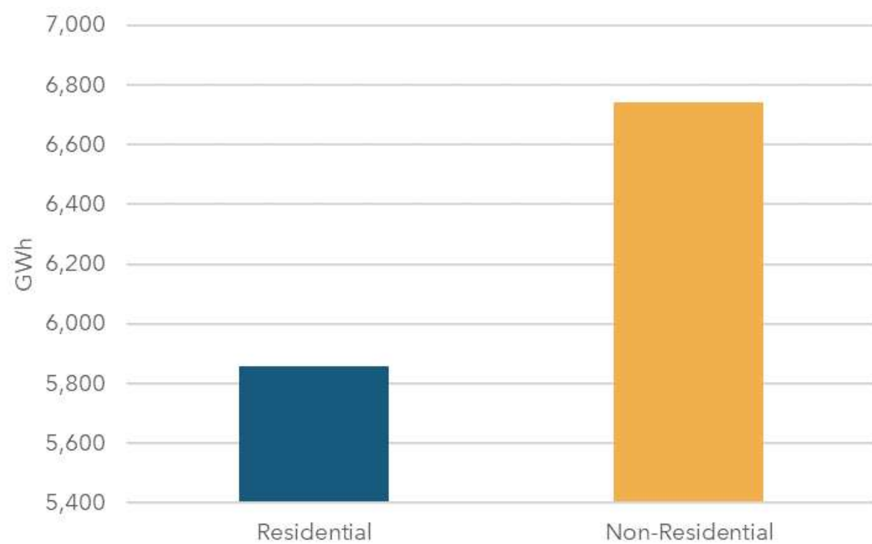
Customer Class	Annual kWh	Estimated Number of Accounts
Small C&I	0-15,000 kWh	32,188
	15,001-25,000 kWh	6,347
	25,001-50,000 kWh	1,131
	50,001 kWh +	13,802
	Total	53,468
Large C&I	0-50 kW	331
	51-300 kW	3,842
	301-500 kW	8
	501 kW +	153
	Total	4,334

3.3 Analysis of System Load

3.3.1 System Energy Sales

Technical potential is based on JEA's load forecast for the year 2025 from their 2023 Ten Year Site Plan, which is illustrated in Figure 5.

Figure 5. 2025 Electricity Sales Forecast by Sector



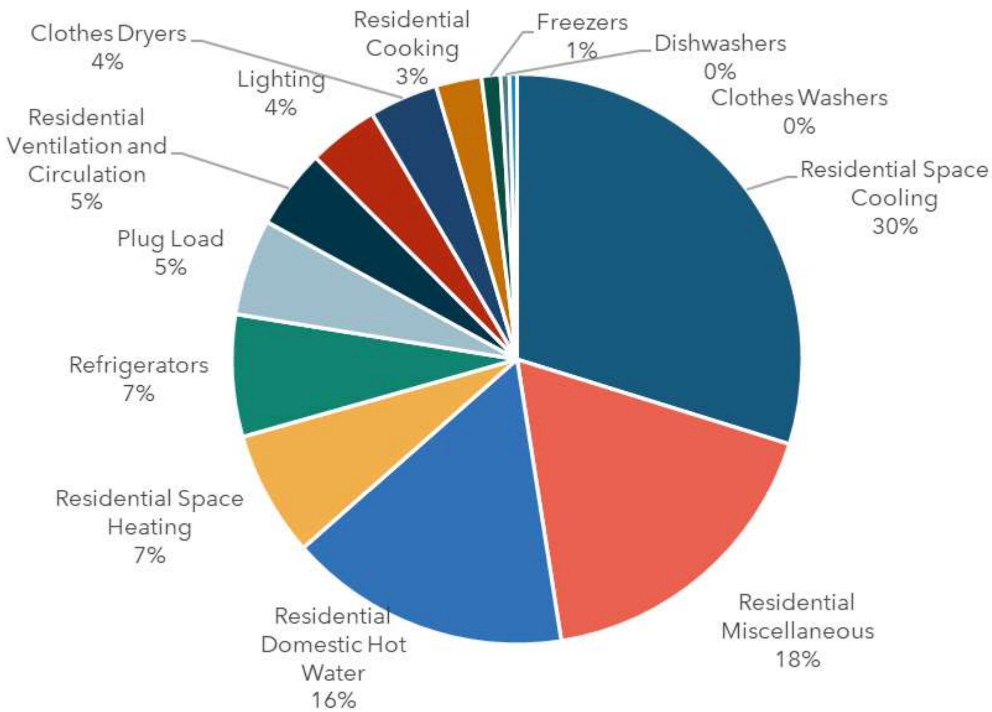
3.3.2 System Demand

To determine the technical potential for DR, Resource Innovations first established peaking conditions for each utility by looking at when each utility historically experienced its maximum demand. The primary data source used to determine when maximum DR impact was the historical system load for JEA. The data provided contained the system loads for all 8,760 hours of the most recent five years leading up to the study (2016-2021). The utility summer and winter peaks were then identified within the utility-defined peaking conditions. For JEA the summer peaking conditions were defined as August from 4:00-5:00 PM and the winter peaking conditions were defined as January from 7:00-8:00 AM. The seasonal peaks were then selected as the maximum demand during utility peaking conditions.

3.3.3 Load Disaggregation

The disaggregated annual electric loads[4] for the base year 2025 by sector and end-use are summarized in Figure 6, Figure 7, and Figure 8.

Figure 6. Residential Baseline (2025) Energy Sales by End-Use



[4] Full disaggregation of system demand by end-use was not conducted, as DR potential for residential and small C&I customers focused on specific end-uses of particular interest because of their large contribution to peak period system load, and was not end-use specific for large C&I customers. A description of the end-use analysis for residential and small C&I customers is included in Section 5.1.2

Figure 7. Commercial Baseline (2025) Energy Sales by End-Use

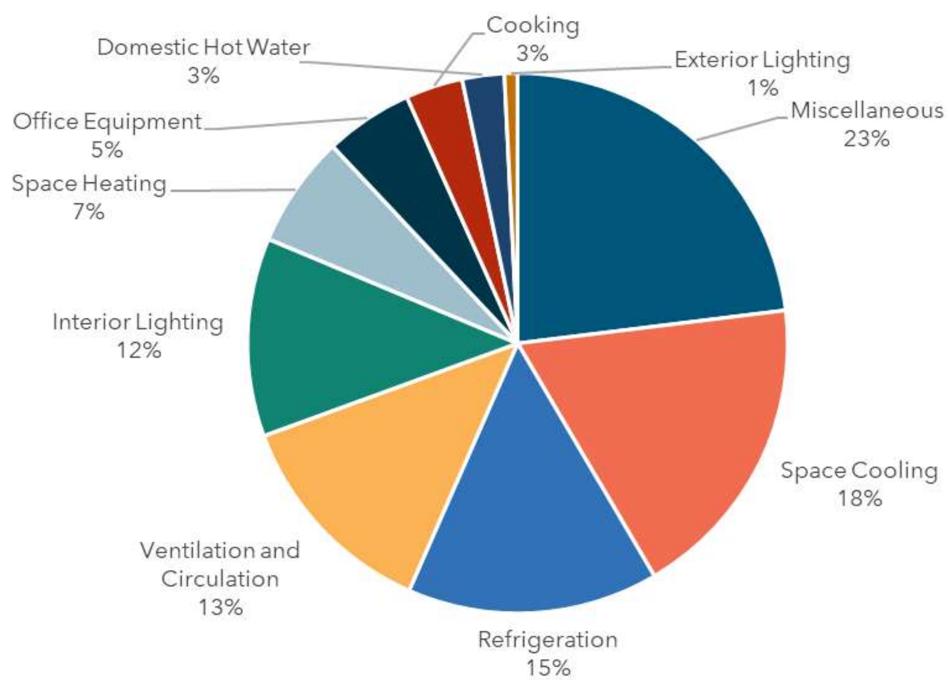
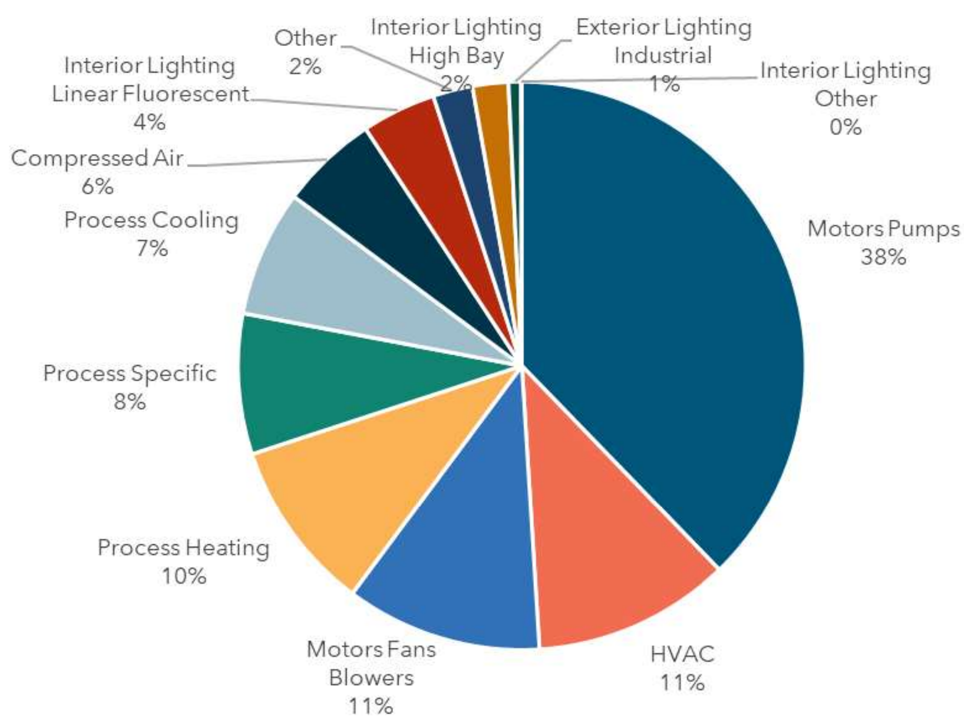


Figure 8. Industrial Baseline (2025) Energy Sales by End-Use



4 DSM Measure Development

DSM potential is described by comparing baseline market consumption with opportunities for savings. Describing these individual savings opportunities results in a list of DSM measures to analyze. This section presents the methodology to develop the EE, DR, and DSRE measure lists.

4.1 Methodology

Resource Innovations identified a comprehensive catalog of DSM measures for the study. The measure list is the same for all FEECA Utilities. The iterative vetting process with the utilities to develop the measure list began by initially examining the list of measures included in the 2019 Goals docket. This list was then adjusted based on proposed measure additions and revisions provided by the FEECA Utilities. Resource Innovations further refined the measure list based on reviews of Resource Innovations' DSM measure library, compiled from similar market potential studies conducted in recent years throughout the United States, as well as measures included in other utility programs where Resource Innovations is involved with program design, implementation, or evaluation. The FEECA Utilities also reached out to interested parties and received input with recommendations on measure additions to the 2019 measure list. Their measure suggestions were reviewed and incorporated into the study as appropriate. External measure suggestions and actions are summarized in Appendix D. The extensive, iterative review process involving multiple parties has ensured that the study included a robust and comprehensive set of DSM measures.

See Appendix A for the list of EE measures, Appendix B for the list of DR measures, and Appendix C for the list of DSRE measures analyzed in the study.

4.2 EE Measures

EE measures represent technologies applicable to the residential, commercial, and industrial customers in the FEECA Utilities' service territories. The development of EE measures included consideration of:

- EE technologies that are applicable to Florida and commercially available: Measures that are not applicable due to climate or customer characteristics were excluded, as were "emerging" technologies that are not currently commercially available to FEECA utility customers.
- Current and planned Florida Building Codes and Federal equipment standards (Codes & Standards) for baseline equipment: Measures included from prior studies

were adjusted to reflect current Codes & Standards as well as updated efficiency tiers, as appropriate.

- Eligibility for utility DSM offerings in Florida: For example, behavioral measures were excluded from consideration, as they historically have not been allowed to count towards utility DSM goals. Behavioral measures are intended to motivate customers to operate in a more energy-efficient manner (e.g., setting an air-conditioner thermostat to a higher temperature) without accompanying: a) physical changes to more efficient end-use equipment or to their building envelope, b) utility-provided products and tools to facilitate the efficiency improvements, or c) permanent operational changes that improve efficiency which are not easily revertible to prior conditions. These types of behavioral measures were excluded because of the variability in forecasting the magnitude and persistence of energy and demand savings from the utility's perspective. Additionally, decoupling behavioral measure savings from the installation of certain EE technologies like smart thermostats can be challenging and could result in overlapping potential with other EE measures included in the study.

Upon development of the final EE measure list, utility-specific measure details were developed. RI maintains a proprietary online database of energy efficiency measures for MPS studies, which was used as a starting point for measure development for this study. Measures are added or updated at the request of project stakeholders or because of changes to the EE marketplace (for example, new codes and standards, or current practice in the market). Measure data are refined as new data or algorithms are developed for estimating measure impacts, and updated for each study to incorporate inputs parameters specific to the service territory being analyzed. The database contains the following information for each of the measures:

- Measure description: measure classification by type, end-use, and subsector, and description of the base-case and the efficient-case scenarios.
- kWh savings: Energy savings associated with each measure were developed through engineering algorithms or building simulation modeling, taking climate data and customer segments into consideration as appropriate. Reference sources used for developing residential, commercial, and industrial measure savings included a variety of Florida-specific, as well as regional and national sources, such as utility-specific measurement & verification (M&V) data, technical reference manuals (TRM) from other jurisdictions, ENERGY STAR calculators, and manufacturer or retailer specifications for particular products.
- Energy savings were applied in RI's TEA-POT model as a percentage of total baseline consumption. Peak demand savings were determined using utility-specific load shapes or coincidence factors.

- Measure Expected Useful Lifetime: Sources included the Database for Energy Efficient Resources (DEER), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, TRMs, and other regional and national measure databases and EE program evaluations.
- Measure Costs: Per-unit costs (full or incremental, depending on the application) associated with measure installations. Sources included: TRMs, ENERGY STAR calculator, online market research, FEECA utility program data, and other secondary sources.

The measure details from the online measure library are exported for use in RI's TEA-POT model, accompanied by utility-specific estimates of measure applicability. Measure applicability is a general term encompassing an array of factors, including technical feasibility of installation, and the measure's current saturation as well as factors to allocate savings associated with competing measures. Information used was primarily derived from data in current regional and national databases, as well as JEA's program tracking data. These factors are described in Table 7.

Table 7. Measure Applicability Factors

Measure Impact	Explanation	Sources
Technical Feasibility	The percentage of buildings that can have the measure physically installed. Various factors may affect this, including, but not limited to, whether the building already has the baseline measure (e.g., dishwasher), and limitations on installation (e.g., size of unit and space available to install the unit).	Various secondary sources and engineering experience.
Measure Incomplete Factor	The percentage of buildings without the specific measure currently installed.	Utility RASS; EIA RECS, CBECS; MECS; ENERGY STAR sales figures; and engineering experience.
Measure Share	Used to distribute the percentage of market shares for competing measures (e.g., only blown-in ceiling insulation or spray foam insulation, not both would be installed in an attic).	Utility customer data, Various secondary sources and engineering experience.

As shown in Table 8, the measure list includes 395 unique energy-efficiency measures. Expanding the measures to account for all appropriate installation scenarios resulted in

9,535 measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (i.e., a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed).

Table 8. EE Measure Counts by Sector

Sector	Unique Measures	Permutations
Residential	119	1,173
Commercial	164	5,798
Industrial	112	2,564

4.3 DR Measures

The DR measures included in the measure list utilize the following DR strategies:

- **Direct Load Control.** Utility control of selected equipment at the customer's home or business, such as HVAC or water heaters.
- **Critical Peak Pricing (CPP) with Technology.** Electricity rate structures that vary based on time of day. Includes CPP when the rate is substantially higher for a limited number of hours or days per year (customers receive advance notification of CPP event) coupled with technology that enables customer to lower their usage in a specific end-use in response to the event (e.g., HVAC via smart thermostat).
- **Contractual DR.** Customers receive incentive payments or a rate discount for committing to reduce load by a pre-determined amount or to a pre-determined firm service level upon utility request.
- **Automated DR.** Utility dispatched control of specific end-uses at a customer facility.

DR initiatives that do not rely on the installation of a specific device or technology to implement (such as a voluntary curtailment program or time of use rates) were not included.

A workbook was developed for each measure which included the same measure inputs as previously described for the EE measures. In addition, the DR workbook included expected load reduction from the measure, based on utility technical potential, existing utility DR programs, and other nationwide DR programs if needed.

For technical potential, Resource Innovations did not break out results by specific measure or control technology because all of the developed measures target the end-uses estimated

for technical potential (i.e., potential is reported for space cooling end-use and not allocated to switches, smart thermostats, etc.).

4.4 DSRE Measures

The DSRE measure list includes rooftop PV systems, battery storage systems charged from PV systems, and CHP systems.

PV Systems

PV systems utilize solar panels (a packaged collection of PV cells) to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter, a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted systems that face south-west, south, and/or, south-east. The potential associated with roof-mounted systems installed on residential and commercial buildings was analyzed.

Battery Storage Systems Charged from PV Systems

Distributed battery storage systems included in this study consist of behind-the-meter battery systems installed in conjunction with an appropriately-sized PV system at residential and commercial customer facilities. These battery systems typically consist of a DC-charged battery, a DC/AC inverter, and electrical system interconnections to a PV system. On their own battery storage systems do not generate or conserve energy, but can collect and store excess PV generation to provide power during particular time periods, which for DSM purposes would be to offset customer demand during the utility's system peak.

CHP Systems

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide other on-site needs. Common prime mover technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Internal combustion engines

A workbook was developed for each measure which included the inputs previously described for EE measures and prime mover operating parameters.

5 Technical Potential

In the previous sections, the approach for DSM measure development was summarized, and the 2025 base year load shares and reference-case load forecast were described. The outputs from these tasks provided the input for estimating the technical potential scenario, which is discussed in this section.

The technical potential scenario estimates the potential energy and demand savings when all technically feasible and commercially available DSM measures are implemented without regard for cost-effectiveness and customer willingness to adopt the most impactful EE, DR, or DSRE technologies. Since the technical potential does not consider the costs or time required to achieve these savings, the estimates provide a theoretical upper limit on electricity savings potential. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. For this study, technical potential included full application of the commercially available DSM measures to all residential, commercial, and industrial customers in the utility's service territory.

5.1 Methodology

5.1.1 EE Technical Potential

EE technical potential refers to delivering less electricity to the same end-uses. In other words, technical potential might be summarized as "doing the same thing with less energy, regardless of the cost."

DSM measures were applied to the disaggregated utility electricity sales forecasts to estimate technical potential. This involved applying estimated energy savings from equipment and non-equipment measures to all electricity end-uses and customers. Technical potential consists of the total energy and demand that can be saved in the market which Resource Innovations reported as single numerical values for each utility's service territory.

The core equation used in the residential sector EE technical potential analysis for each individual efficiency measure is shown in Equation 1 below, while the core equation used in the nonresidential sector technical potential analysis for each individual efficiency measure is shown in Equation 2.

Equation 1: Core Equation for Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Number of Households × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Baseline Equipment Energy Use Intensity** = the electricity used per customer per year by each baseline technology in each market segment. In other words, the baseline equipment energy-use intensity is the consumption of the electrical energy using equipment that the efficient technology replaces or affects.
- **Saturation Share** = the fraction of the end-use electrical energy that is applicable for the efficient technology in a given market segment. For example, for residential cooling, the saturation share would be the fraction of all residential electric customers that have central air conditioners in their household.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of central air conditioners that is not already energy efficient.
- **Feasibility Factor** = the fraction of units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (i.e., it may not be possible to install LEDs in all light sockets in a home because the available styles may not fit in every socket).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

Equation 2: Core Equation for Non-Residential Sector EE Technical Potential

Technical Potential of Efficient Measures = Total Stock Sq. Footage by Building Type by EDC × Base Case Equipment Energy Use Intensity (kWh/unit) × Saturation Shares × Percent Incomplete × Feasibility Factor × Savings Factor

Where:

- **Total Stock Square Footage by Segment** = the forecasted square footage level for a given building type (e.g., square feet of office buildings).
- **Baseline Equipment Energy Use Intensity** = the electricity used per square foot per year by each baseline equipment type in each market segment.

- **Saturation Shares** = the fraction of total end-use energy consumption associated with the efficient technology in a given market segment. For example, for packaged terminal air-conditioner (PTAC), the saturation share would be the fraction of all space cooling kWh in a given market segment that is associated with PTAC equipment.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient.
- **Feasibility Factor** = the fraction of the equipment or practice that is technically feasible for conversion to the efficient technology from an engineering perspective (i.e., it may not be possible to install Variable Frequency Drives (VFD) on all motors in a given market segment).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

It is important to note that the technical potential estimate represents electricity savings potential at a specific point in time. In other words, the technical potential estimate is based on data describing status quo customer electricity use and technologies known to exist today. As technology and electricity consumption patterns evolve over time, the baseline electricity consumption will also change accordingly. For this reason, technical potential is a discrete estimate of a dynamic market. Resource Innovations reported the technical potential for 2025, based on currently known DSM measures and observed electricity consumption patterns.

Measure Interaction and Competition (Overlap)

While the technical potential equations listed above focus on the technical potential of a single measure or technology, Resource Innovations' modeling approach does recognize the overlap of individual measure impacts within an end-use or equipment type, and accounts for the following interactive effects:

- Measure interaction: Installing high-efficiency equipment could reduce energy savings in absolute terms (kWh) associated with non-equipment measures that impact the same end-use. For example, installing a high-efficiency heat pump will reduce heating and cooling consumption which will reduce the baseline against which attic insulation would be applied, thus reducing savings associated with installing insulation. To account for this interaction, Resource Innovations' TEA-POT model ranks measures that interact with one another and reduces the baseline consumption for the subsequent measure based on the savings achieved by the preceding measure. For technical potential, interactive measures are ranked based on total end-use energy savings percentage.
- Measure competition (overlap): The "measure share"—as defined above—accounted for competing measures, ensuring savings were not double-counted. This interaction

occurred when two or more measures "competed" for the same end-use. For example, a T-12 lamp could be replaced with a T-8 or linear LED lamp.

Addressing Naturally-Occurring EE

Naturally occurring energy efficiency includes actions taken by customers to improve the efficiency of their homes and businesses in the absence of utility program intervention. For the analysis of technical potential, Resource Innovations verified with JEA's forecasting group that the baseline sales forecasts incorporated two known sources of naturally-occurring efficiency:

- Codes and Standards: The sales forecasts already incorporated the impacts of known Code & standards changes.
- Baseline Measure Adoption: The sales forecast excluded the projected impacts of future DSM efforts but included already implemented DSM penetration.

By properly accounting for these factors, the technical potential analysis estimated the additional EE opportunities beyond what is already included in the utility sales forecast.

5.1.2 DR Technical Potential

The concept of technical potential applies differently to DR than for EE. Technical potential for DR is effectively the magnitude of loads that can be curtailed during conditions when utilities need peak capacity reductions. In evaluating this potential at peak capacity, the following were considered: which customers are consuming electricity at those times? What end-uses are in play? Can those end-use loads be managed? Large C&I accounts generally do not provide the utility with direct control over particular end-uses. Instead, many of these customers will forego electric demand temporarily if the financial incentive is large enough. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale.

This framework makes end-use disaggregation an important element for understanding DR potential, particularly in the residential and small C&I sectors. When done properly, end-use disaggregation not only provides insights into which loads are on and off when specific grid services are needed, it also provides insight concerning how key loads and end-uses, such as air conditioning use, vary across customers. Resource Innovations' approach used for load disaggregation is more advanced than what is used for most potential studies. Instead of disaggregating annual consumption or peak demand, Resource Innovations produced end-use load disaggregation for all 8,760 hours. This was needed because the loads available at times when different grid applications are needed can vary substantially. Instead

of producing disaggregated loads for the average customer, the study was produced for several customer segments. For JEA, Resource Innovations examined three residential segments based on customer housing type, four different small C&I segments based on customer size, and four different large C&I segments based on customer size, for a total of 11 different customer segments.

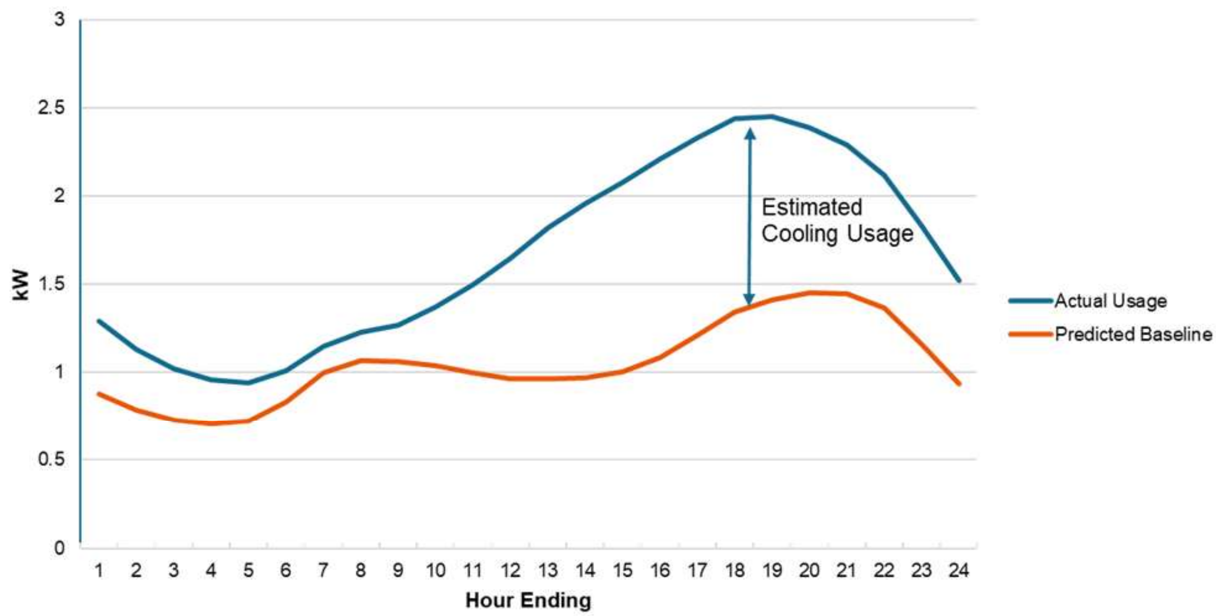
Technical potential, in the context of DR, is defined as the total amount of load available for reduction that is coincident with the period of interest; in this case, the system peak hour for the summer and winter seasons. Thus, two sets of capacity values are estimated: a summer capacity and a winter capacity.

As previously mentioned, for technical potential purposes, all coincident large C&I load is considered dispatchable, while residential and small C&I DR capacity is based on specific end-uses. Summer DR capacity for residential customers was comprised of air-conditioning (AC), pool pumps, water heaters, and managed electric vehicle charging. For small C&I customers, summer capacity was based on AC load. For winter DR capacity, residential was based on electric heating, pool pumps, and water heaters. For small C&I customers, winter capacity was based on electric heating.

AC and heating load profiles were generated for residential and small C&I customers using a segment-level interval data provided by JEA. Resource Innovations then used the interval data to create an average load profile for each customer segment.

The average load profile for each customer segment was combined with historical weather data, and used to estimate hourly load as a function of weather conditions. AC and heating loads were estimated by first calculating the baseline load on days when cooling degree days (CDD) and heating degree days (HDD) were equal to zero, and then subtracting this baseline load. This methodology is illustrated by Figure 9 (a similar methodology was used to predict heating loads).

Figure 9: Methodology for Estimating Cooling Loads



This method was able to produce estimates for average AC/heating load profiles for the different customer segments within the residential and small C&I sectors.

Profiles for residential water heater and pool pump loads were estimated by utilizing end-use load data from NREL's residential end-use load profile database.

For all eligible loads, the technical potential was defined as the amount that was coincident with system peak hours for each season, which are August from 4:00-5:00 PM for summer, and January from 7:00-8:00 AM for winter. As mentioned in Section 4, for technical potential there was also no measure breakout needed, because all measures will target the end-uses' estimated total loads.

5.1.3 DSRE Technical Potential

5.1.3.1 PV Systems

To determine technical potential for PV systems, RI estimated the percentage of rooftop square footage in Florida that is suitable for hosting PV technology. Our estimate of technical potential for PV systems in this report is based in part on the available roof area and consisted of the following steps:

- Step 1: Outcomes from the forecast disaggregation analysis were used to characterize the existing and new residential, commercial and industrial building stocks.
    - To calculate the total roof area for residential buildings, the average roof area per household is multiplied by the number of households.
    - For commercial and industrial buildings, RI calculated the total roof area by first dividing the load forecast by the energy usage intensity, which provides an estimate of the total building square footage. This result is then divided by the average number of floors to derive the total roof area.
- Step 2: The total available roof area feasible for installing PV systems was calculated. Relevant parameters included unusable area due to other rooftop equipment and setback requirements, in addition to possible shading from trees and limitations of roof orientation (factored into a "technical suitability" multiplier).
- Step 3: Estimated the expected power density (kW per square foot of roof area).
- Step 4: Estimated the hourly PV generation profile using NREL's PV Watts Calculator
- Step 5: Calculated total energy and coincident peak demand potential by applying RI's Spatial Penetration and Integration of Distributed Energy Resources (SPIDER) Model.

The methodology presented in this report uses the following formula to estimate overall technical potential of PVs:

Equation 3: Core Equation for Solar DSRE Technical Energy Potential

$$\text{PV Technical Energy Potential} = \text{Suitable Rooftop PV Area (Sq Ft)} \times \text{PV Power Density (kW-DC/Sq Ft)} \times \text{Generation Factor (kWh/kW-DC)}$$

Where:

- **Suitable Rooftop PV Area for Residential [Square Feet]:** Number of Residential Buildings x Average Roof Area Per Building x Technical Suitability Factor
- **Suitable Rooftop PV Area for Commercial [Square Feet] :** Energy Consumption [kWh] / Energy Intensity [kWh / Square Feet] / Average No. of Stories Per Building x Technical Suitability Factor
- **PV Power Density [kW-DC/Square Feet]:** Maximum power generated in Watts per square foot of solar panel.
- **Generation Factor:** Annual Energy Generation Factor for PV, from PV Watts (dependent on local solar irradiance)

5.1.3.2 Battery Storage Systems Charged from PV Systems

Battery storage systems on their own do not generate power or create efficiency improvements, but store power for use at different times. Therefore, in analyzing the technical potential for battery storage systems, the source of the stored power and overlap with technical potential identified in other categories was considered.

Battery storage systems that are powered directly from the grid do not produce annual energy savings but may be used to shift or curtail load during particular time periods. As the DR technical potential analyzes curtailment opportunities for the summer and winter peak period, and battery storage systems can be used as a DR technology, the study concluded that no additional technical potential should be claimed for grid-powered battery systems beyond that already attributed to DR.

Battery storage systems that are connected to on-site PV systems also do not produce additional energy savings beyond the energy produced from the PV system[5]. However, PV-connected battery systems do create the opportunity to store energy during period when the PV system is generating more than the home or business is consuming and use that stored power during utility system peak periods.

To determine the additional technical potential peak demand savings for "solar plus storage" systems, our methodology consisted of the following steps:

- Assume that every PV system included in PV Technical Potential is installed with a paired storage system.
- Size the storage system assuming peak storage power is equal to peak PV generation and energy storage duration is three hours.
- Apply RI's hourly dispatch optimization module in SPIDER to create an hourly storage dispatch profile that flattens the individual customer's load profile to the greatest extent possible accounting for a) customer hourly load profile, b) hourly PV generation profile, and c) battery peak demand, energy capacity, and roundtrip charge/discharge efficiency.
- Calculate the effective hourly impact for the utility using the above storage dispatch profile, aligned with the utility's peak hour (calculated separately for summer and winter)
- Report the output storage kW impact on utility coincident peak demand in summer and winter.

[5] PV-connected battery systems experience some efficiency loss due to storage, charging, and discharging. However, for this study, these losses were not quantified.

5.1.3.3 CHP Systems

The CHP analysis created a series of unique distributed generation potential models for each primary market sector (commercial and industrial).

Only non-residential customer segments whose electric and thermal load profiles allow for the application of CHP were considered. The technical potential analysis followed a three-step process. First, minimum facilities size thresholds were determined for each non-residential customer segment. Next, the full population of non-residential customers were segmented and screened based on the size threshold established for that segment. Finally, the facilities that were of sufficient size were matched with the appropriately sized CHP technology.

To determine the minimum threshold for CHP suitability, a thermal factor was applied to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load in order to achieve improved efficiencies.

The study collected electric and thermal intensity data from other recent CHP studies. For industrial customers, Resource Innovations assumed that the thermal load would primarily be used for process operations and was not modified from the secondary data sources for Florida climate conditions. For commercial customers, the thermal load is more commonly made up of water heating, space heating, and space cooling (through the use of an absorption chiller). Therefore, to account for the hot and humid climate in Florida, which traditionally limits weather-dependent internal heating loads, commercial customers' thermal loads were adjusted to incorporate a higher proportion of space cooling to space heating as available opportunities for waste heat recovery.

Resource Innovations worked with the utility-provided customer data, focusing on annual consumption due to the absence of NAICS or SIC codes for this utility data. Non-residential customers were subsequently classified based on annual consumption and size. Since NAICS or SIC codes were unavailable, no formal segmentation occurred. Instead, the analysis focused exclusively on annual utility usage. Facilities with annual loads below the kWh thresholds were deemed unlikely to possess the consistent electric and thermal loads necessary to support CHP and were consequently excluded from consideration. Conversely, those meeting the size criteria were aligned with the corresponding CHP technology.

In general, internal combustion engines are the prime mover for systems under 500kW with gas turbines becoming progressively more popular as system size increases above that. Based on the available load by customer, adjusted by the estimated thermal factor for each

segment, CHP technologies were assigned to utility customers in a top-down fashion (i.e., starting with the largest CHP generators).

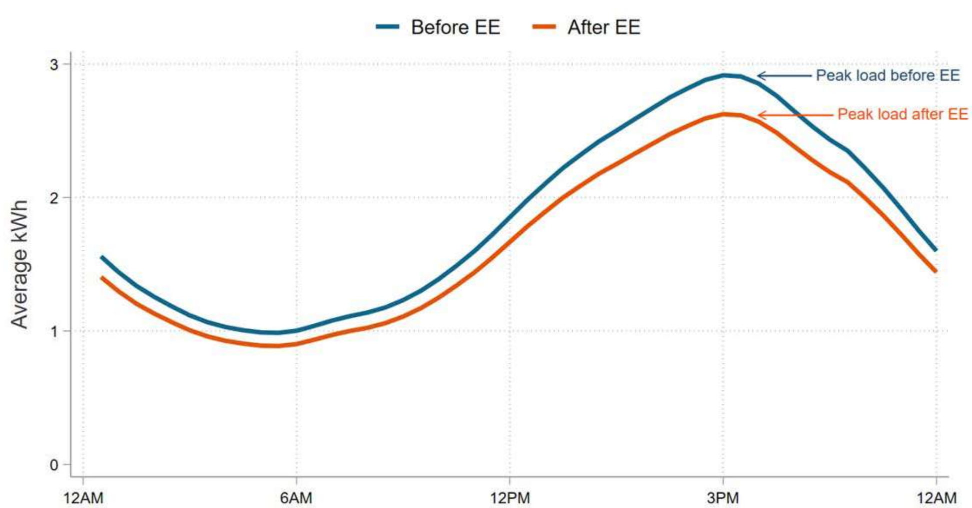
Measure Interaction

PV systems and battery storage charged from PV systems were analyzed collectively due to their common power generation source; and therefore, the identified technical potential for these systems is additive. However, CHP systems were independently analyzed for technical potential without consideration of the competition between DSRE technologies or customer preference for a particular DSRE system. Therefore, results for CHP technical potential should not be combined with PV systems or battery storage systems for overall DSRE potential but used as independent estimates.

5.1.4 Interaction of Technical Potential Impacts

As described above, the technical potential was estimated using separate models for EE, DR, and DSRE systems. However, there is interaction between these technologies; for example, a more efficient HVAC system would result in a reduced peak demand available for DR curtailment, as illustrated in Figure 10.

Figure 10: Illustration of EE Impacts on HVAC System Load Shape



Therefore, after development of the independent models, the interaction between EE, DR, and DSRE was incorporated as follows:

- The EE technical potential was assumed to be implemented first, followed by DR technical potential and DSRE technical potential.

- To account for the impact of EE technical potential on DR, the baseline load forecast for the applicable end-uses was adjusted by the EE technical potential, resulting in a reduction in baseline load available for curtailment.
- For DSRE systems, the EE and DR technical potential was incorporated in a similar fashion, adjusting the baseline load used to estimate DSRE potential.
  - For the PV analysis, this did not impact the results as the EE and DR technical potential did not affect the amount of PV that could be installed on available rooftops.
  - For the battery storage charged from PV systems, the reduced baseline load from EE resulted in additional PV-generated energy being available for the battery systems and for use during peak periods. The impact of DR events during the assumed curtailment hours was incorporated into the modeling of available battery storage and discharge loads.
- For CHP systems, the reduced baseline load from EE resulted in a reduction in the number of facilities that met the annual energy threshold needed for CHP installations. Installed DR capacity was assumed to not impact CHP potential as the CHP system feasibility was determined based on energy and thermal consumption at the facility. It should be noted that CHP systems not connected to the grid could impact the amount of load available for curtailment with utility-sponsored DR. Therefore, CHP technical potential should not be combined with DR potential but used as independent estimates.

5.2 EE Technical Potential

5.2.1 Summary

Table 9 summarizes the EE technical potential by sector:

Table 9. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	517	297	1,887
Non-Residential[6]	280	251	1,690
Total	797	548	3,577

[6] Non-Residential results include all commercial and industrial customer segments.

5.2.2 Residential

Figure 11, Figure 12, and Figure 13 summarize the residential sector EE technical potential by end-use.

Figure 11: Residential EE Technical Potential by End-Use (Summer Peak Savings)

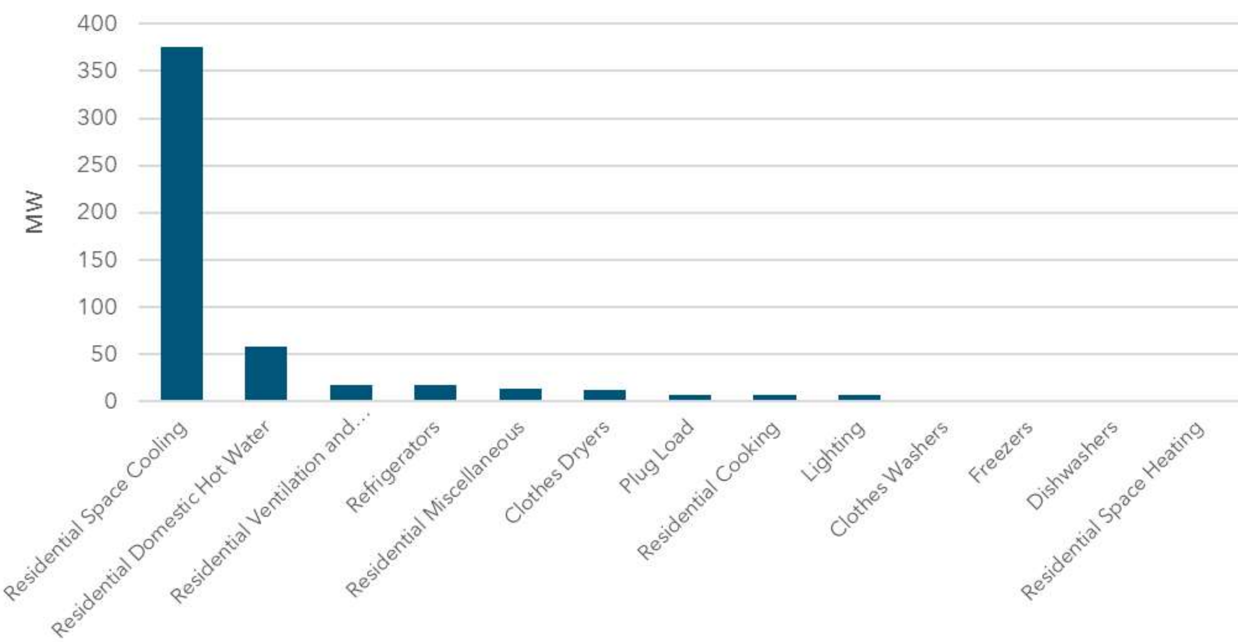


Figure 12: Residential EE Technical Potential by End-Use (Winter Peak Savings)

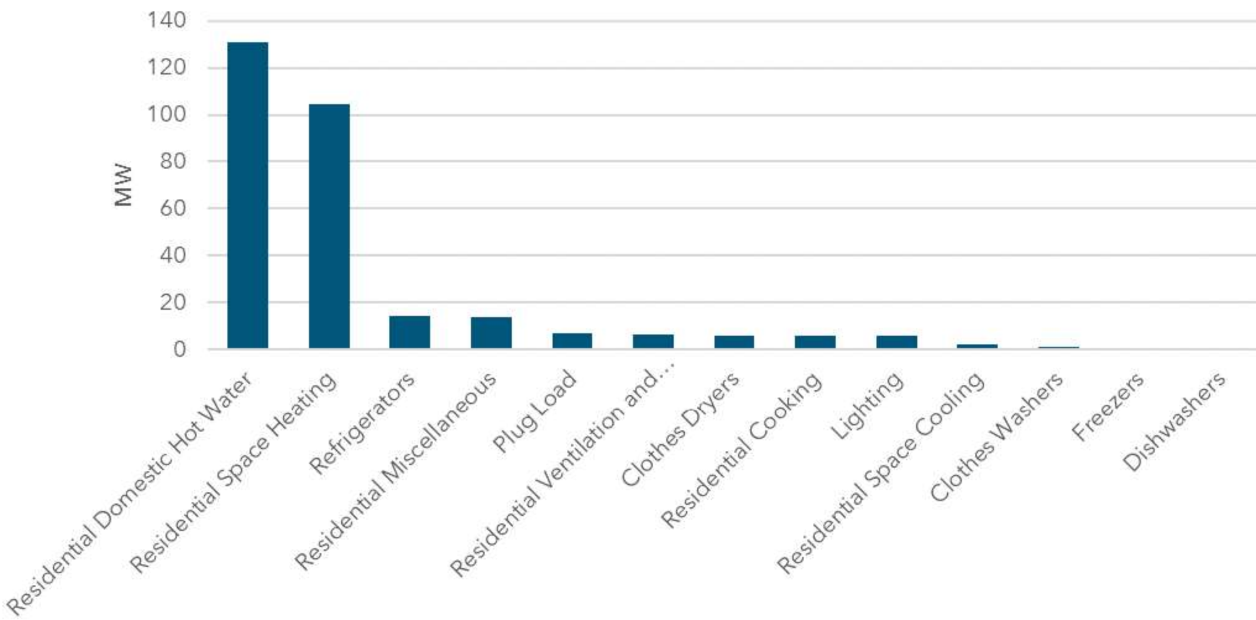
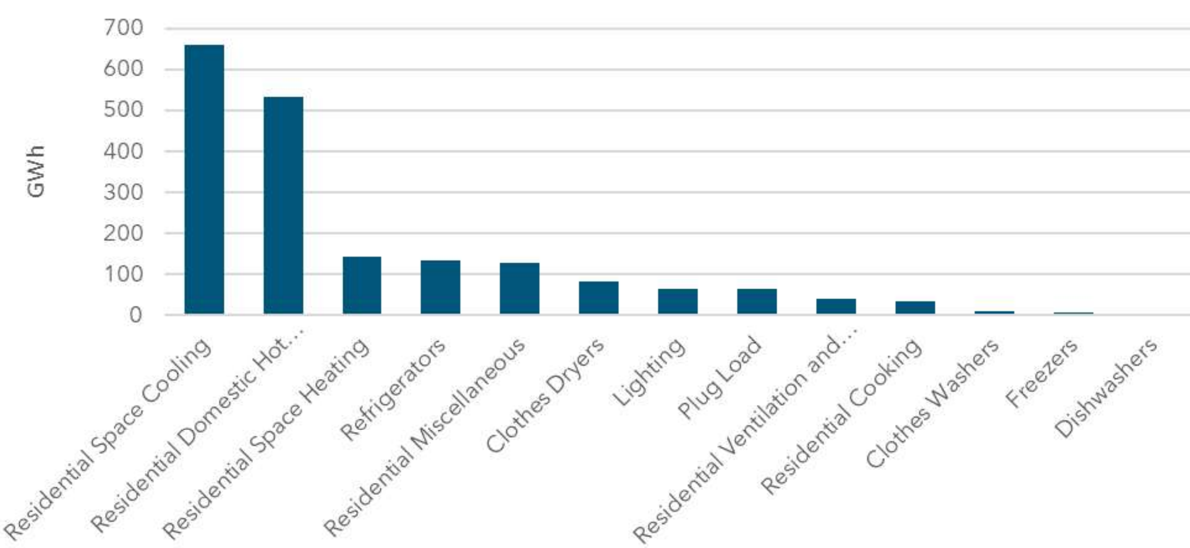


Figure 13: Residential EE Technical Potential by End-Use (Energy Savings)



5.2.3 Non-Residential

5.2.3.1 Commercial Segments

Figure 14, Figure 15, and Figure 16 summarize the commercial sector EE technical potential by end-use.

Figure 14: Commercial EE Technical Potential by End-Use (Summer Peak Savings)

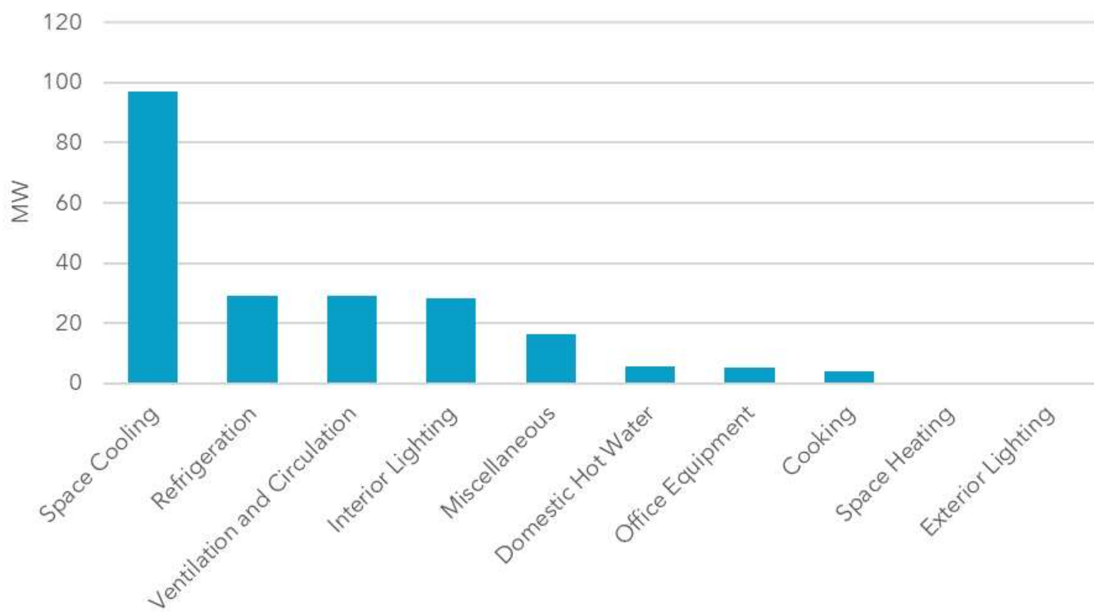


Figure 15: Commercial EE Technical Potential by End-Use (Winter Peak Savings)

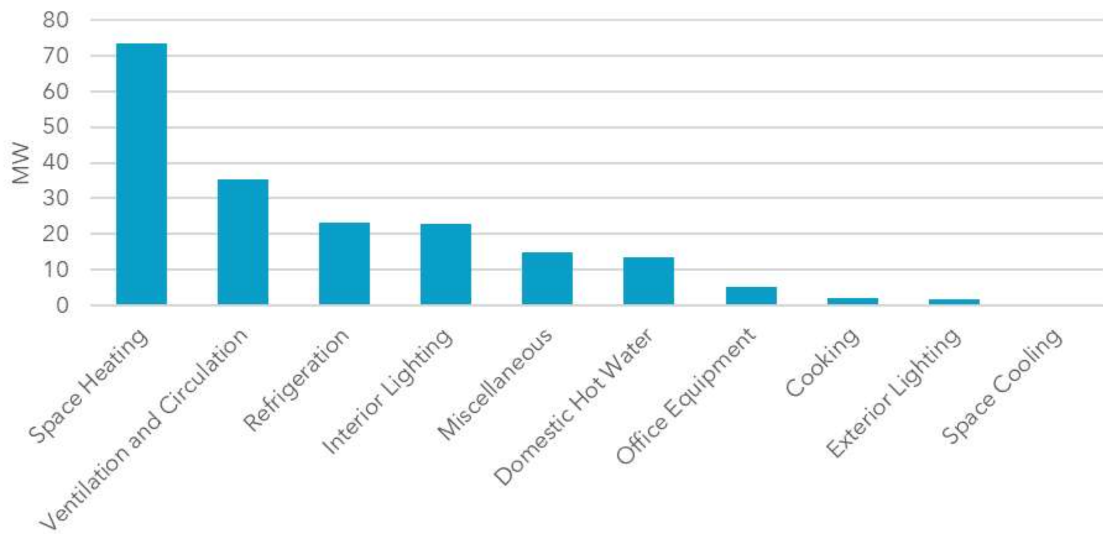
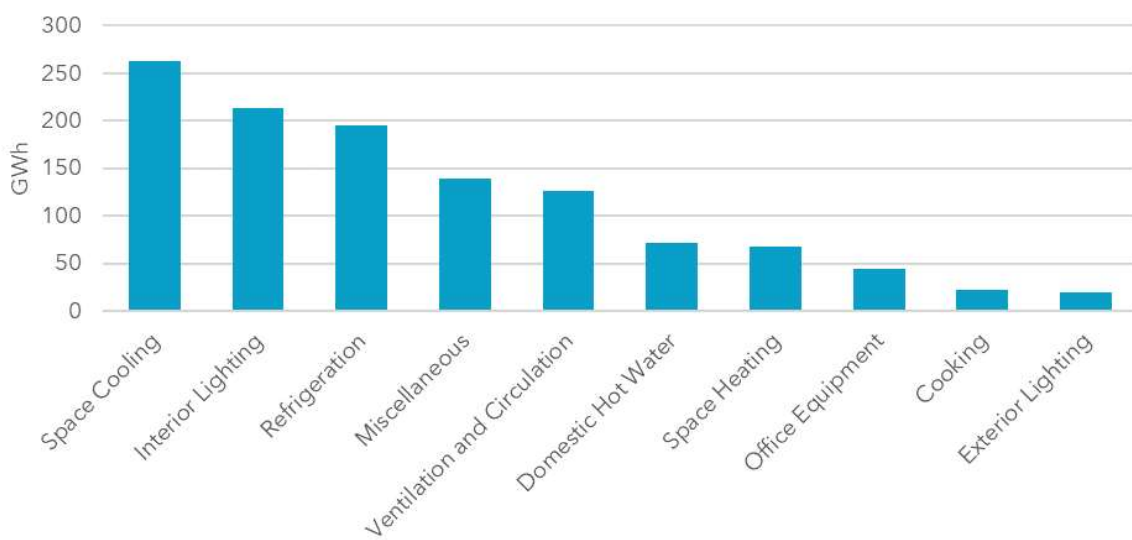


Figure 16: Commercial EE Technical Potential by End-Use (Energy Savings)



5.2.3.2 Industrial Segments

Figure 17, Figure 18, and Figure 19 summarize the industrial sector EE technical potential by end-use.

Figure 17: Industrial EE Technical Potential by End-Use (Summer Peak Savings)

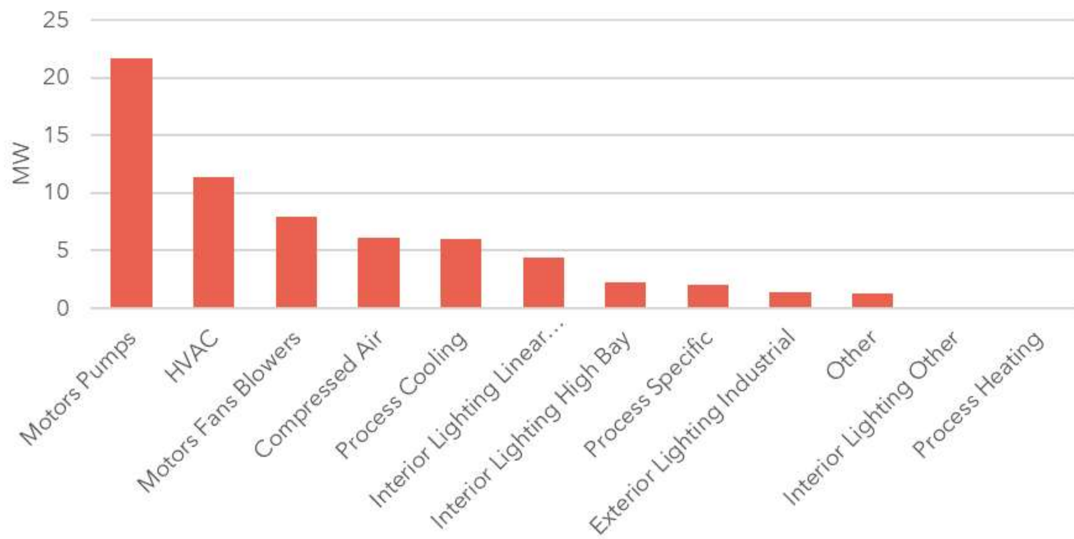


Figure 18: Industrial EE Technical Potential by End-Use (Winter Peak Savings)

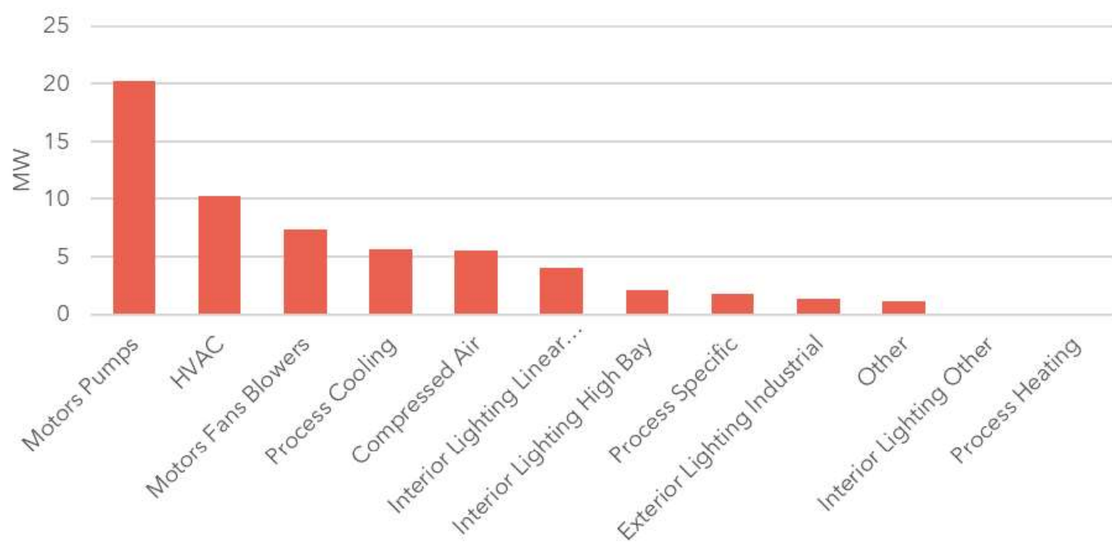
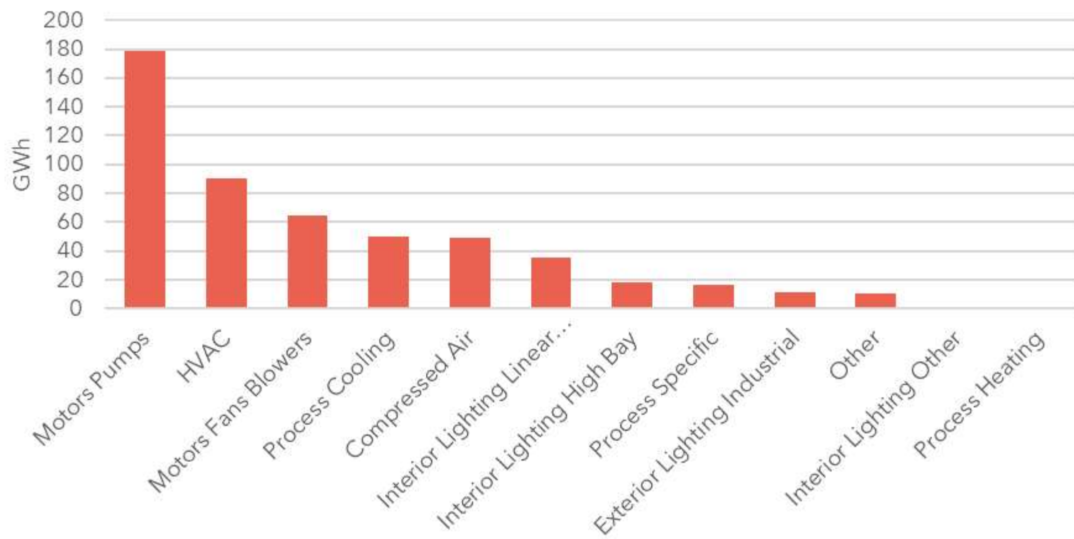


Figure 19: Industrial EE Technical Potential by End-Use (Energy Savings)



5.3 DR Technical Potential

Technical potential for DR is defined for each class of customers as follows:

- Residential & Small C&I customers – Technical potential is equal to the aggregate load for all end-uses that can participate in JEA's current programs plus DR measures not currently offered in which the utility uses specialized devices to control loads (i.e., direct load control programs). This includes cooling and heating loads for residential and small C&I customers and water heater and pool pump loads for residential customers. Not all demand reductions are delivered via direct load control of end-uses. The magnitude of demand reductions from non-direct load control such as time varying pricing, peak time rebates and targeted notifications is linked to cooling and heating loads.
- Large C&I customers – Technical potential is equal to the total amount of load for each customer segment (i.e., that customers reduce their total load to zero when called upon).

Table 10 summarizes the seasonal DR technical potential by sector:

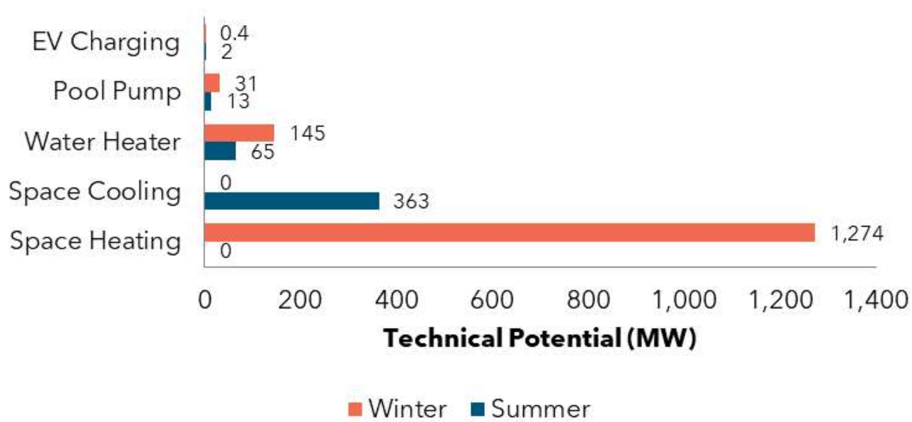
Table 10. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	443	1,451
Non-Residential	673	578
Total	1,116	2,029

5.3.1 Residential

Residential technical potential is summarized in Figure 20.

Figure 20: Residential DR Technical Potential by End-Use

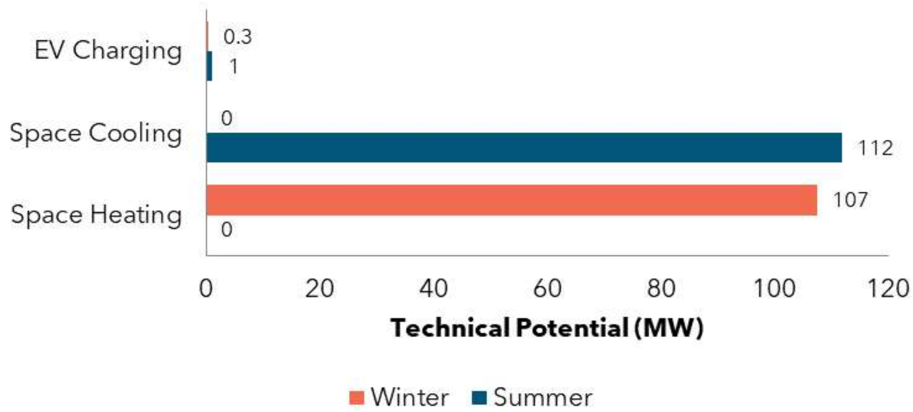


5.3.2 Non-Residential

5.3.2.1 Small C&I Customers

For small C&I technical potential, Resource Innovations looked at cooling and heating loads only. Small C&I technical potential is provided in Figure 21.

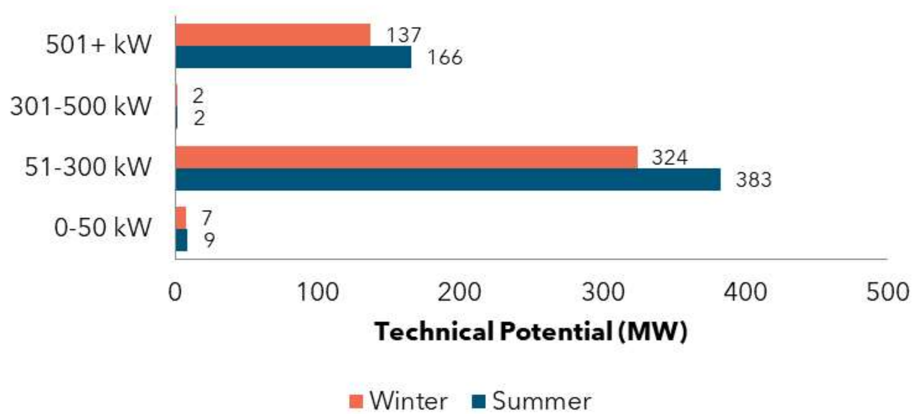
Figure 21: Small C&I DR Technical Potential by End-Use



5.3.2.2 Large C&I Customers

Figure 22 provides the technical potential for large C&I customers, broken down by customer size.

Figure 22: Large C&I DR Technical Potential by Segment



5.4 DSRE Technical Potential

Table 11 provides the results of the DSRE technical potential for each customer segment:

Table 11. DSRE Technical Potential[7]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	493	19	4,146
Non-Residential	214	3	1,617
Total	707	22	5,763
Battery Storage charged from PV Systems			
Residential	304	557	0
Non-Residential	0	158	0
Total	304	715	0
CHP Systems			
Total	397	359	1,811

[7] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

Appendix A EE Measure List

For information on how Resource Innovations developed this list, please see Section 4.

Table 12: Residential EE Measures

Measure	End-Use	Description	Baseline
120v Heat Pump Water Heater 50 Gallons	Residential Domestic Hot Water	120v Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Air Sealing-Infiltration Control	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Improved Infiltration Control	Standard Heating and Cooling System with Standard Infiltration Control
Air-to-Water Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star Air-to-Water Heat Pump, 25 SEER, 13 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - 15 SEER/14.3 SEER2 from base electric resistance	Residential Space Cooling, Residential Space Heating	ASHP 15 SEER from base electric resistance	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2 (from elec resistance)	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2, 10.5 HSPF	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating

Measure	End-Use	Description	Baseline
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2 (from elect resistance)	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
Basement or Crawlspace Wall Insulation R-15	Residential Space Cooling, Residential Space Heating	Increased Basement or Crawlspace Wall Insulation (R-15)	Code-Compliant Exterior Below-Grade Wall Insulation (R-10)
Bathroom Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
CEE Advanced Tier Clothes Dryer	Clothes Dryers	CEE Advanced Tier Clothes Dryer	One Clothes Dryer meeting Federal Standard
CEE Advanced Tier Clothes Washer	Clothes Washers	Tier 3 CEE Clothes washer	One Clothes Washer meeting Federal Standard
CEE Tier 3 Refrigerator	Refrigerators	Residential Tier 3 Refrigerator	One Refrigerator meeting Federal Standard
Ceiling Insulation (R11 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R38 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Residential Space Cooling	Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - 24 SEER/22.9 SEER2	Residential Space Cooling	Central AC - 24 SEER/22.9 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Residential Space Cooling	Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling	Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC Tune Up	Residential Space Cooling	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Existing Typical Central AC without Regular Maintenance/tune-up
Dehumidifier Recycling	Plug Load	No dehumidifier	One Dehumidifier meeting Federal Standard
Drain Water Heat Recovery	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Duct Insulation	Residential Space Cooling, Residential Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork	Standard Electric Heating and Central AC with Uninsulated Ductwork
Duct Repair	Residential Space Cooling, Residential Space Heating	Duct Repair to eliminate/minimize leaks, includes testing and sealing	Standard Electric Heating and Central AC with typical duct leakage
ECM Circulator Pump	Residential Miscellaneous	Install ECM Circulator Pump	Install Standard Circulator Pump
Energy Star Air Purifier	Plug Load	One Air Purifier meeting ENERGY STAR 2.0 Standards	One Standard Conventional Air Purifier
Energy Star Audio-Video Equipment	Plug Load	One DVD/Blu-Ray Player meeting current ENERGY STAR Standards	One Market Average DVD/Blu-Ray Player
Energy Star Bathroom Ventilating Fan	Residential Ventilation and Circulation	Bathroom Exhaust Fan meeting current ENERGY STAR Standards	Bathroom Exhaust Fan meeting Federal Standard
Energy Star Ceiling Fan	Residential Miscellaneous	60" Ceiling Fan Meeting ENERGY STAR 3.1 Standards	Standard 60" Ceiling Fan
Energy Star Clothes Dryer	Clothes Dryers	One Electric Resistance Clothes Dryer meeting ENERGY STAR 1.1 Standards	One Clothes Dryer meeting Federal Standard
Energy Star Clothes Washer	Clothes Washers	One Clothes Washer meeting ENERGY STAR 8.1 Standards	One Clothes Washer meeting Federal Standard

Measure	End-Use	Description	Baseline
Energy Star Dehumidifier	Plug Load	One Dehumidifier meeting ENERGY STAR 5.0 Standards	One Dehumidifier meeting Federal Standard
Energy Star Dishwasher	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements (effective on July 19, 2023), electric water heating	One Dishwasher meeting Federal Standard
Energy Star Dishwasher (Gas Water Heating)	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements, gas water heating	One Dishwasher meeting Federal Standard; gas water heating
Energy Star Door	Residential Space Cooling, Residential Space Heating	100ft2 of Opaque Door meeting Energy Star Version 6.0 Requirements (U-Value: 0.17)	100ft2 of Opaque Door meeting current FL Code Requirements
ENERGY STAR EV supply equipment (level 2 charger)	Residential Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Freezer	Freezers	One Freezer meeting current ENERGY STAR 5.1 Standards	One Freezer meeting Federal Standard
Energy Star Ground Source Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star GSHP, 17.1 SEER, 12 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Energy Star Imaging Equipment	Plug Load	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star Monitor	Plug Load	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star Personal Computer	Plug Load	One Personal Computer meeting ENERGY STAR 8.0 Standards	One Personal Computer meeting ENERGY STARÂ® 3.0 Standards
Energy Star Refrigerator	Refrigerators	One Refrigerator/Freezer meeting ENERGY STAR 5.1 Standards	One Refrigerator/Freezer meeting Federal Standard
Energy Star Room AC	Residential Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star Set-Top Receiver	Plug Load	One Set-top Box meeting ENERGY STAR 4.1 Standards	One Market Average Set-top Box
Energy Star TV	Plug Load	One Television meeting ENERGY STAR 9.0 Standards	One non-ENERGY STAR Television
Energy Star Windows	Residential Space Cooling, Residential Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window current FL energy code requirements
Exterior Wall Insulation	Residential Space Cooling, Residential Space Heating	Increased Exterior Above-Grade Wall Insulation (R-13)	Market Average Existing Exterior Above-Grade Wall Insulation

Measure	End-Use	Description	Baseline
Filter Whistle	Residential Ventilation and Circulation	Install the Furnace Filter Alarm	No Furnace Filter Alarm on a Central Forced-Air Furnace
Floor Insulation	Residential Space Heating	Increased Floor Insulation (R-30)	Code-Compliant Floor Insulation
Freezer Recycling	Freezers	No Freezer	Current Market Freezer
Green Roof	Residential Space Cooling	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
Heat Pump Clothes Dryer	Clothes Dryers	One Heat Pump Clothes Dryer	One Clothes Dryer meeting Federal Standard
Heat Pump Pool Heater	Residential Miscellaneous	Heat Pump Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Heat Pump Tune Up	Residential Space Cooling, Residential Space Heating	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Standard Heating and Cooling System without Regular Maintenance/tune-up
Heat Pump Water Heater 50 Gallons-CEE Advanced Tier	Residential Domestic Hot Water	CEE Advanced Tier Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 50 Gallons-ENERGY STAR	Residential Domestic Hot Water	Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 80 Gallons-ENERGY STAR	Residential Domestic Hot Water	Energy Star Heat Pump Water Heater 80 Gallons	Code-Compliant 80 Gallon Electric Resistance Water Heater
Heat Trap	Residential Domestic Hot Water	Heat Trap	Existing Water Heater without heat trap
High Efficiency Convection Oven	Residential Cooking	One Full-Size Convection Oven meeting ENERGY STAR 3.0 Standards	One Standard Economy-Grade Full-Size Oven
High Efficiency Induction Cooktop	Residential Cooking	One residential induction cooktop	One standard residential electric cooktop
Home Energy Management System	Lighting, Plug Load, Residential Space Cooling, Residential Space Heating	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Hot Water Pipe Insulation	Residential Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-5	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
HVAC ECM Motor	Residential Ventilation and Circulation	A brushless permanent magnet (ECM) blower motor for electric furnace	Permanent Split Capacitor Motor for Electric Furnace
HVAC Economizer	Residential Space Cooling	Install residential economizer	No economizer
HVAC Zoning System	Residential Space Cooling, Residential Space Heating	Install dampers in the ducts, dividing home into multiple	Single zone HVAC system

Measure	End-Use	Description	Baseline
		zones, each controlled by its own thermostat	
Indoor Daylight Sensor	Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Range	Residential Cooking	Residential induction range	Electric range
Instantaneous Hot Water System	Residential Domestic Hot Water	Instantaneous Hot Water System	Standard Efficiency Storage Tank Water Heater
Kitchen Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
LED - 9W_CFL Baseline	Lighting	LED (assume 9W) replacing CFL baseline lamp	14W CFL (60W equivalent)
LED - 9W_Halogen Baseline	Lighting	LED (assume 9W) replacing EISA-2020 compliant baseline lamp	EISA-2020 compliant baseline lamp (60W equivalent)
LED Specialty Lamps-5W Chandelier	Lighting	5 W Chandelier LED	Standard incandescent chandelier lamp
Linear LED	Lighting	Linear LED Lamps in Linear Fluorescent Fixture	Standard (32w) T8 lamps in Linear Fluorescent Fixture
Low Flow Showerhead	Residential Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
New Construction - Whole Home Improvements - Tier 1	Whole Home	Performance-based improvements in new homes - 20% savings	Residential New Construction (Baseline Efficiency)
New Construction - Whole Home Improvements - Tier 2	Whole Home	Performance-based improvements in new homes - 35% savings	Residential New Construction (Baseline Efficiency)
Occupancy Sensors Switch Mounted	Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Timer	Lighting	Timer on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Outdoor Motion Sensor	Lighting	Motion Sensor on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Ozone Laundry	Clothes Washers	Add a New, Single-Unit Ozone Laundry System to the Clothes Washer	One Clothes Washer meeting Federal Standard
Programmable Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Properly Sized CAC	Residential Space Cooling	Properly Sized Central Air Conditioning	Standard Central Air Conditioning, Oversized

Measure	End-Use	Description	Baseline
Radiant Barrier	Residential Space Cooling	Radiant Barrier	No radiant barrier
Reflective Roof	Residential Space Cooling	Reflective Roof Treatment	Standard dark shingle
Refrigerator Coil Cleaning	Refrigerators	Refrigerator Coil Cleaning	
Refrigerator Recycling	Refrigerators	No Refrigerator	Current Market Average Refrigerator
Residential Whole House Fan	Residential Space Cooling	Standard Central Air Conditioning with Whole House Fan	Standard Central Air Conditioning, No Whole House Fan
Sealed crawlspace	Residential Space Cooling, Residential Space Heating	Encapsulated and semi-conditioned crawlspace	Naturally vented, unconditioned crawlspace
Smart Breaker	Whole Home	Smart Breaker	standard electric breakers
Smart Panel	Whole Home	Multi-channel device that attaches to customer's circuit breaker to enable monitoring and control of major end-use appliances by customer	standard electric panel
Smart Power Strip	Plug Load	Smart plug strips for entertainment centers and home office	Standard entertainment center or home office usage, no smart strip controls
Smart Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Solar Attic Fan	Residential Space Cooling	Standard Central Air Conditioning with Solar Attic Fan	Standard Central Air Conditioning, No Solar Attic Fan
Solar Pool Heater	Residential Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pumps	Residential Miscellaneous	Solar Powered Pool Pump	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System	Residential Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Spray Foam Insulation(Base R11)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation(Base R19)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation(Base R2)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Spray Foam Insulation(Base R30)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Thermostatic Shower Restriction Valve	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Thermostatic Shower Valves	50 Gallon Electric Resistance Heater and Standard Shower Valves
Variable Refrigerant Flow (VRF) HVAC Systems	Residential Space Cooling, Residential Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Water Heater Blanket	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Insulated Tank Wrap	Code-Compliant 50 Gallon Electric Resistance Water Heater, No Tank Wrap
Water Heater Thermostat Setback	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Temperature Setpoint of 119°F	Code-Compliant 50 Gallon Electric Resistance Water Heater (Temp. Setpoint = 130Â°F)
Water Heater Timeclock	Residential Domestic Hot Water	Water Heater Timeclock	Existing Water Heater without time clock
Weather stripping	Residential Space Cooling, Residential Space Heating	Specific quantity of weather stripping to seal	
Window Caulking	Residential Space Cooling, Residential Space Heating	Window caulking	
Window Sun Protection	Residential Space Cooling	Window Film Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

Table 13: Commercial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
Advanced Rooftop Controller	Ventilation and Circulation	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Miscellaneous	Performing Routine Maintenance on 20HP Inlet	20 HP Inlet Modulation Fixed-Speed Compressor

Measure	End-Use	Description	Baseline
		Modulation Fixed-Speed Compressor	
Air Curtains	Space Cooling, Space Heating	Air Curtain across door opening	Door opening with no air curtain
Airside Economizer	Space Cooling	Airside Economizer	No economizer
Anti-Sweat Controls	Refrigeration	One Medium Temperature Reach-In Case with Anti-Sweat Heater Controls	One Medium Temperature Reach-In Case without Anti-Sweat Heater Controls
Auto Off Time Switch	Interior Lighting	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Automatic Door Closer for Walk-in Coolers and Freezers	Refrigeration	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Beverage Vending Machine Controls	Refrigeration	One non-ENERGY STAR beverage vending machine equipped with infrared occupancy sensing controls	One non-ENERGY STAR beverage vending machine, no controls
Bi-Level Lighting Control (Exterior)	Exterior Lighting	Bi-Level Controls on Exterior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Interior)	Interior Lighting	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ceiling Insulation (R19 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Chilled Water Reset	Space Cooling	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Chiller maintenance	Space Cooling	O&M improvements to restore chiller performance	

Measure	End-Use	Description	Baseline
CO Sensors for Parking Garage Exhaust	Miscellaneous	Enclosed Parking Garage Exhaust with CO Control	Constant Volume Enclosed Parking Garage Exhaust
Commercial Duct Sealing	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Commercial Strategic Energy Management	Whole Building	Commercial Strategic Energy Management	No active energy management
Custom measure - Non-lighting	Space Cooling, Space Heating	Custom Improvement to Facility's Operations	Baseline Technology/Process
Data Center Hot Cold Aisle	Office Equipment	Equipment configuration that saves HVAC	No hot, cold aisle containment
Dedicated Outside Air System (DOAS)	Space Cooling, Space Heating	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Circulating Systems	Domestic Hot Water	Recirculation Pump with Demand Control Mechanism	Uncontrolled Recirculation Pump
Demand Controlled Ventilation	Ventilation and Circulation	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Refrigeration	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Destratification Fans	Space Heating	Destratification Fans improve temperature distribution by circulating warmer air from the ceiling back down to the floor level	No destratification fan
Door Gasket (Cooler)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Door Gasket (Freezer)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Drain water heat recovery	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Dual Enthalpy Economizer	Ventilation and Circulation	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
Duct Insulation	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork (R-8)	Standard Electric Heating and Central AC with Uninsulated Ductwork (R-4)
Ductless Mini-Split AC	Space Cooling	Ductless Mini-Split AC, 4 Ton, 16 SEER	Code-Compliant AC Unit, 4 Ton, 15 SEER

Measure	End-Use	Description	Baseline
Ductless Mini-Split HP	Space Cooling, Space Heating	Ductless Mini-Split HP, 17 SEER, 9.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
DX Coil Cleaning	Space Cooling	DX Coil Cleaning	DX Coil Not Cleaned
ECM Motors on Furnaces	Space Heating	Variable Speed Electronically Commutated Motor for an Electric Furnace	Permanent Split Capacitor Motor for Electric Furnace
Efficient Battery Charger	Miscellaneous	Efficient Battery Charger	FR or SCR charging stations with power conversion efficiency < 89% or > 10 W
Efficient Exhaust Hood	Cooking	Kitchen ventilation with automatically adjusting fan controls	Kitchen ventilation with constant speed ventilation motor
Efficient Motor Belts	Miscellaneous	Synchronous belt, 98% efficiency	Standard V-belt drive
Efficient New Construction Lighting	Interior Lighting	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Energy Recovery Ventilation System (ERV)	Space Cooling	Unitary Cooling Equipment that Incorporates Energy Recovery	Current Market Packaged or Split DX Unit
Energy Star Combination Oven	Cooking	Energy Star Combination Oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade 10-Pan Combination Oven
Energy Star Commercial Clothes Washer	Miscellaneous	One Commercial Clothes Washer meeting current ENERGY STAR Version 8.1 Standards	One Commercial Clothes Washer meeting Federal Standard
Energy Star Commercial Dishwasher	Domestic Hot Water	One Commercial Dishwasher meeting ENERGY STAR Version 3.0 Standards	One Dishwasher meeting Federal Standard
Energy Star Commercial Glass Door Freezer	Refrigeration	One Glass Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Glass Door Freezer meeting Federal Standards
Energy Star Commercial Glass Door Refrigerator	Refrigeration	One Glass Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Glass Door Refrigerator meeting Federal Standards
Energy Star Commercial Solid Door Freezer	Refrigeration	One Solid Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Solid Door Freezer meeting Federal Standards
Energy Star Commercial Solid Door Refrigerator	Refrigeration	One Solid Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Solid Door Refrigerator meeting Federal Standards
Energy Star convection oven	Cooking	Energy Star convection oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Full-Size Convection Oven

Measure	End-Use	Description	Baseline
Energy Star EV Chargers	Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Fryer	Cooking	One Standard Vat Electric Fryer meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Standard Vat Electric Fryer
Energy Star Griddle	Cooking	One Griddle meeting current ENERGY STAR Version 1.2 Standards	One Conventional Griddle
Energy Star Hot Food Holding Cabinet	Cooking	One Hot Food Holding Cabinet meeting current ENERGY STAR Version 2.0 Standards	One Standard Hot Food Holding Cabinet
Energy Star Ice Maker	Refrigeration	One Continuous Self-Contained Ice Maker meeting ENERGY STAR Version 3.0 Standards	One Continuous Self-Contained Ice Maker meeting Federal Standard
ENERGY STAR Imaging Equipment	Office Equipment	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star LED Directional Lamp	Interior Lighting	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star Monitors	Office Equipment	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star PCs	Office Equipment	One Personal Computer (desktop or laptop) meeting current ENERGY STARÂ® Standards	One non-ENERGY STARÂ® Personal Computer
Energy Star room AC	Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC, 1 Ton, 10.9 CEER
Energy Star Servers	Office Equipment	One Server meeting ENERGY STAR 2.0 Standards	One Standard Server
Energy Star Steamer	Cooking	One 4-Pan Electric Steamer meeting ENERGY STARÂ® 2.0 Standards	One Standard Economy-Grade 4-Pan Steamer
Energy Star Uninterruptable Power Supply	Office Equipment	Standard Desktop Plugged into Energy Star Uninterruptable Power Supply at 25% Load	Standard Desktop Plugged into Average Rotary Uninterruptable Power Supply at 25% Load
Energy Star Vending Machine	Refrigeration	One Refrigerated Vending Machine meeting ENERGY STAR Version 4.0 Standards	One Refrigerated Vending Machine meeting ENERGY STARÂ® 1.0 Standards
ENERGY STAR Water Cooler	Miscellaneous	One Storage Type Hot/Cold Water Cooler Unit meeting ENERGY STAR Version 3.0 Standards	One Standard Storage Type Hot/Cold Water Cooler Unit
Energy Star windows	Space Cooling, Space Heating	100ft2 of Window meeting Energy Star Version 6.0	100ft2 of Window meeting Energy Star Version 5.0

Measure	End-Use	Description	Baseline
		Requirements (U-Value: 0.27, SHGC: 0.21)	Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Miscellaneous	Plug-in timer that activates engine block timer to reduce unnecessary run time	Engine block heater (typically used for backup generators) running continuously
Escalator Motor Efficiency Controller	Miscellaneous	Install Escalator Motor Efficiency Controller	Escalator without Motor Efficiency Controller
Facility Commissioning	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility commissioning to optimize building operations in new facilities	Standard new construction facility with no commissioning
Facility Energy Management System	Space Cooling, Space Heating, Ventilation and Circulation	Typical HVAC by Building Type Controlled by Energy Management System	Standard/manual facility equipment controls
Faucet Aerator	Domestic Hot Water	Low-flow lavatory faucet aerator, flow rate: 1.0 gpm	Federal lavatory flow rate standard, 1994, flow rate: 2.2 gpm
Floating Head Pressure Controls	Refrigeration	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Floor Insulation	Space Cooling, Space Heating	Increased Floor Insulation (R-19)	Market Average Existing Floor Insulation
Geothermal Heat Pump	Space Cooling, Space Heating	Geothermal Heat Pump	Code-Compliant Air Source Heat Pump
Green roof	Space Cooling, Space Heating	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
HE Air Cooled Chiller - All Compressor Types - 100 Tons	Space Cooling	HE Air Cooled Chiller - Air Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE DX 11.25-20.0 Tons Elec Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER

Measure	End-Use	Description	Baseline
HE DX Less than 5.4 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
Heat Pump Pool Heater Commercial	Miscellaneous	High Efficiency Pool Heater Eff. >=84%	Standard Efficiency Pool Heater 78% Eff.
Heat Pump Water Heater	Domestic Hot Water	Efficient 50 Gallon Electric Heat Pump Water Heater	Code-Compliant 50 Gallon Electric Heat Pump Water Heater
High Efficiency Air Compressor	Miscellaneous	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Data Center Cooling	Space Cooling	High Efficiency CRAC (computer room air conditioner)	Standard Efficiency CRAC
High Efficiency PTAC	Space Cooling	High Efficiency PTAC	Code-Compliant PTAC
High Efficiency PTHP	Space Cooling, Space Heating	High Efficiency PTHP	Code-Compliant PTHP
High Efficiency Refrigeration Compressor_Discus	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor_Scroll	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Speed Fans	Ventilation and Circulation	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
Hot water pipe insulation	Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-4	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation

Measure	End-Use	Description	Baseline
Hotel Card Energy Control Systems	Space Cooling, Space Heating	Guest Room HVAC Unit Controlled by Hotel-Key-Card Activated Energy Control System	Guest Room HVAC Unit, Manually Controlled by Guest
Indoor daylight sensor	Interior Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Cooktops	Cooking	Efficient Induction Cooktop	One Standard Electric Cooktop
Infiltration Reduction - Air Sealing	Space Cooling, Space Heating	Reduced leakage through caulking, weather-stripping	Standard Heating and Cooling System with Moderate Infiltration
Instantaneous Hot Water System Commercial	Domestic Hot Water	Instantaneous Hot Water System	Code-Compliant Electric Storage Water Heater
LED - 14W_CFL Baseline	Interior Lighting	LED (assume 14W) replacing CFL	100W equivalent CFL
LED - 9W Flood_CFL Baseline	Exterior Lighting	LED (assume 9W) replacing CFL	14W CFL
LED Canopy Lighting (Exterior)	Exterior Lighting	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Exit Sign	Interior Lighting	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting	2x4 LED Troffer	Lumen-Equivalent 32-Watt T8 Lamp
LED Linear - Lamp Replacement	Interior Lighting	Linear LED (16W)	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	Space Cooling, Space Heating	LEED New Construction Whole Building	Comparable facility, code-compliance construction
Light Tube	Interior Lighting	One 14" Light Tube, Delivering light to 250 S.F. of Commercial Space	250 S.F. of Commercial Space Lit by Typical Lighting Strategies

Measure	End-Use	Description	Baseline
Low Flow Shower Head	Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.50 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
Low-Flow Pre-Rinse Sprayers	Domestic Hot Water	Low-Flow Pre-Rinse Sprayer with Flow Rate of 1.6 gpm	Pre-Rinse Sprayer with Federal Standard Flow Rate of 2.25 gpm
Network PC Power Management	Office Equipment	One computer and monitor attached to centralized energy management system that controls when desktop computers and monitors plugged into a n	One computer and monitor, manually controlled
Networked Lighting Controls	Interior Lighting	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Night Covers for Display Cases	Refrigeration	One Open Vertical Case with Night Covers	One Existing Open Vertical Case, No Night Covers
Occupancy Sensors, Ceiling Mounted	Interior Lighting	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy Sensors, Switch Mounted	Interior Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ozone Laundry Commercial	Miscellaneous	Add a new ozone laundry system onto a commercial clothes washer	One commercial clothes washer without ozone laundry system
Programmable thermostat	Space Cooling, Space Heating	Pre-set programmable thermostat that replaces manual thermostat	Standard Heating and Cooling System with Manual Thermostat
PSC to ECM Evaporator Fan Motor (Reach-In)	Refrigeration	Medium Temperature Reach-In Case with equivalent size Electronically Commutated Evaporator Fan Motor	Medium Temperature Reach-In Case with Permanent Split Capacitor Evaporator Fan Motor
PSC to ECM Evaporator Fan Motor (Walk-In, Refrigerator)	Refrigeration	Medium Temperature Walk-In Case with Electronically Commutated Evaporator Fan Motor	Medium Temperature Walk-In Case with Permanent Split Capacitor Evaporator Fan Motor
Q-Sync Evaporator Fan Motor	Refrigeration	Medium Temperature Reach-In Case with	Medium Temperature Reach-In Case with 20W Permanent Split Capacitor Fan Motor

Measure	End-Use	Description	Baseline
		equivalent size Q-Sync Evaporator Fan Motor	
Reflective Roof Treatment	Space Cooling	Reflective Roof Treatment	Standard Black Roof
Refrigerated Display Case LED Lighting	Refrigeration	60" Refrigerated Case LED Strip	Lumen-Equivalent 32-Watt T8 Fixture
Refrigerated Display Case Lighting Controls	Refrigeration	Occupancy Sensors for Refrigerated Case Lighting to reduce run time	Market-Share Weighted Existing Linear Fluorescent Fixture
Refrigeration Commissioning	Refrigeration	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Refrigeration Economizer	Refrigeration	Walk-in refrigerator with economizer	Walk-in refrigerator without economizer
Regenerative Drive Elevator Motor	Miscellaneous	Regenerative drive produced energy when motor in overhaul condition	Standard motor
Retro-Commissioning (Existing Construction)	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	
Roof Insulation	Space Cooling, Space Heating	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Server Virtualization	Office Equipment	2 Virtual Host Server	20 Single Application Servers
Smart Strip Plug Outlet	Office Equipment	One Smart Strip Plug Outlet	One Standard plug strip/outlet
Smart thermostat	Space Cooling, Space Heating	Thermostats that include "smart" features such as occupancy sensors, geo-fencing, multi-zone sensors	Standard Heating and Cooling System with Manual Thermostat
Solar Pool Heater Commercial	Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pump	Miscellaneous	Solar Powered Pool Pump Motor	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System Commercial	Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Strip Curtains - Freezers	Refrigeration	Walk-in freezer with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in freezer without strip curtains
Strip Curtains - Refrigerators	Refrigeration	Walk-in cooler with strip curtains at least 0.06 inches	Walk-in cooler without strip curtains

Measure	End-Use	Description	Baseline
		thick covering the entire area of the doorway	
Suction Pipe Insulation - Freezers	Refrigeration	Suction Pipe Insulation - Freezers	Uninsulated freezer suction lines
Suction Pipe Insulation - Refrigerators	Refrigeration	Suction Pipe Insulation - Refrigerators	Uninsulated refrigeration suction lines
Thermal Energy Storage	Space Cooling	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Thermostatic Shower Restriction Valve Commercial	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Pressure Balance Shower Valves	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater and Standard Shower Valves
Time Clock Control	Interior Lighting	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Variable Refrigerant Flow (VRF) HVAC Systems	Space Cooling, Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant PTHP
VAV System	Ventilation and Circulation	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Cooling Tower Fans	Space Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Pump	Space Cooling, Space Heating	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VSD Controlled Compressor	Refrigeration	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Wall Insulation	Space Cooling, Space Heating	Increased Exterior Above-Grade Wall Insulation	Market Average Existing Exterior Above-Grade Wall Insulation
Warehouse Loading Dock Seals	Space Cooling, Space Heating	Seals to reduce infiltration losses at loading dock	Loading dock with no seals
Water Cooled Refrigeration Heat Recovery	Domestic Hot Water	The heat reclaim system transfers waste heat from refrigeration system to space heating or hot water	No heat recovery
Water Heater Setback	Domestic Hot Water	A 50 gallon electric hot water tank with a thermostat setting reduced to no lower than 120 degrees.	A 50 gallon electric hot water tank with a thermostat setting that is higher than 120 degrees, typically hot water tanks with settings of 130 degrees or higher.
Water source heat pump	Space Cooling, Space Heating	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside Economizer	Space Cooling	Waterside Economizer	No economizer

Measure	End-Use	Description	Baseline
Window shade film	Space Cooling	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC
Zero Energy Doors	Refrigeration	Install zero energy doors for a reach-in refrigerated cooler or freezer	Standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors

Table 14: Industrial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
3-phase High Frequency Battery Charger - 1 shift	Other	3-phase High Frequency Battery Charger	Standard Charger
Advanced Rooftop Controller	HVAC	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Compressed Air	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air curtains	HVAC	Air Curtain across door opening	Door opening with no air curtain
Airside economizer	HVAC	Airside Economizer	No economizer
Auto Closer on Refrigerator Door	Process Cooling	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Auto Off Time Switch	Interior Lighting High Bay	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Exterior)	Exterior Lighting Industrial	Install Exterior Bi-Level Lighting Control, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Bi-Level Lighting Control (Interior)	Interior Lighting High Bay	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting

Measure	End-Use	Description	Baseline
Chilled Water Reset	HVAC	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Cogged Belt on 15hp ODP Motor	Motors Pumps	15HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	15HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Cogged Belt on 40hp ODP Motor	Motors Pumps	40HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	40HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Compressed Air Desiccant Dryer	Process Specific	heated regenerative desiccant dryer without dew point demand controls	heatless regenerative desiccant dryer without dew point demand controls
Compressed Air No-Loss Condensate Drains	Process Specific	Install no-loss condensate drains	Install standard condensate drains
Compressed Air Storage Tank	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Receiver Tank	20 HP Inlet Modulation Fixed-Speed Compressor, No Receiver Tank
Custom Measure - Non-Lighting	HVAC	Custom Improvement to Facility's Operations	Baseline Technology/Process
Dairy Refrigeration Heat Recovery	Other	refrigeration equipment with refrigeration heat recovery tank installed	existing dairy farm with refrigeration equipment and a water heater unit without an RHR unit
Dedicated Outside Air System (DOAS)	HVAC	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Ventilation	HVAC	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Process Cooling	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Dew Point Sensor Control for Dessicant CA Dryer	Compressed Air	1000 CFM Heated Desicant Air Dryer with Dew Point Controls	1000 CFM Modulating Heated Desicant Air Dryer
Drip Irrigation Nozzles	Other	Flow Control Nozzles	Standard Irrigation Nozzles
Dual Enthalpy Economizer	Process Cooling	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
DX Coil Cleaning	HVAC	DX Coil Cleaning	DX Coil Not Cleaned
Efficient Compressed Air Nozzles	Compressed Air	1/4" Engineered Air Nozzle	1/4" Open-End Air Nozzle

Measure	End-Use	Description	Baseline
Efficient New Construction Lighting	Interior Lighting High Bay	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Electric Actuators	Other	Electric Actuator	Pneumatic Actuator
Energy Efficient Laboratory Fume Hood	HVAC	Variable Air Volume High Performance Fume Hood	Constant Volume Conventional Bypass Fume Hood
Energy Efficient Transformers	Other	Energy Efficient Dry Type Transformer (CSL-3)	Standard Transformer (TP-1)
Energy Recovery Ventilation System	HVAC	Unitary Cooling Equipment that Incorporates Energy Recovery	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11.2 EER
Energy Star LED Directional Lamp	Interior Lighting Other	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star room ac	HVAC	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star windows	HVAC	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Other	An engine block heater operated by an outdoor plug-in timer	An engine block heater that is manually plugged in
Facility Commissioning	HVAC	Perform facility commissioning	Comparable facility, no commissioning
Facility Energy Management System	HVAC	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Fan Thermostat Controller	HVAC	Typical HVAC by Building Type with Fan Thermostat Controller Installed	Typical HVAC by Building Type with Programmable Thermostat
Floating Head Pressure Controller	Process Cooling	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Grain Bin Aeration Control System	Process Specific	Grain Storage Fan System with Automatic Controls	Grain Storage Fan System with Manual Controls
HE Air Cooled Chiller - All Compressor Types - 100 Tons	HVAC	HE Air Cooled Chiller - All Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE Air Cooled Chiller - All Compressor Types - 300 Tons	HVAC	Air Cooled Positive Displacement Chiller with Integral VFD, 300 Tons, 13.7 EER	Code-Compliant Air Cooled Positive Displacement Chiller, 300 Tons, 12.5 EER

Measure	End-Use	Description	Baseline
HE DX 11.25-20.0 Tons Elec Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
High Bay Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 800 Watts Controlled	800 Watts of Lighting, Manually Controlled
High Efficiency Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Refrigeration Compressor - Discus	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor

Measure	End-Use	Description	Baseline
High Efficiency Refrigeration Compressor - Scroll	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Welder	Process Specific	High Efficiency Welder	Standard Welding Practices
High Speed Fans	HVAC	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
High Volume Low Speed Fan (HVLS)	Motors Fans Blowers	20' High Volume Low Speed Fan	Conventional Circulating Fan
Indoor Agriculture - LED Grow Lights	Interior Lighting High Bay	LED grow light	1000W High Pressure Sodium
Indoor daylight sensor	Interior Lighting High Bay	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Industrial Duct Sealing	HVAC	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Injection Mold and Extruder Barrel Wraps	Other	2' Diameter, 20' Long Machine Barrel with 1" Insulation	2' Diameter, 20' Long Machine Barrel with no Insulation
Insulated Pellet Dryer Tanks and Ducts	Process Heating	Insulation for Pellet Tank and Duct	Uninsulated Pellet Tank and Duct
LED - 14W_CFL Baseline	Interior Lighting Other	LED (assume 14W) replacing CFL	100W equivalent CFL
LED Canopy Lighting (Exterior)	Exterior Lighting Industrial	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting Industrial	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting Other	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED exit sign	Interior Lighting Other	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting Industrial	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting Linear Fluorescent	2x4 LED Troffer Fixture	Lumen-Equivalent 32-Watt T8 Fixture

Measure	End-Use	Description	Baseline
LED Linear - Lamp Replacement	Interior Lighting Linear Fluorescent	Linear LED	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting Industrial	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	HVAC	LEED Qualifying New Construction	Comparable facility, code-compliance construction
Light Tube	Interior Lighting Other	One 14" Light Tube, Delivering light to 250 S.F. of Industrial Space	250 S.F. of Industrial Space Lit by Typical Lighting Strategies
Low Energy Livestock Waterer	Motors Pumps	Install Thermostatically Controlled Livestock Watering System	Standard Livestock Watering System
Low Pressure Sprinkler Nozzles	Motors Pumps	Low Pressure Irrigation Nozzles operate at 35 psi or lower	Standard high pressure irrigation nozzles that operate at 50 psi or greater
Low Pressure-drop Filters	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Low Pressure Drop Filter	20 HP Inlet Modulation Fixed-Speed Compressor, No Particulate Removal
Milk Pre-Cooler	Other	Installed pre-cooler heat exchanger	no pre-cooler heat exchanger installed
Networked Lighting Controls	Interior Lighting Linear Fluorescent	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy sensors, switch mounted	Interior Lighting Linear Fluorescent	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting Industrial	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting Industrial	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Packaged Terminal AC	HVAC	High Efficiency Packaged Terminal AC	Code-Compliant PTAC, 10.9 EER
Process Cooling Ventilation Reduction	Process Cooling	Standard Process Cooling with Reduced Ventilation	Standard Process Cooling
Programmable thermostat	HVAC	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Reflective Roof Treatment	HVAC	Reflective Roof Treatment	Standard Black Roof

Measure	End-Use	Description	Baseline
Refrigeration Commissioning	Process Cooling	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Retro-Commissioning (Existing Construction)	HVAC	Perform Facility Retro-commissioning	
Roof insulation	HVAC	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Smart thermostat	HVAC	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Strategic Energy Management	HVAC	SEM goal setting and tracking	No active energy management
Synchronous Belt on 15hp ODP Motor	Motors Pumps	15 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	15 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 5hp ODP Motor	Motors Pumps	5 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	5 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 75hp ODP Motor	Motors Pumps	75 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	75 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Thermal energy storage	HVAC	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Time Clock Control	Interior Lighting High Bay	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
VAV System	HVAC	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
VFD on Cooling Tower Fans	Process Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Fan	Motors Fans Blowers	5 HP HVAC Fan Motor, with VFD Control	5 HP HVAC Fan Motor, no VFD Control
VFD on HVAC Pump	Motors Pumps	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VFD on process pump	Motors Pumps	20 HP Process Pump Equipped with VFD Control	20 HP Process Pump, Constant Speed
VSD Controlled Compressor	Process Cooling	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System

Measure	End-Use	Description	Baseline
Water source heat pump	HVAC	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside economizer	HVAC	Waterside Economizer	No economizer
Window shade film	HVAC	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

The following EE measures from the 2019 Technical Potential Study were eliminated from the current study[8]:

Table 15: 2019 EE Measures Eliminated from Current Study

Sector	Measure	End-Use	Reason for Removal
Residential	CFL – 15W Flood	Lighting	Better technology (LED) available
Residential	CFL – 15W Flood (Exterior)	Lighting	Better technology (LED) available
Residential	CFL – 13W	Lighting	Better technology (LED) available
Residential	CFL – 23W	Lighting	Better technology (LED) available
Residential	Low Wattage T8 Fixture	Lighting	Better technology (LED) available
Residential	15 SEER Central AC	Space Cooling	Updated Federal Standard
Residential	15 SEER Air Source Heat Pump	Space Cooling, Space Heating	Updated Federal Standard
Residential	14 SEER ASHP from base electric resistance heating	Space Cooling, Space Heating	Updated Federal Standard
Residential	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Storm Door	Space Cooling, Space Heating	Minimal/uncertain energy savings
Commercial	CFL – 15W Flood	Exterior Lighting	Better technology (LED) available
Commercial	High Efficiency HID Lighting	Exterior Lighting	Better technology (LED) available

[8] Additional measures from the 2019 study were updated to reflect current vintage/technology for the current study.

Sector	Measure	End-Use	Reason for Removal
Commercial	LED Street Lights	Exterior Lighting	Market standard
Commercial	LED Traffic and Crosswalk Lighting	Exterior Lighting	Market standard
Commercial	CFL-23W	Interior Lighting	Better technology (LED) available
Commercial	High Bay Fluorescent (T5)	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Fixture Replacement	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Lamp Replacement	Interior Lighting	Better technology (LED) available
Commercial	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Tank Wrap on Water Heater	Domestic Hot Water	Limited applicability
Commercial	Ceiling Insulation (R12 to R38)	Space Cooling, Space Heating	Consolidated measure baseline assumptions
Commercial	Ceiling Insulation (R30 to R38)	Miscellaneous	Consolidated measure baseline assumptions

Appendix B DR Measure List

Table 16: Residential DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Water heater control	Direct load control	Summer and Winter	Load control installed on a water heater (integrated or external switch)
Pool pump switches	Direct load control	Summer and Winter	Load control program with switch installed on pool pump
Room AC	Direct load control	Summer	Load control program that is focused on room AC units rather than central AC
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 17: Small C&I DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 18: Large C&I DR Measures

Measure	Type	Season	Description
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of

Measure	Type	Season	Description
			CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Auto DR	Utility-controlled loads	Summer and Winter	Custom load control of specific end-uses/processes that is triggered by utility signal to building management system; customer can sometimes opt-out of specific events
Firm Service Level	Contractual	Summer and Winter	Customer commits to a maximum usage level during peak periods and, when notified by the utility, agrees to cut usage to that level.
Guaranteed Load Drop	Contractual	Summer and Winter	Customer agrees to reduce usage by an agreed upon amount when notified

No DR measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix C DSRE Measure List

Table 19: Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation

Table 20: Non-Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation
CHP – Fuel Cell	An electrochemical cell-based generator that reacts hydrogen fuel with oxygen
CHP – Micro Turbine	Small combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Gas Turbine	A combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Reciprocating Engine	An engine that uses one or more pistons to convert pressure into rotational motion
CHP - Steam Turbine	A turbine that extracts thermal energy from pressured steam to drive a generator

No DSRE measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix D External Measure Suggestions

Table 21: External Measure Suggestions and Actions

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Efficient Electrification Measures	All measures that can produce substantial site energy savings by converting from natural gas or other fossil fuels should be included in the Florida electric utilities' next efficiency potential study. Key examples include efficient heat pumps to displace gas furnaces and efficient heat pump water heaters to displace gas water heaters. It is important to note that these electrification measures provide not only heating energy savings and water heating energy savings, but can also potentially provide cooling efficiency benefits as well. In the case of heat pumps, that can occur because efficient heat pumps can operate in cooling mode more efficiently than standard central air conditioners. In the case of heat pump water heaters, cooling and dehumidification benefits can occur when/if the water heater is in conditioned space because they transfer heat (particularly latent heat) from the air around them to the water they are heating. A growing number of jurisdictions – including Illinois, Minnesota and some northeastern states – have begun to include efficient electrification measures in their efficiency programs portfolios.	Fuel-switching and electrification are outside the scope of this study
Networked Lighting Controls	LED lighting technology has become increasingly accepted and installed in commercial buildings. The next big efficiency opportunity in commercial lighting efficiency is in sophisticated controls integrated into the light fixtures themselves – both luminaire level lighting controls and networked lighting controls. For example, a 2017 report for both the Northwest Energy Efficiency Alliance and the Design Lights Consortium, a non-profit that works with utilities and manufacturers of lighting products (and which many utilities across the country reference for determination of eligibility of lighting products for efficiency program rebates), found that networked lighting controls can provide on the order of 50% additional savings after LED conversion. Other studies have also found the national savings potential from such products to be enormous. Moreover, these products can be designed to provide not only lighting energy savings but also a number of other non-energy benefits (e.g., asset tracking, such as the ability of hospitals to know the location of all wheel chairs). Numerous utilities across the country now actively promote this technology through their efficiency programs. For example, Commonwealth Edison, the utility serving Chicago and other parts of northern Illinois, is currently getting a significant portion of its commercial lighting savings from promotion of networked lighting controls	Added to measure list for 2024 study

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Ductless mini-split heat pumps to displace inefficient electric baseboard heating	While most Florida residential buildings with electric heat provide that heat with heat pumps, at least some (perhaps most likely being older multi-family rental buildings) still use inefficient electric resistance heat. Ductless mini- split heat pump retrofits can very efficiently displace such inefficient electric heat and should be added to the residential measure list.	Added to measure list for 2024 study
Air Source Heat Pump baseline assumptions	There are seven air source heat pump (ASHP) measures included in the residential measure list. Two of them – one at SEER 14 and a second at SEER 21 – are listed as relative to an electric resistance baseline. Five of them – SEER 15, SEER 16, SEER 17, SEER 18 and SEER 21 – appear to be relative to a baseline of a standard new ASHP. Are we interpreting this correctly? If so, we have a couple of comments/questions/suggestions: • The efficiency standards assessed need to be modified to be consistent with new federal standards, including new testing procedures. • For cases where the baseline is "electric resistance", why only assessing two efficiency tiers (i.e., fewer than for standard ASHP baselines)? The same number of efficiency tiers should be assessed for both baselines.	Incorporated suggestions into 2024 study, including updated baseline standard and assessing same efficiency tiers for both baselines
Heat Pump Water Heater Efficiency	The Res EE tab of the utilities draft measure list suggests that the efficiency of a heat pump water heater is an EF of 2.50. That is unrealistically low. In fact, of the 222 products listed on the Energy Star website, none had UEFs less than 2.80 and only 29 (13%) had UEFs that were less than 3.4; the average was 3.57. Indeed, the first product listed on a search of heat pump water heaters on Home Depot's website is a 50 gallon, Rheem (Pro Terra) product with a UEF of 3.75 and a cost of $1699.	Incorporated suggestion into 2024 study
New Construction Measure Packages	The measures lists did not appear to include packages of measures for building new residential and/or new commercial buildings to levels of efficiency beyond those required by code. Utilities in many jurisdictions run new construction efficiency programs supporting such measure packages. In the residential sector, many base their programs on the long-standing Federal Energy Star standard. However, increasingly utility programs are promoting additional efficiency tiers – often as part of all-electric new construction program offerings – that go well beyond the Energy Star standard. For example, Consumers Energy (Michigan) offers $1000 rebates to builders who construct Energy Star single family homes	Incorporated suggestion into 2024 study with 2 tiers of residential new construction whole-home improvement measures.

Docket Nos. 20240012-EG to 20240017-EG
TPS for JEA
Exhibit JH-6, Page 81 of 84

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
	with a Home Energy Rating (HERS) score of 57 or less, but offer higher rebates for more efficient buildings – up to $4000 for all electric homes with a HERS score of 40 or less. The Florida utilities potential study should assess savings potential for both the Energy Star level and a tier or two of additional efficiency beyond that level. Similar assessments of new commercial building savings potential should also be assessed.	
Custom Industrial Measures	The utilities' list of industrial efficiency measures addresses common industrial efficiency opportunities. However, it does not address efficiency opportunities that may be unique to individual industries or even to individual industrial facilities. That can include such things as changes in types of materials used in manufacturing, reductions in waste streams, improved use of water delivered by agricultural irrigation systems, and/or other things that are not directly related to energy using equipment or controls of such equipment. It is obviously not possible to list all such measures. However, a potential study will understate savings potential if it does not include a way of capturing such potential in its estimates. One potential way to get a sense of such potential is to review results of comprehensive industrial efficiency programs run by other utilities to identify the portion of actual program savings from such unique custom measures – and then assume that portion of custom savings could be added to the savings estimated in the study for named measures.	Added to measure list for 2024 study
Electric Vehicle measures	Some EV chargers are more efficient than others. The Federal Energy Star program has a standard for them. Savings potential may not be huge, but should be considered in the study. With a growing number of EV sales, the study should also consider the potential savings from promoting the most efficient EVs within different size/style categories	Added to measure list for 2024 study
Removing screw-based LEDs	The screw-based LEDs on both the Residential and Commercial measure lists should now be considered baseline due to federal efficiency standards adopted earlier this year. Utility load forecasts for IRPs should reflect resulting improvements in end use efficiency.	Screw-based LEDs were included in the study but with limited applicability to reflect current market
Removing Commercial fluorescent lighting	LED technology – for both fixtures and lamps – has advanced significantly in recent years, to the point where it should be the only technology considered for commercial lighting. Measures such as high performance T-8 fluorescent fixtures and high bay T-5 fluorescent fixtures should be replaced with LED alternatives in the study.	Updated measure list for 2024 study to only include LED-based lamps for linear fluorescent replacements

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Removing fossil-gas fueled CHP	Fossil-fuel fired CHP systems should not be considered "renewable" and have questionable benefits if electric generation is expected to get increasingly more renewable and clean. Biogas-fueled CHP – such as systems installed in wastewater treatment facilities that use methane byproducts of processing waste – should be included in the study.	2024 study will continue to assess all CHP options
Adding livestock methane power generation to renewables list	For example, see the "cow power" program currently being run by Green Mountain Power, Vermont's largest electric utility	2024 study will continue to assess DSRE options consistent with prior study, including customer-sited solar, solar plus storage, and CHP
Adding EV managed charging to DR list	With national market shares for EVs growing, it is important that utilities consider programs for managing when charging occurs. Numerous utilities are currently running managed charging programs. This does not currently appear to be on the measure list and should be added to the Florida utilities' potential study.	Added to measure list for 2024 study
Residential "smart thermostat" measure can provide both efficiency savings and demand response potential	This is recognized in the inclusion of smart thermostats in both the Res EE and DR tabs of the measure list spreadsheet. We simply want to flag that it is important when assessing cost-effectiveness of this measure that these two potential benefits are considered together. In other words, the cost should be considered compared to the combined efficiency and DR potential rather than separately considered relative to just EE savings and then separately again compared to just DR potential	2024 study will include interactive impacts of EE and DR opportunities
Emerging Technologies	The efficiency potential study measure list appears to be somewhat outdated. It does not include a number of new and emerging technologies. The potential list of such technologies is long. We suggest reviewing the attached list of emerging technologies developed almost two years ago by Consumers Energy (Michigan) and including them in the study.	Consumers Energy study was reviewed and commercially available measures were added to measure list for 2024 study, including heat pump water heaters - CEE advanced tier, heat pump clothes dryers, ozone laundry systems, and 21+ SEER HVAC units

Technical Potential Study of Demand Side Management

Orlando Utilities Commission

Date: 03.07.2024

Table of Contents

Executive Summary

In October, 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems.

The main objective of the study was to assess the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of Orlando Utilities Commission's (OUC) service territory.

1.1 Methodology

Resource Innovations estimates DSM savings potential by applying an analytical framework that aligns baseline market conditions for energy consumption and demand with DSM opportunities. After describing the baseline condition, Resource Innovations applies estimated measure savings to disaggregated consumption and demand data. The approach varies slightly according to the type of DSM resources and available data; the specific approaches used for each type of DSM are described below.

1.1.1 EE Potential

This study utilized Resource Innovations' proprietary EE modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual program savings. The methodology for the EE potential assessment was based on a hybrid "top-down/bottom-up" approach, which started with the current utility load forecast, then disaggregated it into its constituent customer-class and end-use components. Our assessment examined the effect of the range of EE measures and practices on each end-use, taking into account current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the end-use, customer class, and system levels for OUC.

1.1.2 DR Potential

The assessment of DR potential in OUC's service territory was an analysis of mass market direct load control programs for residential and small commercial and industrial (C&I) customers, and an analysis of DR programs for large C&I customers. The direct load control program assessment focused on the potential for demand reduction through heating, ventilation, and air conditioning (HVAC), water heater, managed electric vehicle charging, and pool pump load control. These end-uses were of particular interest because of their large contribution to peak period system load. For this analysis, a range of direct load control measures were examined for each customer segment to highlight the range of potential. The assessment further accounted for existing DR programs for OUC when calculating the total DR potential.

1.1.3 DSRE Potential

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from customers' PV systems, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

1.2 Savings Potential

Technical potential for EE, DR, and DSRE are as follows:

1.2.1 EE Potential

EE technical potential describes the savings potential when all technically feasible EE measures are fully implemented, ignoring all non-technical constraints on electricity savings, such as cost-effectiveness and customer willingness to adopt EE.

The estimated EE technical potential results are summarized in Table 1.

Table 1. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	249	98	935
Non-Residential[1]	201	99	1,044
Total	450	197	1,979

1.2.2 DR Potential

DR technical potential describes the magnitude of loads that can be managed during conditions when grid operators need peak capacity. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale such as heating, cooling, water heaters, managed electric vehicle charging, and pool pumps. For large C&I customers, this included their entire electric demand during a utility's system peak, as many of these types of customers will forego virtually all electric demand temporarily if the financial incentive is large enough.

The estimated DR technical potential results are summarized in Table 2.

Table 2. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	235	223
Non-Residential	582	563
Total	817	786

[1] Non-Residential results include all commercial and industrial customer segments.

1.2.3 DSRE Potential

DSRE technical potential estimates quantify all technically feasible distributed generation opportunities from PV systems, battery storage systems charged from PV, and CHP technologies based on the customer characteristics of OUC's customer base.

The estimated DSRE technical potential results are summarized in Table 3.

Table 3. DSRE Technical Potential[2]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	339	0	2,731
Non-Residential	162	0	1,169
Total	501	0	3,900
Battery Storage charged from PV Systems			
Residential	171	166	0
Non-Residential	14	70	0
Total	185	236	0
CHP Systems			
Total	354	292	1,591

[2] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

2 Introduction

In October, 2022, the six electric utilities subject to the Florida Energy Efficiency and Conservation Act (FEECA Utilities) retained Resource Innovations, Inc. for the purpose of identifying and characterizing the market for demand-side management (DSM) opportunities, including energy efficiency (EE) improvement and building retrofits, peak load reductions from demand response (DR), and demand-side renewable energy (DSRE) systems. The main objective of the study was:

- Assessing the technical potential of demand-side resources for reducing customer electric energy consumption and seasonal peak capacity demands.

This report provides the detailed methodology and results for the technical potential analysis of OUC's service territory.

The following deliverables were developed by Resource Innovations as part of the project and are addressed in this report:

- DSM measure list and detailed assumption workbooks
- Disaggregated baseline demand and energy use by year, sector, and end-use
- Baseline technology saturations, energy consumption, and demand
- Technical potential demand and energy savings
- Supporting calculation spreadsheets

2.1 Technical Potential Study Approach

Resource Innovations estimates technical potential according to the industry standard categorization, as follows:

> Technical Potential is the theoretical maximum amount of energy and capacity that could be displaced by DSM, regardless of cost and other barriers that may prevent the installation or adoption of a DSM measure.

For this study, technical potential included full application of commercially available DSM technologies to all residential, commercial, and industrial customers in the utility's service territory.

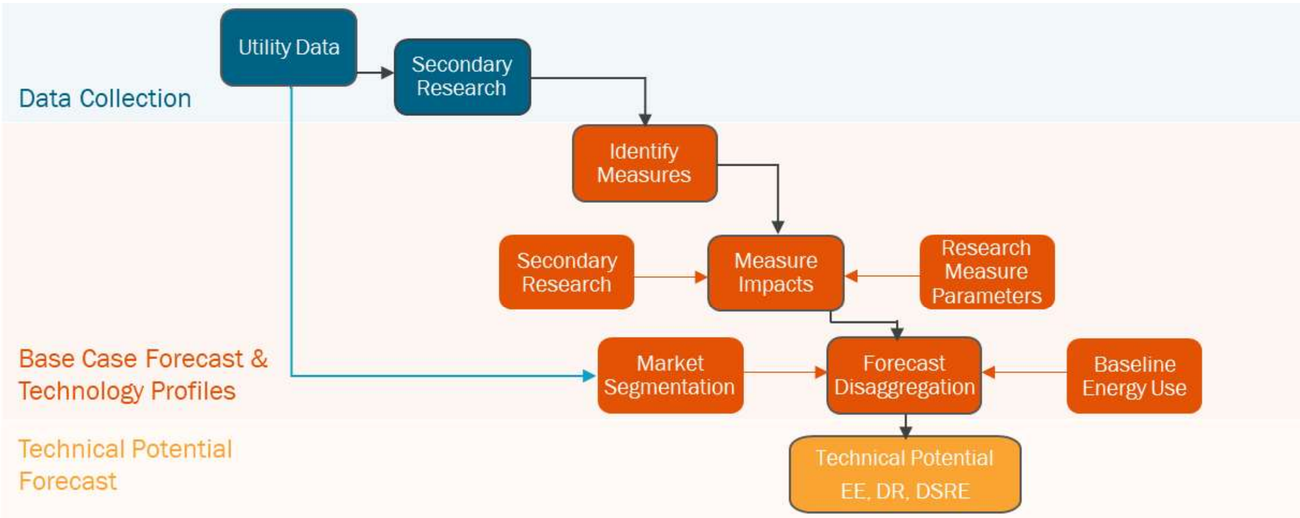
Quantifying DSM technical potential is the result of an analytical process that refines DSM opportunities that align with OUC's customers' electric consumption patterns. Resource Innovations' general methodology for estimating technical potential is a hybrid "top-

down/bottom-up" approach, which is described in detail in Sections 3 through 5 of this report and includes the following steps:

- Develop a baseline forecast: the study began with a disaggregation of the utility's official electric energy forecast to create a baseline electric energy forecast. This forecast does not include any utility-specific assumptions around DSM performance. Resource Innovations applied customer segmentation and consumption data from each utility and data from secondary sources to describe baseline customer-class and end-use components. Additional details on the forecast disaggregation are included in Section 3.
- Identify DSM opportunities: A comprehensive set of DSM opportunities applicable to OUC's climate and customers were analyzed to best depict DSM technical potential. Effects for a range of DSM technologies for each end-use could then be examined while accounting for current market saturations, technical feasibility, and impacts.
- Collect cost and impact data for measures: For those measures applicable to OUC's customers, Resource Innovations conducted primary and secondary research and estimated costs, energy savings, measure life, and demand savings. We differentiated between the type of cost (capital, installation labor, maintenance, etc.) to separately evaluate different implementation modes: retrofit (capital plus installation labor plus incremental maintenance); new construction (incremental capital and incremental maintenance); and burnout costs (incremental capital and incremental maintenance costs for replacement of appliances and equipment that has reached the end of its useful life). Additional details on measure development are included in Section 4.

Figure 1 provides an illustration of the technical potential modeling process conducted for OUC, with the assessment starting with the current utility load forecast, disaggregated into its constituent customer-class and end-use components, and calibrated to ensure consistency with the overall forecast. Resource Innovations considered the range of DSM measures and practices application to each end-use, accounting for current market saturations, and technical feasibility. These unique impacts were aggregated to produce estimates of potential at the technology, end-use, customer class, and system levels.

Figure 1. Approach to Technical Potential Modeling



Resource Innovations estimated DSM technical potential based on a combination of market research, utility load forecasts and customer data, and measure impact analysis, all in coordination with OUC. Resource Innovations examined the technical potential for EE, DR, and DSRE opportunities; this report is organized to offer detail on each DSM category, with additional details on technical potential methodology presented in Section 5.

2.2 EE Potential Overview

To estimate EE potential, this study utilized Resource Innovations' modeling tool, TEA-POT (Technical / Economic / Achievable POTential). This modeling tool was built on a platform that provides the ability to create and analyze multiple scenarios and recalculate potential savings based on variable inputs such as sales/load forecasts, electricity prices, discount rates, and actual utility program savings, as described in Section 5.1.1 below. While the analysis estimates the impacts of individual EE measures, the model accounts for interactions and overlap of individual measure impacts within an end-use or equipment type. The model provides transparency into the assumptions and calculations for estimating EE potential.

2.3 DR Potential Overview

To estimate DR market potential, Resource Innovations considered customer demand during utility peaking conditions and projected customer response to DR measures. Customer demand was determined by looking at account-level interval data for all OUC customers within each customer segment. For each segment, Resource Innovations determined the portion of a customer's load that could be curtailed during the system peak.

2.4 DSRE Potential Overview

The DSRE technologies included in this study are rooftop solar photovoltaic (PV) systems, battery storage systems charged from PV, and combined heat and power (CHP) systems. The study leveraged the customer segmentation and load disaggregation data assembled for the EE and DR analyses, and applied our DSRE model, SPIDER™ (Spatial Penetration and Integration of Distributed Energy Resources), for economic and adoption analysis of solar and battery storage. This model dynamically responds to rapidly changing technologies and accounts for all key time-varying elements such as technology costs, incentives, tax credits, and electric rates. To estimate technical potential for CHP, the study utilized a series of unique distributed generation potential models for each primary market sector (commercial and industrial), calculating the average building consumption, assigning minimum facility size thresholds, and estimating building energy savings share percentage for each CHP technology based on its generation capacity.

3 Baseline Forecast Development

3.1 Market Characterization

The OUC base year energy use and sales forecast provided the reference point to determine potential savings. The end-use market characterization of the base year energy use and reference case forecast included customer segmentation and load forecast disaggregation. The characterization is described in this section, while the subsequent section addresses the measures and market potential energy and demand savings scenarios.

3.1.1 Customer Segmentation

In order to estimate EE, DR, and DSRE potential, the sales forecast and peak load forecasts were segmented by customer characteristics. As electricity consumption patterns vary by customer type, Resource Innovations segmented customers into homogenous groups to identify which customer groups are eligible to adopt specific DSM technologies, have similar building characteristics and load profiles, or are able to provide DSM grid services.

Resource Innovations segmented customers according to the following:

1) By Sector – how much of OUC's energy sales, summer and winter peak demand forecast is attributable to the residential, commercial, and industrial sectors?
2) By Customer – how much electricity does each customer typically consume annually and during system peaking conditions?
3) By End-Use – within a home or business, what equipment is using electricity during the system peak? How much energy does this end-use consume over the course of a year?

Table 4 summarizes the segmentation within each sector. In addition to the segmentation described here for the EE and DSRE analyses, the residential customer segments were further segmented by heating type (electric heat, gas heat, or unknown) and by annual consumption bins within each sub-segment for the DR analysis.

Table 4. Customer Segmentation

Residential	Commercial		Industrial	
Single Family	Assembly	Miscellaneous	Agriculture and Assembly	Primary Resources Industries
Multi-Family	College and University	Offices	Chemicals and Plastics	Stone/Glass/ Clay/Concrete
Manufactured Homes	Grocery	Restaurant	Construction	Textiles and Leather
	Healthcare	Retail	Electrical and Electronic Equipment	Transportation Equipment
	Hospitals	Schools K-12	Lumber/Furniture/ Pulp/Paper	Water and Wastewater
	Institutional	Warehouse	Metal Products and Machinery	Other
	Lodging/ Hospitality		Miscellaneous Manufacturing	

From an equipment and energy use perspective, each segment has variation within each building type or sub-sector. For example, the energy consuming equipment in a convenience store will vary significantly from the equipment found in a supermarket. To account for this variation, the selected end-uses describe energy consumption patterns that are consistent with those typically studied in national or regional surveys, such as the U.S. Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS), Commercial Building Energy Consumption Survey (CBECS) and Manufacturing Energy Consumption Survey (MECS), among others. The end-uses selected for this study are listed in Table 5.

Table 5. End-Uses

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Space heating[3]	Space heating[3]	Process heating
Space cooling[3]	Space cooling[3]	Process cooling
Domestic hot water	Domestic hot water	Compressed air
Ventilation and circulation	Ventilation and circulation	Motors/pumps

[3] Includes the contribution of building envelope measures and efficiencies.

Residential End-Uses	Commercial End-Uses	Industrial End-Uses
Lighting	Interior lighting	Fan, blower motors
Cooking	Exterior lighting	Process-specific
Appliances	Cooking	Industrial lighting
Electronics	Refrigeration	Exterior lighting
Miscellaneous	Office equipment	HVAC[3]
	Miscellaneous	Other

For DR, the end-uses targeted were those with controllable load for residential customers (i.e., HVAC, water heaters, pool pumps, and electric vehicles) and small C&I customers (HVAC and electric vehicles). For large C&I customers, all load during peak hours was included assuming these customers would potentially be willing to reduce electricity consumption for a limited time if offered a large enough incentive during temporary system peak demand conditions.

3.1.2 Forecast Disaggregation

A common understanding of the assumptions and granularity in the baseline load forecast was developed with input from OUC. Key discussion topics reviewed included:

- How current DSM offerings are reflected in the energy and demand forecast.
- Assumed weather conditions and hour(s) of the day when the system is projected to peak.
- Are there portions of the load forecast attributable to customers or equipment not eligible for DSM programs?
- How are projections of population increase, changes in appliance efficiency, and evolving distribution of end-use load shares accounted for in the peak demand forecast?

3.1.2.1 Electricity Consumption (kWh) Forecast

Resource Innovations segmented OUC's electricity consumption forecast into electricity consumption load shares by customer class and end-use. The baseline customer segmentation represents the electricity market by describing how electricity was consumed within the service territory. Resource Innovations developed the forecast for the year 2025, and based it on data provided by OUC, primarily their 2023 Ten-Year Site Plan, which was the most recent plan available at the time the studies were initiated. The data addressed current baseline consumption, system load, and sales forecasts.

3.1.2.2 Peak Demand (kW) Forecast

A fundamental component of DR potential was establishing a baseline forecast of what loads or operational requirements would be absent due to existing dispatchable DR or time varying rates. This baseline was necessary to assess how DR can assist in meeting specific planning and operational requirements. We utilized OUC's summer and winter peak demand forecast, which was developed for system planning purposes.

3.1.2.3 Estimating Consumption by End-Use Technology

As part of the forecast disaggregation, Resource Innovations developed a list of electricity end-uses by sector (Table 5). To develop this list, Resource Innovations began with OUC's estimates of average end-use consumption by customer and sector. Resource Innovations combined these data with other information, such as utility residential appliance saturation surveys, as available, to develop estimates of customers' baseline consumption. Resource Innovations calibrated the utility-provided data with data available from public sources, such as the EIA's recurring data-collection efforts that describe energy end-use consumption for the residential, commercial, and manufacturing sectors.

To develop estimates of end-use electricity consumption by customer segment and end-use, Resource Innovations applied estimates of end-use and equipment-type saturation to the average energy consumption for each sector. The following data sources and adjustments were used in developing the base year 2025 sales by end-use:

Residential Sector:

- The disaggregation was based on OUC's rate class load shares and intensities.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - OUC rate class load share is based on average per customer.
    - Resource Innovations made conversions to usage estimates generated by applying EIA RECS data, residential end-use study data from other FEECA utilities, and EIA's Annual Energy Outlook (AEO) 2023.

Commercial Sector:

- The disaggregation was based on OUC's rate class load shares, intensities, and EIA CBECS data.
- Segment data from EIA and OUC.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:

    - Rate class load share based on EIA CBECS and end-use forecasts from OUC.

Industrial Sector:

- The disaggregation was based on rate class load shares, intensities, and EIA MECS data.
- Segment data from EIA and OUC.
- Baseline intensity was calibrated to account for differences in end-use saturation, fuel source, and equipment saturation as follows:
    - Rate class load share based on EIA MECS and end-use forecasts from OUC.

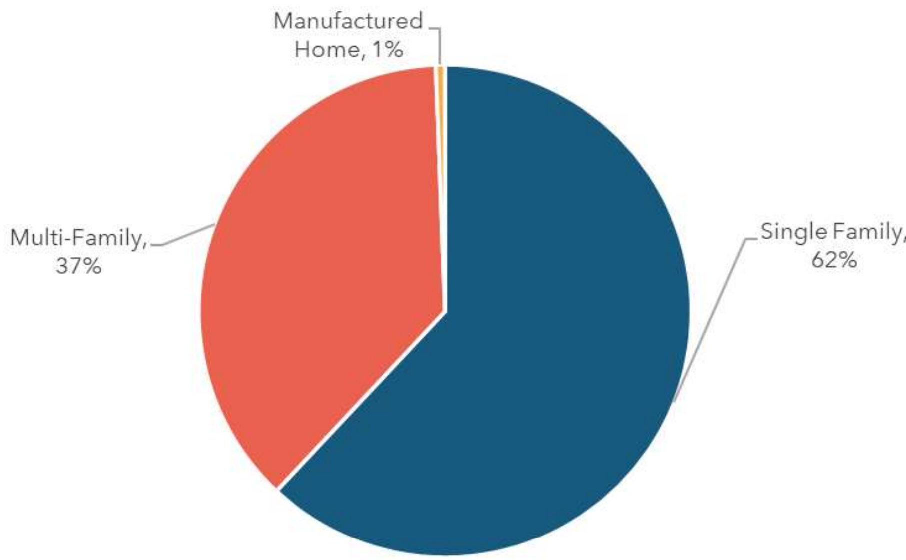
3.2 Analysis of Customer Segmentation

Customer segmentation is important to ensuring that a MPS examines DSM measure savings potential in a manner that reflects the diversity of energy savings opportunities existing across the utility's customer base. OUC provided Resource Innovations with data concerning the premise type and loads characteristics for all customers for the MPS analysis. Resource Innovations examined the provided data from multiple perspectives to identify customer segments. Resource Innovations' approach to segmentation varied slightly for non-residential and residential accounts, but the overall logic was consistent with the concept of expressing the accounts in terms that were relevant to DSM opportunities.

3.2.1 Residential Customers (EE, DR, and DSRE Analysis)

Segmentation of residential customer accounts enabled Resource Innovations to align DSM opportunities with appropriate DSM measures. Resource Innovations used utility customer data, supplemented with EIA data, to segment the residential sector by customer dwelling type (single family, multi-family, or manufactured home). The resulting distribution of customers according to dwelling unit type is presented in Figure 2.

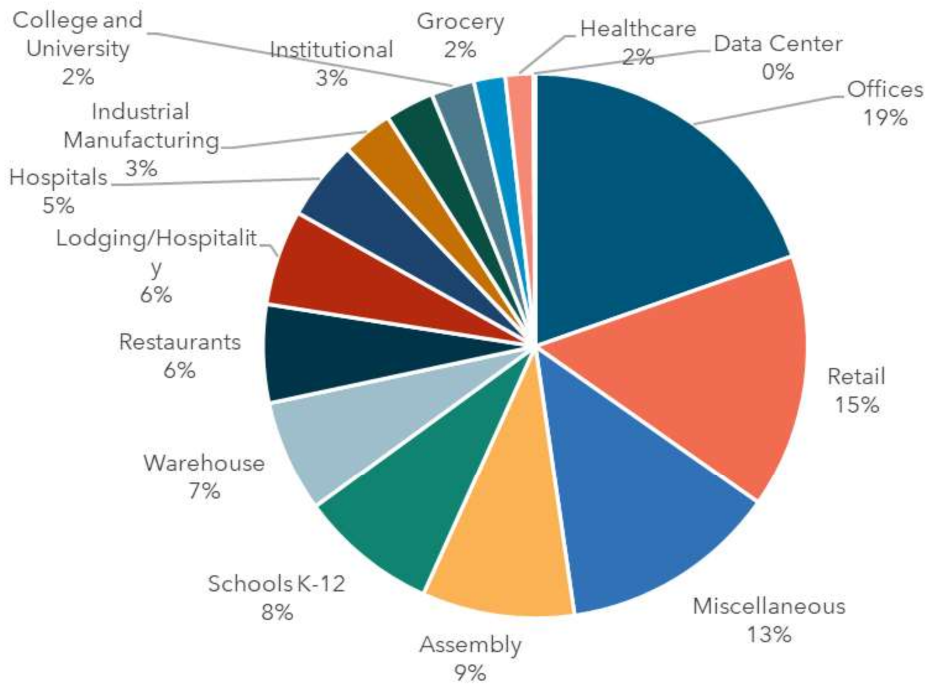
Figure 2. Residential Customer Segmentation



3.2.2 Non-Residential (Commercial and Industrial) Customers (EE and DSRE Analysis)

For the EE and DSRE analysis, Resource Innovations segmented C&I accounts using the utility's North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes, supplemented by data produced by the EIA's CBECS and MECS. Resource Innovations classified the customers in this group as either commercial or industrial, on the basis of DSM measure information available and applicable to each. For example, agriculture and forestry DSM measures are commonly considered industrial savings opportunities. Resource Innovations based this classification on the types of DSM measures applicable by segment, rather than on the annual energy consumption or maximum instantaneous demand from the segment as a whole. The estimated energy sales distributions Resource Innovations applied are shown below in Figure 3.

Figure 3. Business Customer Segmentation



3.2.3 Commercial and Industrial Accounts (DR Analysis)

For the DR analysis, Resource Innovations divided the non-residential customers into the two customer classes of small C&I and large C&I using rate class and annual consumption. For the purposes of this analysis, small C&I customers are those on the General Service (GS) tariff. Large C&I customers are all customers on the General Service Demand (GSD) tariff or on the General Service Large Demand (GSLD) tariff. Resource Innovations further segmented these two groups based on customer size. For small C&I, segmentation was determined using annual customer consumption and for large C&I the customer's maximum demand was used. Both customer maximum demand and customer annual consumption were calculated using billing data provided by OUC.

Table 6 shows the account breakout between small C&I and large C&I.

Table 6. Summary of Customer Classes for DR Analysis

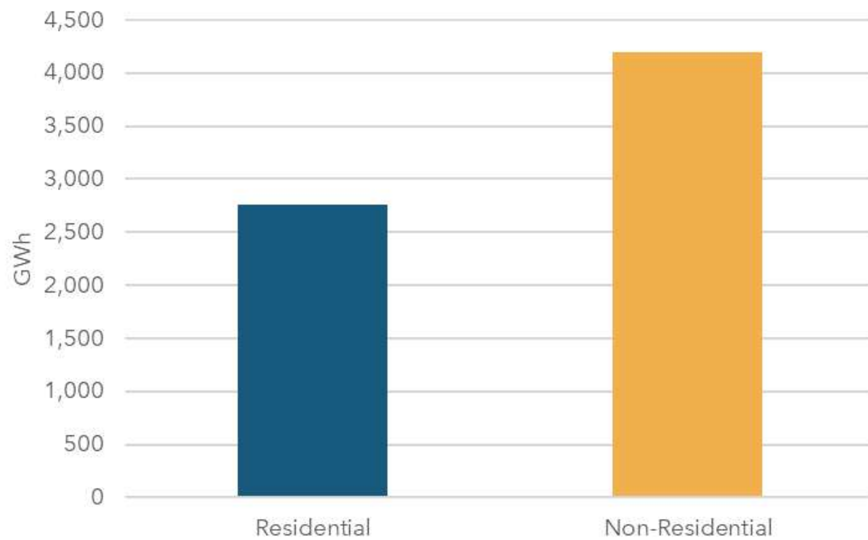
Customer Class	Annual kWh	Estimated Number of Accounts
Small C&I	0-15,000 kWh	15,967
	15,001-25,000 kWh	3,211
	25,001-50,000 kWh	3,269
	50,001 kWh +	2,096
	Total	24,543
Large C&I	0-50 kW	1,764
	51-300 kW	2,114
	301-500 kW	267
	501 kW +	373
	Total	4,518

3.3 Analysis of System Load

3.3.1 System Energy Sales

Technical potential is based on OUC's load forecast for the year 2025 from their 2023 Ten Year Site Plan, which is illustrated in **Error! Reference source not found.**.

Figure 4: 2025 Electricity Sales Forecast by Sector



3.3.2 System Demand

To determine the technical potential for DR, Resource Innovations first established peaking conditions for each utility by looking at when each utility historically experienced its maximum demand. The primary data source used to determine when maximum DR impact was the historical system load for OUC. The data provided contained the system loads for all 8,760 hours of the most recent five years leading up to the study (2016-2021). The OUV summer and winter peaks were then identified within the utility-defined peaking conditions. For OUC the summer peaking conditions were defined as August from 5:00-6:00 PM and the winter peaking conditions were defined as January from 6:00-7:00 PM. The seasonal peaks were then selected as the maximum demand during utility peaking conditions.

3.3.3 Load Disaggregation

The disaggregated annual electric loads[4] for the base year 2025 by sector and end-use are summarized in Figure 5 and Figure 6.

[4] Full disaggregation of system demand by end-use was not conducted, as DR potential for residential and small C&I customers focused on specific end-uses of particular interest because of their large contribution to peak period system load, and was not end-use specific for large C&I customers. A description of the end-use analysis for residential and small C&I customers is included in Section 5.1.2

Figure 5: Residential Baseline (2025) Energy Sales by End-Use

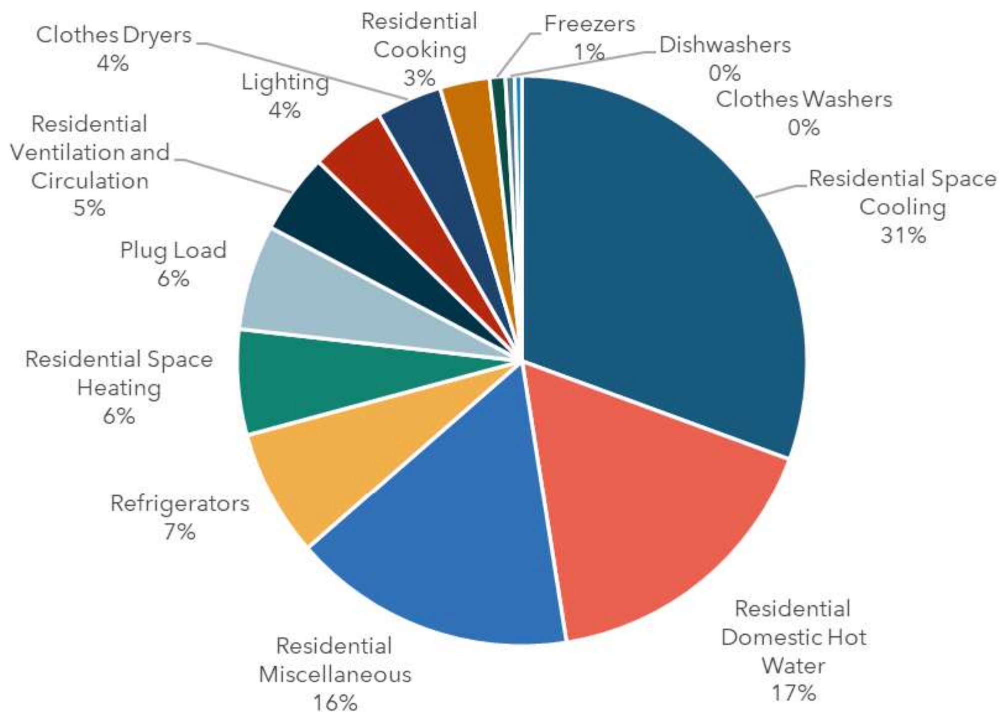
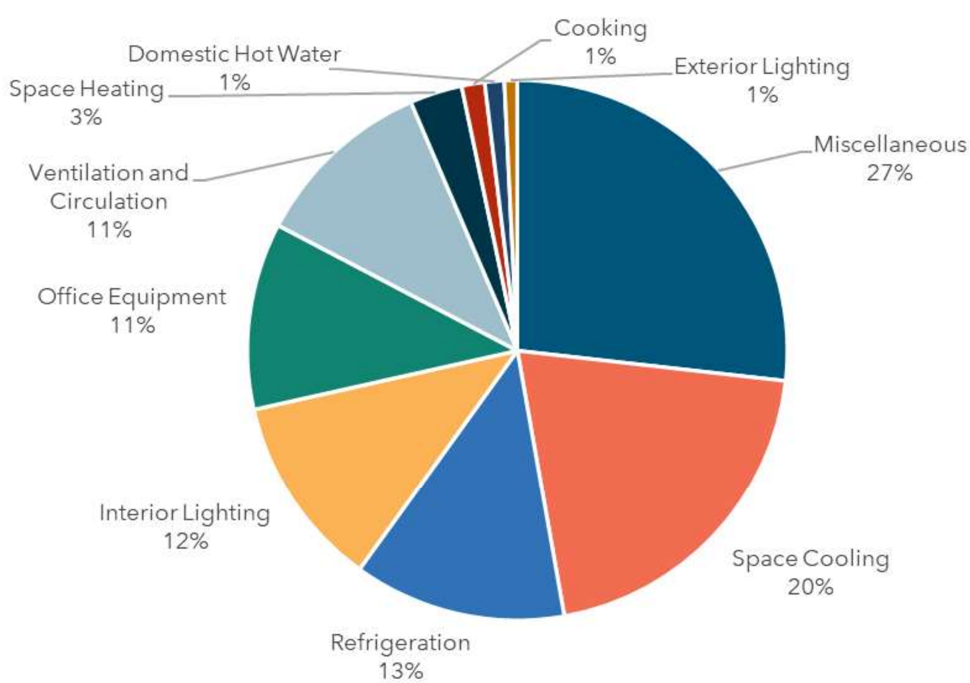


Figure 6: Business Baseline (2025) Energy Sales by End-Use



4 DSM Measure Development

DSM potential is described by comparing baseline market consumption with opportunities for savings. Describing these individual savings opportunities results in a list of DSM measures to analyze. This section presents the methodology to develop the EE, DR, and DSRE measure lists.

4.1 Methodology

Resource Innovations identified a comprehensive catalog of DSM measures for the study. The measure list is the same for all FEECA Utilities. The iterative vetting process with the utilities to develop the measure list began by initially examining the list of measures included in the 2019 Goals docket. This list was then adjusted based on proposed measure additions and revisions provided by the FEECA Utilities. Resource Innovations further refined the measure list based on reviews of Resource Innovations' DSM measure library, compiled from similar market potential studies conducted in recent years throughout the United States, as well as measures included in other utility programs where Resource Innovations is involved with program design, implementation, or evaluation. The FEECA Utilities also reached out to interested parties and received input with recommendations on measure additions to the 2019 measure list. Their measure suggestions were reviewed and incorporated into the study as appropriate. External measure suggestions and actions are summarized in Appendix D. The extensive, iterative review process involving multiple parties has ensured that the study included a robust and comprehensive set of DSM measures.

See Appendix A for the list of EE measures, Appendix B for the list of DR measures, and Appendix C for the list of DSRE measures analyzed in the study.

4.2 EE Measures

EE measures represent technologies applicable to the residential, commercial, and industrial customers in the FEECA Utilities' service territories. The development of EE measures included consideration of:

- EE technologies that are applicable to Florida and commercially available: Measures that are not applicable due to climate or customer characteristics were excluded, as were "emerging" technologies that are not currently commercially available to FEECA utility customers.
- Current and planned Florida Building Codes and Federal equipment standards (Codes & Standards) for baseline equipment: Measures included from prior studies

were adjusted to reflect current Codes & Standards as well as updated efficiency tiers, as appropriate.

- Eligibility for utility DSM offerings in Florida: For example, behavioral measures were excluded from consideration, as they historically have not been allowed to count towards utility DSM goals. Behavioral measures are intended to motivate customers to operate in a more energy-efficient manner (e.g., setting an air-conditioner thermostat to a higher temperature) without accompanying: a) physical changes to more efficient end-use equipment or to their building envelope, b) utility-provided products and tools to facilitate the efficiency improvements, or c) permanent operational changes that improve efficiency which are not easily revertible to prior conditions. These types of behavioral measures were excluded because of the variability in forecasting the magnitude and persistence of energy and demand savings from the utility's perspective. Additionally, decoupling behavioral measure savings from the installation of certain EE technologies like smart thermostats can be challenging and could result in overlapping potential with other EE measures included in the study.

Upon development of the final EE measure list, utility-specific measure details were developed. RI maintains a proprietary online database of energy efficiency measures for MPS studies, which was used as a starting point for measure development for this study. Measures are added or updated at the request of project stakeholders or because of changes to the EE marketplace (for example, new codes and standards, or current practice in the market). Measure data are refined as new data or algorithms are developed for estimating measure impacts, and updated for each study to incorporate inputs parameters specific to the service territory being analyzed. The database contains the following information for each of the measures:

- Measure description: measure classification by type, end-use, and subsector, and description of the base-case and the efficient-case scenarios.
- kWh savings: Energy savings associated with each measure were developed through engineering algorithms or building simulation modeling, taking climate data and customer segments into consideration as appropriate. Reference sources used for developing residential, commercial, and industrial measure savings included a variety of Florida-specific, as well as regional and national sources, such as utility-specific measurement & verification (M&V) data, technical reference manuals (TRM) from other jurisdictions, ENERGY STAR calculators, and manufacturer or retailer specifications for particular products.
- Energy savings were applied in RI's TEA-POT model as a percentage of total baseline consumption. Peak demand savings were determined using utility-specific load shapes or coincidence factors.

- Measure Expected Useful Lifetime: Sources included the Database for Energy Efficient Resources (DEER), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, TRMs, and other regional and national measure databases and EE program evaluations.
- Measure Costs: Per-unit costs (full or incremental, depending on the application) associated with measure installations. Sources included: TRMs, ENERGY STAR calculator, online market research, FEECA utility program data, and other secondary sources.

The measure details from the online measure library are exported for use in RI's TEA-POT model, accompanied by utility-specific estimates of measure applicability. Measure applicability is a general term encompassing an array of factors, including technical feasibility of installation, and the measure's current saturation as well as factors to allocate savings associated with competing measures. Information used was primarily derived from data in current regional and national databases, as well as OUC's program tracking data. These factors are described in Table 7.

Table 7. Measure Applicability Factors

Measure Impact	Explanation	Sources
Technical Feasibility	The percentage of buildings that can have the measure physically installed. Various factors may affect this, including, but not limited to, whether the building already has the baseline measure (e.g., dishwasher), and limitations on installation (e.g., size of unit and space available to install the unit).	Various secondary sources and engineering experience.
Measure Incomplete Factor	The percentage of buildings without the specific measure currently installed.	OUC RASS; EIA RECS, CBECS; MECS; ENERGY STAR sales figures; and engineering experience.
Measure Share	Used to distribute the percentage of market shares for competing measures (e.g., only blown-in ceiling insulation or spray foam insulation, not both would be installed in an attic).	OUC customer data, Various secondary sources and engineering experience.

As shown in Table 8, the measure list includes 395 unique energy-efficiency measures. Expanding the measures to account for all appropriate installation scenarios resulted in

9,535 measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (i.e., a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed).

Table 8. EE Measure Counts by Sector

Sector	Unique Measures	Permutations
Residential	119	1,173
Commercial	164	5,798
Industrial	112	2,564

4.3 DR Measures

The DR measures included in the measure list utilize the following DR strategies:

- **Direct Load Control.** OUC control of selected equipment at the customer's home or business, such as HVAC or water heaters.
- **Critical Peak Pricing (CPP) with Technology.** Electricity rate structures that vary based on time of day. Includes CPP when the rate is substantially higher for a limited number of hours or days per year (customers receive advance notification of CPP event) coupled with technology that enables customer to lower their usage in a specific end-use in response to the event (e.g., HVAC via smart thermostat).
- **Contractual DR.** Customers receive incentive payments or a rate discount for committing to reduce load by a pre-determined amount or to a pre-determined firm service level upon utility request.
- **Automated DR.** OUC dispatched control of specific end-uses at a customer facility.

DR initiatives that do not rely on the installation of a specific device or technology to implement (such as a voluntary curtailment program or time of use rates) were not included.

A workbook was developed for each measure which included the same measure inputs as previously described for the EE measures. In addition, the DR workbook included expected load reduction from the measure, based on utility technical potential, existing utility DR programs, and other nationwide DR programs if needed.

For technical potential, Resource Innovations did not break out results by specific measure or control technology because all of the developed measures target the end-uses estimated

for technical potential (i.e., potential is reported for space cooling end-use and not allocated to switches, smart thermostats, etc.).

4.4 DSRE Measures

The DSRE measure list includes rooftop PV systems, battery storage systems charged from PV systems, and CHP systems.

PV Systems

PV systems utilize solar panels (a packaged collection of PV cells) to convert sunlight into electricity. A system is constructed with multiple solar panels, a DC/AC inverter, a racking system to hold the panels, and electrical system interconnections. These systems are often roof-mounted systems that face south-west, south, and/or, south-east. The potential associated with roof-mounted systems installed on residential and commercial buildings was analyzed.

Battery Storage Systems Charged from PV Systems

Distributed battery storage systems included in this study consist of behind-the-meter battery systems installed in conjunction with an appropriately-sized PV system at residential and commercial customer facilities. These battery systems typically consist of a DC-charged battery, a DC/AC inverter, and electrical system interconnections to a PV system. On their own battery storage systems do not generate or conserve energy, but can collect and store excess PV generation to provide power during particular time periods, which for DSM purposes would be to offset customer demand during the utility's system peak.

CHP Systems

In most CHP applications, a heat engine creates shaft power that drives an electrical generator (fuel cells can produce electrical power directly from electrochemical reactions). The waste heat from the engine is then recovered to provide other on-site needs. Common prime mover technologies used in CHP applications and explored in this study include:

- Steam turbines
- Gas turbines
- Micro turbines
- Fuel Cells
- Internal combustion engines

A workbook was developed for each measure which included the inputs previously described for EE measures and prime mover operating parameters.

5 Technical Potential

In the previous sections, the approach for DSM measure development was summarized, and the 2025 base year load shares and reference-case load forecast were described. The outputs from these tasks provided the input for estimating the technical potential scenario, which is discussed in this section.

The technical potential scenario estimates the potential energy and demand savings when all technically feasible and commercially available DSM measures are implemented without regard for cost-effectiveness and customer willingness to adopt the most impactful EE, DR, or DSRE technologies. Since the technical potential does not consider the costs or time required to achieve these savings, the estimates provide a theoretical upper limit on electricity savings potential. Technical potential is only constrained by factors such as technical feasibility and applicability of measures. For this study, technical potential included full application of the commercially available DSM measures to all residential, commercial, and industrial customers in the utility's service territory.

5.1 Methodology

5.1.1 EE Technical Potential

EE technical potential refers to delivering less electricity to the same end-uses. In other words, technical potential might be summarized as "doing the same thing with less energy, regardless of the cost."

DSM measures were applied to the disaggregated utility electricity sales forecasts to estimate technical potential. This involved applying estimated energy savings from equipment and non-equipment measures to all electricity end-uses and customers. Technical potential consists of the total energy and demand that can be saved in the market which Resource Innovations reported as single numerical values for each utility's service territory.

The core equation used in the residential sector EE technical potential analysis for each individual efficiency measure is shown in Equation 1 below, while the core equation used in the nonresidential sector technical potential analysis for each individual efficiency measure is shown in Equation 2.

Equation 1: Core Equation for Residential Sector EE Technical Potential

$$\text{Technical Potential of Efficient Measures} = \text{Total Number of Households} \times \text{Base Case Equipment Energy Use Intensity (kWh/unit)} \times \text{Saturation Shares} \times \text{Percent Incomplete} \times \text{Feasibility Factor} \times \text{Savings Factor}$$

Where:

- **Baseline Equipment Energy Use Intensity** = the electricity used per customer per year by each baseline technology in each market segment. In other words, the baseline equipment energy-use intensity is the consumption of the electrical energy using equipment that the efficient technology replaces or affects.
- **Saturation Share** = the fraction of the end-use electrical energy that is applicable for the efficient technology in a given market segment. For example, for residential cooling, the saturation share would be the fraction of all residential electric customers that have central air conditioners in their household.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of central air conditioners that is not already energy efficient.
- **Feasibility Factor** = the fraction of units that is technically feasible for conversion to the most efficient available technology from an engineering perspective (i.e., it may not be possible to install LEDs in all light sockets in a home because the available styles may not fit in every socket).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

Equation 2: Core Equation for Non-Residential Sector EE Technical Potential

$$\text{Technical Potential of Efficient Measures} = \text{Total Stock Sq. Footage by Building Type by EDC} \times \text{Base Case Equipment Energy Use Intensity (kWh/unit)} \times \text{Saturation Shares} \times \text{Percent Incomplete} \times \text{Feasibility Factor} \times \text{Savings Factor}$$

Where:

- **Total Stock Square Footage by Segment** = the forecasted square footage level for a given building type (e.g., square feet of office buildings).
- **Baseline Equipment Energy Use Intensity** = the electricity used per square foot per year by each baseline equipment type in each market segment.

- **Saturation Shares** = the fraction of total end-use energy consumption associated with the efficient technology in a given market segment. For example, for packaged terminal air-conditioner (PTAC), the saturation share would be the fraction of all space cooling kWh in a given market segment that is associated with PTAC equipment.
- **Percent Incomplete** = the fraction of equipment that is not considered to already be energy efficient.
- **Feasibility Factor** = the fraction of the equipment or practice that is technically feasible for conversion to the efficient technology from an engineering perspective (i.e., it may not be possible to install Variable Frequency Drives (VFD) on all motors in a given market segment).
- **Savings Factor** = the percentage reduction in electricity consumption resulting from the application of the efficient technology.

It is important to note that the technical potential estimate represents electricity savings potential at a specific point in time. In other words, the technical potential estimate is based on data describing status quo customer electricity use and technologies known to exist today. As technology and electricity consumption patterns evolve over time, the baseline electricity consumption will also change accordingly. For this reason, technical potential is a discrete estimate of a dynamic market. Resource Innovations reported the technical potential for 2025, based on currently known DSM measures and observed electricity consumption patterns.

Measure Interaction and Competition (Overlap)

While the technical potential equations listed above focus on the technical potential of a single measure or technology, Resource Innovations' modeling approach does recognize the overlap of individual measure impacts within an end-use or equipment type, and accounts for the following interactive effects:

- Measure interaction: Installing high-efficiency equipment could reduce energy savings in absolute terms (kWh) associated with non-equipment measures that impact the same end-use. For example, installing a high-efficiency heat pump will reduce heating and cooling consumption which will reduce the baseline against which attic insulation would be applied, thus reducing savings associated with installing insulation. To account for this interaction, Resource Innovations' TEA-POT model ranks measures that interact with one another and reduces the baseline consumption for the subsequent measure based on the savings achieved by the preceding measure. For technical potential, interactive measures are ranked based on total end-use energy savings percentage.
- Measure competition (overlap): The "measure share"—as defined above—accounted for competing measures, ensuring savings were not double-counted. This interaction

occurred when two or more measures "competed" for the same end-use. For example, a T-12 lamp could be replaced with a T-8 or linear LED lamp.

Addressing Naturally-Occurring EE

Naturally occurring energy efficiency includes actions taken by customers to improve the efficiency of their homes and businesses in the absence of utility program intervention. For the analysis of technical potential, Resource Innovations verified with OUC's forecasting group that the baseline sales forecasts incorporated two known sources of naturally-occurring efficiency:

- Codes and Standards: The sales forecasts already incorporated the impacts of known Code & standards changes.
- Baseline Measure Adoption: The sales forecast excluded the projected impacts of future DSM efforts but included already implemented DSM penetration.

By properly accounting for these factors, the technical potential analysis estimated the additional EE opportunities beyond what is already included in the utility sales forecast.

5.1.2 DR Technical Potential

The concept of technical potential applies differently to DR than for EE. Technical potential for DR is effectively the magnitude of loads that can be curtailed during conditions when utilities need peak capacity reductions. In evaluating this potential at peak capacity, the following were considered: which customers are consuming electricity at those times? What end-uses are in play? Can those end-use loads be managed? Large C&I accounts generally do not provide the utility with direct control over particular end-uses. Instead, many of these customers will forego electric demand temporarily if the financial incentive is large enough. For residential and small C&I customers where DR generally takes the form of direct utility control, technical potential for DR is limited by the loads that can be controlled remotely at scale.

This framework makes end-use disaggregation an important element for understanding DR potential, particularly in the residential and small C&I sectors. When done properly, end-use disaggregation not only provides insights into which loads are on and off when specific grid services are needed, it also provides insight concerning how key loads and end-uses, such as air conditioning use, vary across customers. Resource Innovations' approach used for load disaggregation is more advanced than what is used for most potential studies. Instead of disaggregating annual consumption or peak demand, Resource Innovations produced end-use load disaggregation for all 8,760 hours. This was needed because the loads available at times when different grid applications are needed can vary substantially. Instead

of producing disaggregated loads for the average customer, the study was produced for several customer segments. For OUC, Resource Innovations examined three residential segments based on customer housing type, four different small C&I segments based on customer size, and four different large C&I segments based on customer size, for a total of 11 different customer segments.

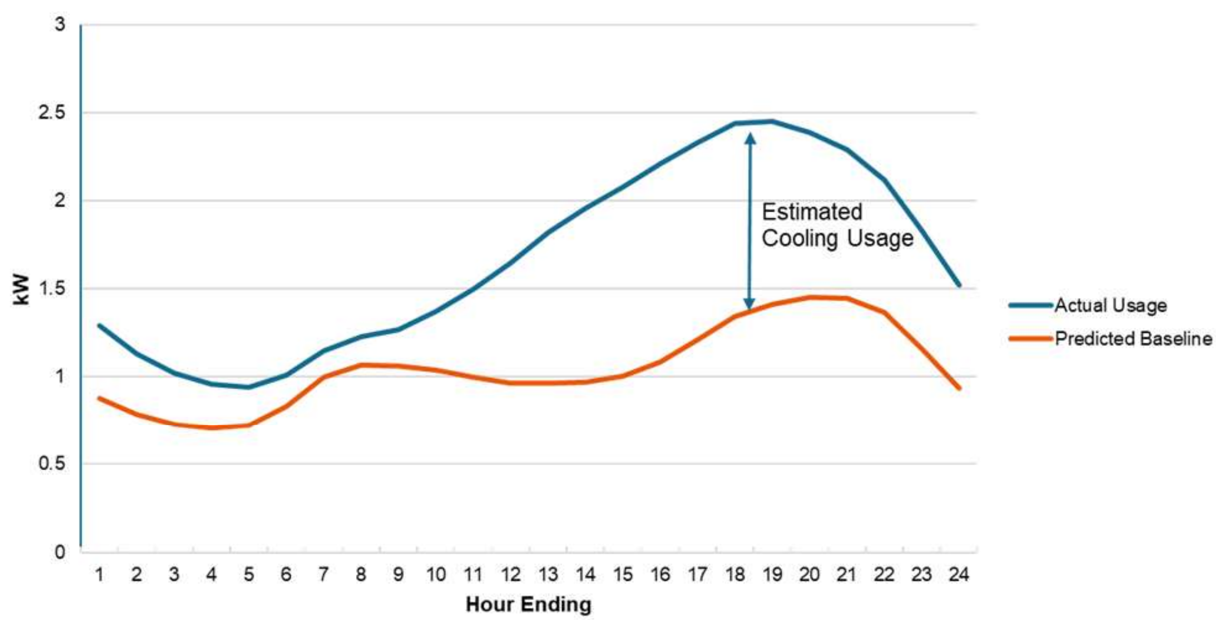
Technical potential, in the context of DR, is defined as the total amount of load available for reduction that is coincident with the period of interest; in this case, the system peak hour for the summer and winter seasons. Thus, two sets of capacity values are estimated: a summer capacity and a winter capacity.

As previously mentioned, for technical potential purposes, all coincident large C&I load is considered dispatchable, while residential and small C&I DR capacity is based on specific end-uses. Summer DR capacity for residential customers was comprised of air-conditioning (AC), pool pumps, water heaters, and managed electric vehicle charging. For small C&I customers, summer capacity was based on AC load. For winter DR capacity, residential was based on electric heating, pool pumps, and water heaters. For small C&I customers, winter capacity was based on electric heating.

AC and heating load profiles were generated for residential and small C&I customers using census-level customer interval data provided by OUC. This data included a customer breakout based on housing type for residential customers and size for small C&I customers. Resource Innovations then used the interval data from these customers to create an average load profile for each customer segment.

The average load profile for each customer segment was combined with historical weather data, and used to estimate hourly load as a function of weather conditions. AC and heating loads were estimated by first calculating the baseline load on days when cooling degree days (CDD) and heating degree days (HDD) were equal to zero, and then subtracting this baseline load. This methodology is illustrated by Figure 7 (a similar methodology was used to predict heating loads).

Figure 7: Methodology for Estimating Cooling Loads



This method was able to produce estimates for average AC/heating load profiles for the seven different customer segments within the residential and small C&I sectors.

Profiles for residential water heater and pool pump loads were estimated by utilizing end-use load data from NREL's residential end-use load profile database.

For all eligible loads, the technical potential was defined as the amount that was coincident with system peak hours for each season, which are August from 5:00-6:00 PM for summer, and January from 6:00-7:00 PM for winter. As mentioned in Section 4, for technical potential there was also no measure breakout needed, because all measures will target the end-uses' estimated total loads.

5.1.3 DSRE Technical Potential

5.1.3.1 PV Systems

To determine technical potential for PV systems, RI estimated the percentage of rooftop square footage in Florida that is suitable for hosting PV technology. Our estimate of technical potential for PV systems in this report is based in part on the available roof area and consisted of the following steps:

- Step 1: Outcomes from the forecast disaggregation analysis were used to characterize the existing and new residential, commercial and industrial building stocks.
    - To calculate the total roof area for residential buildings, the average roof area per household is multiplied by the number of households.
    - For commercial and industrial buildings, RI calculated the total roof area by first dividing the load forecast by the energy usage intensity, which provides an estimate of the total building square footage. This result is then divided by the average number of floors to derive the total roof area.
- Step 2: The total available roof area feasible for installing PV systems was calculated. Relevant parameters included unusable area due to other rooftop equipment and setback requirements, in addition to possible shading from trees and limitations of roof orientation (factored into a "technical suitability" multiplier).
- Step 3: Estimated the expected power density (kW per square foot of roof area).
- Step 4: Estimated the hourly PV generation profile using NREL's PV Watts Calculator
- Step 5: Calculated total energy and coincident peak demand potential by applying RI's Spatial Penetration and Integration of Distributed Energy Resources (SPIDER) Model.

The methodology presented in this report uses the following formula to estimate overall technical potential of PVs:

Equation 3: Core Equation for Solar DSRE Technical Energy Potential

$$\text{PV Technical Energy Potential} = \text{Suitable Rooftop PV Area (Sq Ft)} \times \text{PV Power Density (kW-DC/Sq Ft)} \times \text{Generation Factor (kWh/kW-DC)}$$

Where:

- **Suitable Rooftop PV Area for Residential [Square Feet]:** Number of Residential Buildings x Average Roof Area Per Building x Technical Suitability Factor
- **Suitable Rooftop PV Area for Commercial [Square Feet] :** Energy Consumption [kWh] / Energy Intensity [kWh / Square Feet] / Average No. of Stories Per Building x Technical Suitability Factor
- **PV Power Density [kW-DC/Square Feet]:** Maximum power generated in Watts per square foot of solar panel.
- **Generation Factor:** Annual Energy Generation Factor for PV, from PV Watts (dependent on local solar irradiance)

5.1.3.2 Battery Storage Systems Charged from PV Systems

Battery storage systems on their own do not generate power or create efficiency improvements, but store power for use at different times. Therefore, in analyzing the technical potential for battery storage systems, the source of the stored power and overlap with technical potential identified in other categories was considered.

Battery storage systems that are powered directly from the grid do not produce annual energy savings but may be used to shift or curtail load during particular time periods. As the DR technical potential analyzes curtailment opportunities for the summer and winter peak period, and battery storage systems can be used as a DR technology, the study concluded that no additional technical potential should be claimed for grid-powered battery systems beyond that already attributed to DR.

Battery storage systems that are connected to on-site PV systems also do not produce additional energy savings beyond the energy produced from the PV system[5]. However, PV-connected battery systems do create the opportunity to store energy during period when the PV system is generating more than the home or business is consuming and use that stored power during utility system peak periods.

To determine the additional technical potential peak demand savings for "solar plus storage" systems, our methodology consisted of the following steps:

- Assume that every PV system included in PV Technical Potential is installed with a paired storage system.
- Size the storage system assuming peak storage power is equal to peak PV generation and energy storage duration is three hours.
- Apply RI's hourly dispatch optimization module in SPIDER to create an hourly storage dispatch profile that flattens the individual customer's load profile to the greatest extent possible accounting for a) customer hourly load profile, b) hourly PV generation profile, and c) battery peak demand, energy capacity, and roundtrip charge/discharge efficiency.
- Calculate the effective hourly impact for the utility using the above storage dispatch profile, aligned with the utility's peak hour (calculated separately for summer and winter)
- Report the output storage kW impact on utility coincident peak demand in summer and winter.

---

[5] PV-connected battery systems experience some efficiency loss due to storage, charging, and discharging. However, for this study, these losses were not quantified.

5.1.3.3 CHP Systems

The CHP analysis created a series of unique distributed generation potential models for each primary market sector (commercial and industrial).

Only non-residential customer segments whose electric and thermal load profiles allow for the application of CHP were considered. The technical potential analysis followed a three-step process. First, minimum facilities size thresholds were determined for each non-residential customer segment. Next, the full population of non-residential customers were segmented and screened based on the size threshold established for that segment. Finally, the facilities that were of sufficient size were matched with the appropriately sized CHP technology.

To determine the minimum threshold for CHP suitability, a thermal factor was applied to potential candidate customer loads to reflect thermal load considerations in CHP sizing. In most cases, on-site thermal energy demand is smaller than electrical demand. Thus, CHP size is usually dictated by the thermal load in order to achieve improved efficiencies.

The study collected electric and thermal intensity data from other recent CHP studies. For industrial customers, Resource Innovations assumed that the thermal load would primarily be used for process operations and was not modified from the secondary data sources for Florida climate conditions. For commercial customers, the thermal load is more commonly made up of water heating, space heating, and space cooling (through the use of an absorption chiller). Therefore, to account for the hot and humid climate in Florida, which traditionally limits weather-dependent internal heating loads, commercial customers' thermal loads were adjusted to incorporate a higher proportion of space cooling to space heating as available opportunities for waste heat recovery.

Resource Innovations worked with the utility-provided customer data, focusing on annual consumption due to the absence of NAICS or SIC codes for this utility data. Non-residential customers were subsequently classified based on annual consumption and size. Since NAICS or SIC codes were unavailable, no formal segmentation occurred. Instead, the analysis focused exclusively on annual utility usage. Facilities with annual loads below the kWh thresholds were deemed unlikely to possess the consistent electric and thermal loads necessary to support CHP and were consequently excluded from consideration. Conversely, those meeting the size criteria were aligned with the corresponding CHP technology.

In general, internal combustion engines are the prime mover for systems under 500kW with gas turbines becoming progressively more popular as system size increases above that. Based on the available load by customer, adjusted by the estimated thermal factor for each

segment, CHP technologies were assigned to utility customers in a top-down fashion (i.e., starting with the largest CHP generators).

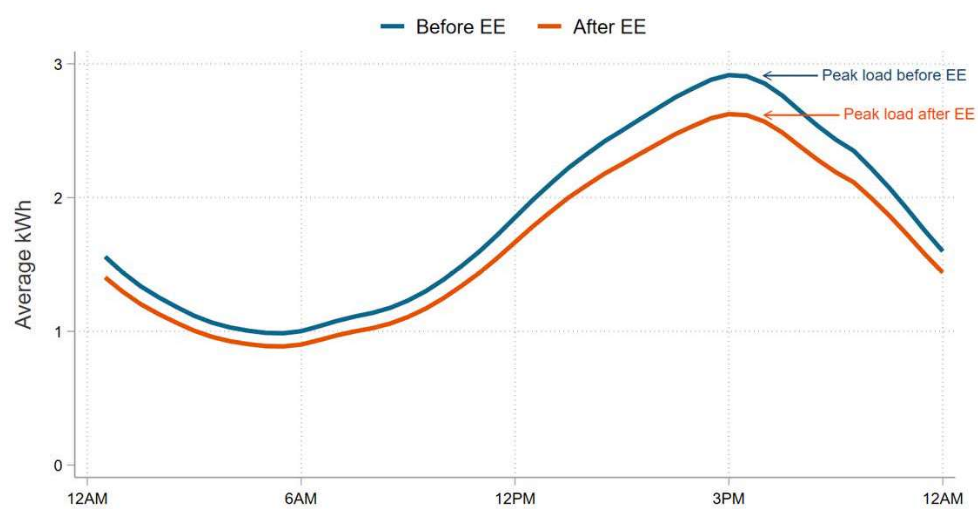
Measure Interaction

PV systems and battery storage charged from PV systems were analyzed collectively due to their common power generation source; and therefore, the identified technical potential for these systems is additive. However, CHP systems were independently analyzed for technical potential without consideration of the competition between DSRE technologies or customer preference for a particular DSRE system. Therefore, results for CHP technical potential should not be combined with PV systems or battery storage systems for overall DSRE potential but used as independent estimates.

5.1.4 Interaction of Technical Potential Impacts

As described above, the technical potential was estimated using separate models for EE, DR, and DSRE systems. However, there is interaction between these technologies; for example, a more efficient HVAC system would result in a reduced peak demand available for DR curtailment, as illustrated in Figure 8.

Figure 8: Illustration of EE Impacts on HVAC System Load Shape



Therefore, after development of the independent models, the interaction between EE, DR, and DSRE was incorporated as follows:

- The EE technical potential was assumed to be implemented first, followed by DR technical potential and DSRE technical potential.

- To account for the impact of EE technical potential on DR, the baseline load forecast for the applicable end-uses was adjusted by the EE technical potential, resulting in a reduction in baseline load available for curtailment.
- For DSRE systems, the EE and DR technical potential was incorporated in a similar fashion, adjusting the baseline load used to estimate DSRE potential.
    - For the PV analysis, this did not impact the results as the EE and DR technical potential did not affect the amount of PV that could be installed on available rooftops.
    - For the battery storage charged from PV systems, the reduced baseline load from EE resulted in additional PV-generated energy being available for the battery systems and for use during peak periods. The impact of DR events during the assumed curtailment hours was incorporated into the modeling of available battery storage and discharge loads.
- For CHP systems, the reduced baseline load from EE resulted in a reduction in the number of facilities that met the annual energy threshold needed for CHP installations. Installed DR capacity was assumed to not impact CHP potential as the CHP system feasibility was determined based on energy and thermal consumption at the facility. It should be noted that CHP systems not connected to the grid could impact the amount of load available for curtailment with utility-sponsored DR. Therefore, CHP technical potential should not be combined with DR potential but used as independent estimates.

5.2 EE Technical Potential

5.2.1 Summary

Table 9 summarizes the EE technical potential by sector:

Table 9. EE Technical Potential

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
Residential	249	98	935
Non-Residential[6]	201	99	1,044
Total	450	197	1,979

[6] Non-Residential results include all commercial and industrial customer segments.

5.2.2 Residential

Figure 10, Figure 10 and Figure 11 summarize the residential sector EE technical potential by end-use.

Figure 9: Residential EE Technical Potential by End-Use (Summer Peak Savings)

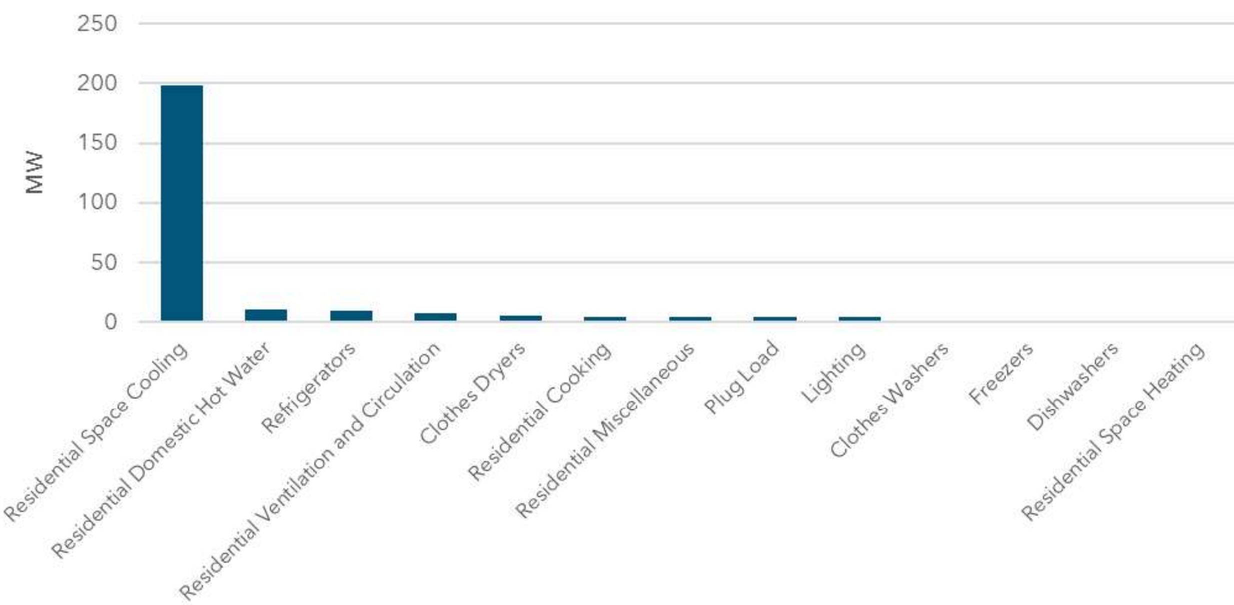


Figure 10: Residential EE Technical Potential by End-Use (Winter Peak Savings)

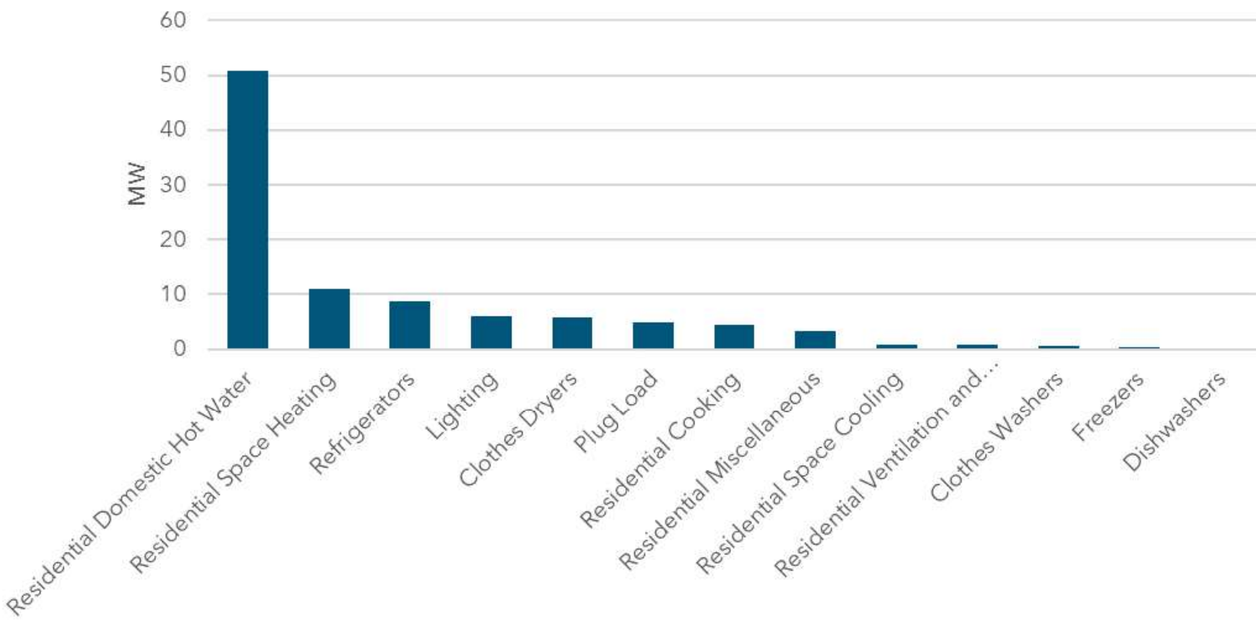
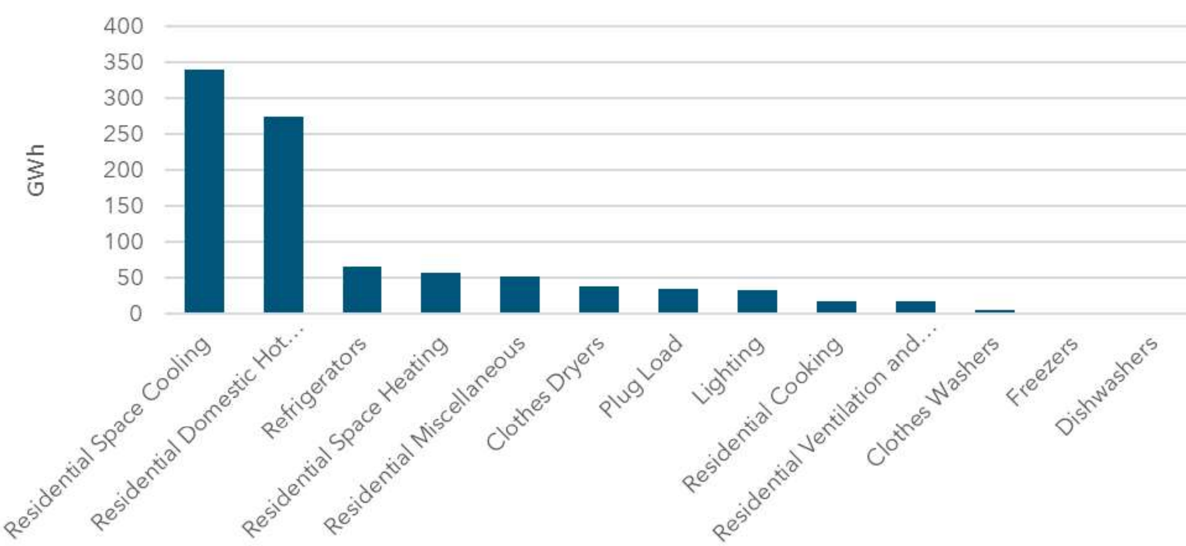


Figure 11: Residential EE Technical Potential by End-Use (Energy Savings)



5.2.3 Non-Residential

5.2.3.1 Business Segments

Figure 13, Figure 13 and Figure 14 summarize the business sector EE technical potential by end-use.

Figure 12: Business EE Technical Potential by End-Use (Summer Peak Savings)

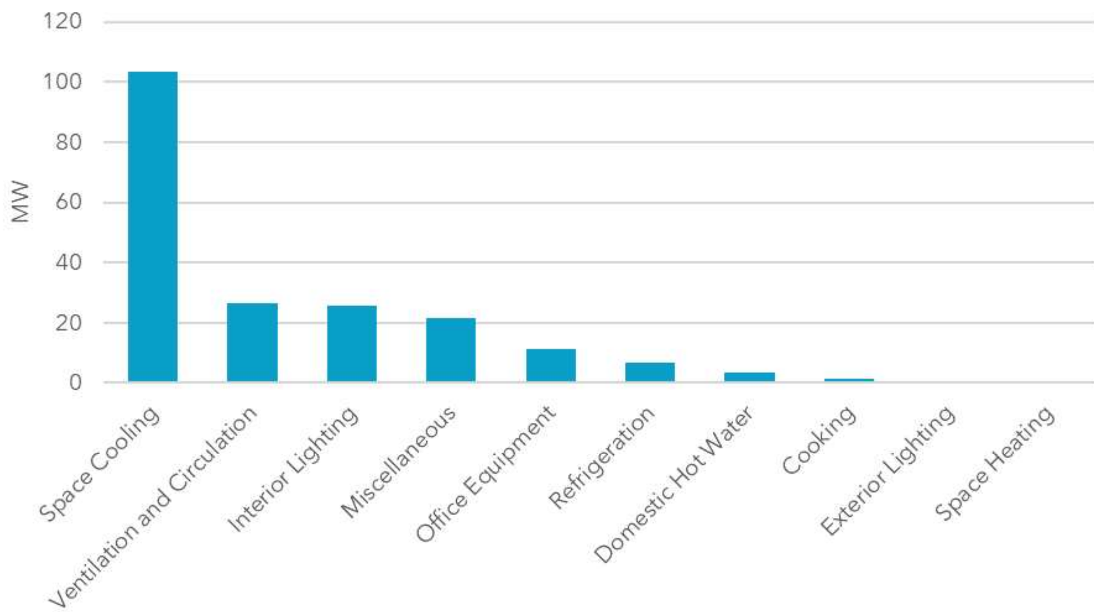


Figure 13: Business EE Technical Potential by End-Use (Winter Peak Savings)

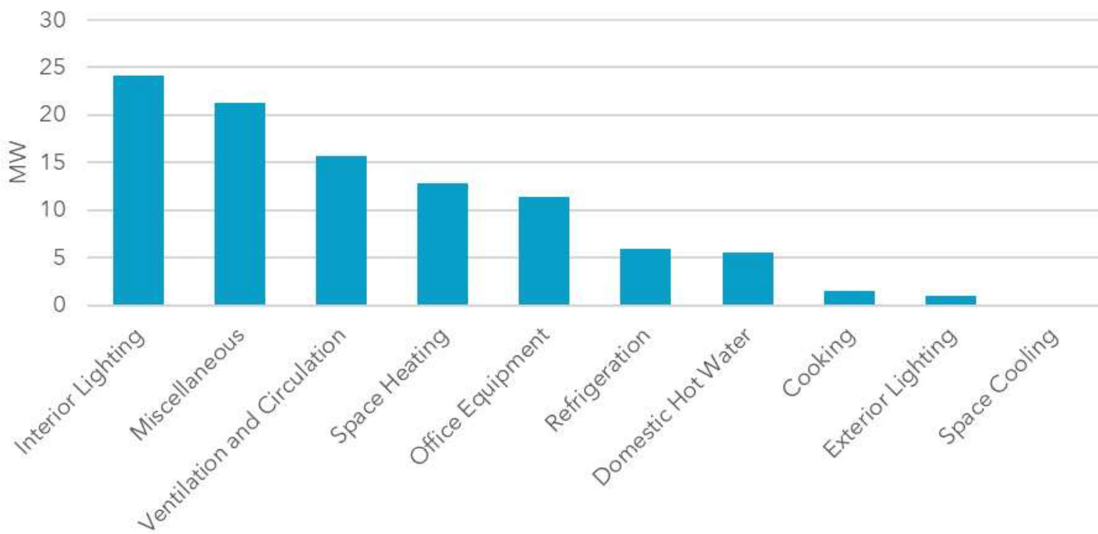
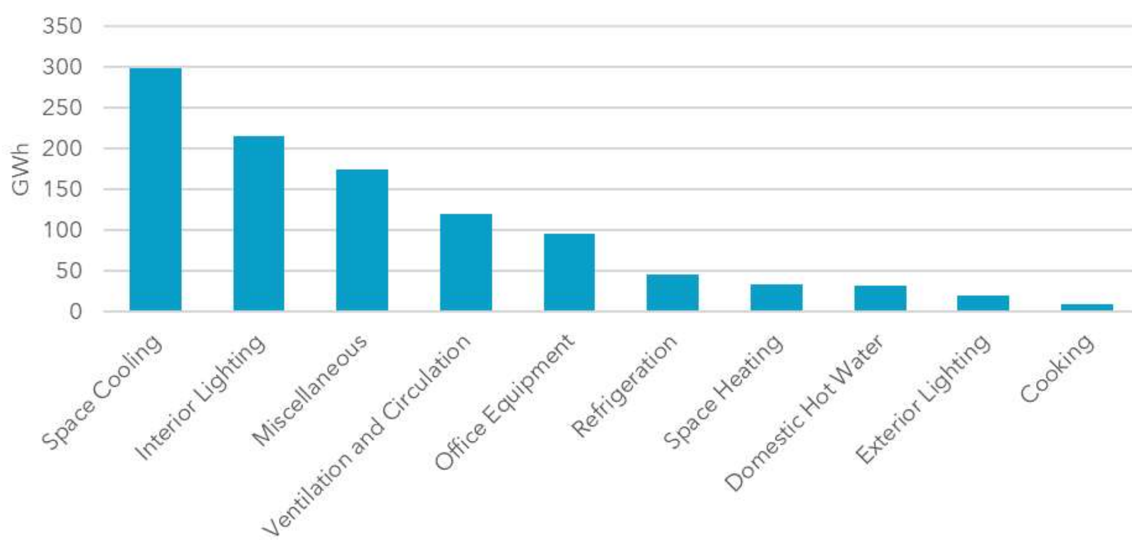


Figure 14: Business EE Technical Potential by End-Use (Energy Savings)



5.3 DR Technical Potential

Technical potential for DR is defined for each class of customers as follows:

- Residential & Small C&I customers – Technical potential is equal to the aggregate load for all end-uses that can participate in OUC's current programs plus DR measures not currently offered in which the utility uses specialized devices to control loads (i.e. direct load control programs). This includes cooling and heating loads for residential and small C&I customers and water heater and pool pump loads for residential customers. Not all demand reductions are delivered via direct load control of end-uses. The magnitude of demand reductions from non-direct load control such as time varying pricing, peak time rebates and targeted notifications is linked to cooling and heating loads.
- Large C&I customers – Technical potential is equal to the total amount of load for each customer segment (i.e., that customers reduce their total load to zero when called upon).

Table 10 summarizes the seasonal DR technical potential by sector:

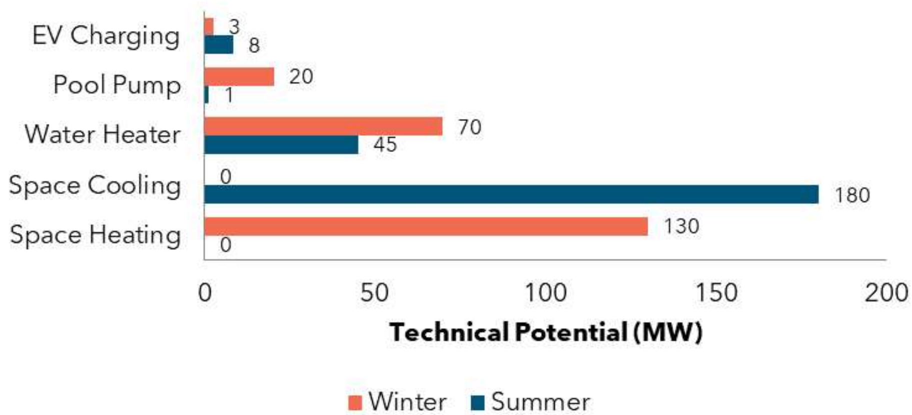
Table 10. DR Technical Potential

	Savings Potential	
	Summer Peak Demand (MW)	Winter Peak Demand (MW)
Residential	235	223
Non-Residential	582	563
Total	817	786

5.3.1 Residential

Residential technical potential is summarized in Figure 15.

Figure 15: Residential DR Technical Potential by End-Use

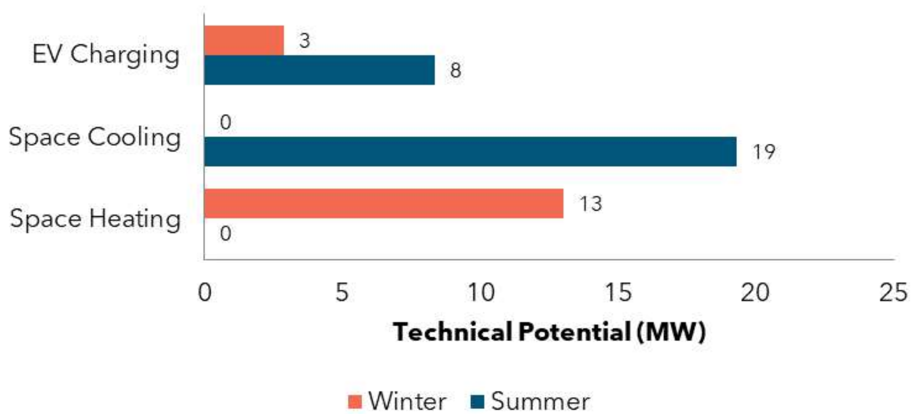


5.3.2 Non-Residential

5.3.2.1 Small C&I Customers

For small C&I technical potential, Resource Innovations looked at cooling and heating loads only. Small C&I technical potential is provided in Figure 16.

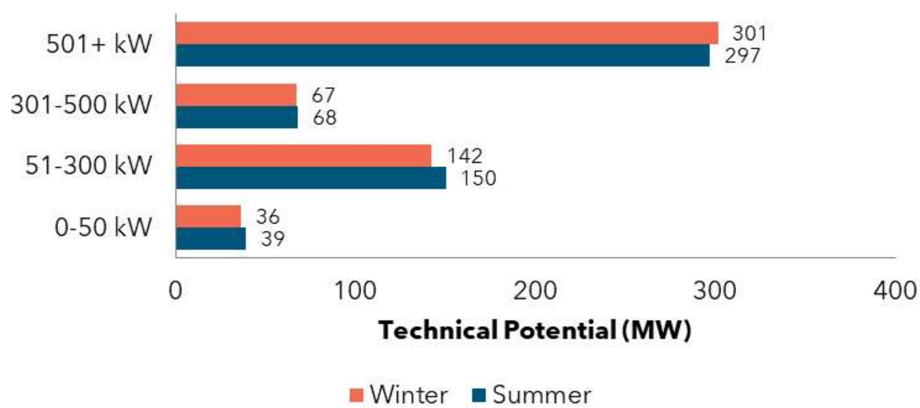
Figure 16: Small C&I DR Technical Potential by End-Use



5.3.2.2 Large C&I Customers

Figure 17 provides the technical potential for large C&I customers, broken down by customer size.

Figure 17: Large C&I DR Technical Potential by Segment



5.4 DSRE Technical Potential

Table 11 provides the results of the DSRE technical potential for each customer segment:

Table 11. DSRE Technical Potential[7]

	Savings Potential		
	Summer Peak Demand (MW)	Winter Peak Demand (MW)	Energy (GWh)
PV Systems			
Residential	339	0	2,731
Non-Residential	162	0	1,169
Total	501	0	3,900
Battery Storage charged from PV Systems			
Residential	171	166	0
Non-Residential	14	70	0
Total	185	236	0
CHP Systems			
Total	354	292	1,591

[7] PV systems and CHP systems were independently analyzed for technical potential without consideration of the competition between technologies or customer preference for DSRE system.

Appendix A EE Measure List

For information on how Resource Innovations developed this list, please see Section 4.

Table 12: Residential EE Measures

Measure	End-Use	Description	Baseline
120v Heat Pump Water Heater 50 Gallons	Residential Domestic Hot Water	120v Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Air Sealing-Infiltration Control	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Improved Infiltration Control	Standard Heating and Cooling System with Standard Infiltration Control
Air-to-Water Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star Air-to-Water Heat Pump, 25 SEER, 13 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - 15 SEER/14.3 SEER2 from base electric resistance	Residential Space Cooling, Residential Space Heating	ASHP 15 SEER from base electric resistance	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2 (from elec resistance)	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2, 10.5 HSPF	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating

Measure	End-Use	Description	Baseline
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2 (from elect resistance)	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
Basement or Crawlspace Wall Insulation R-15	Residential Space Cooling, Residential Space Heating	Increased Basement or Crawlspace Wall Insulation (R-15)	Code-Compliant Exterior Below-Grade Wall Insulation (R-10)
Bathroom Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
CEE Advanced Tier Clothes Dryer	Clothes Dryers	CEE Advanced Tier Clothes Dryer	One Clothes Dryer meeting Federal Standard
CEE Advanced Tier Clothes Washer	Clothes Washers	Tier 3 CEE Clothes washer	One Clothes Washer meeting Federal Standard
CEE Tier 3 Refrigerator	Refrigerators	Residential Tier 3 Refrigerator	One Refrigerator meeting Federal Standard
Ceiling Insulation (R11 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Ceiling Insulation (R38 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Residential Space Cooling	Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - 24 SEER/22.9 SEER2	Residential Space Cooling	Central AC - 24 SEER/22.9 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Residential Space Cooling	Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling	Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC Tune Up	Residential Space Cooling	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Existing Typical Central AC without Regular Maintenance/tune-up
Dehumidifier Recycling	Plug Load	No dehumidifier	One Dehumidifier meeting Federal Standard
Drain Water Heat Recovery	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Duct Insulation	Residential Space Cooling, Residential Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork	Standard Electric Heating and Central AC with Uninsulated Ductwork
Duct Repair	Residential Space Cooling, Residential Space Heating	Duct Repair to eliminate/minimize leaks, includes testing and sealing	Standard Electric Heating and Central AC with typical duct leakage
ECM Circulator Pump	Residential Miscellaneous	Install ECM Circulator Pump	Install Standard Circulator Pump
Energy Star Air Purifier	Plug Load	One Air Purifier meeting ENERGY STAR 2.0 Standards	One Standard Conventional Air Purifier
Energy Star Audio-Video Equipment	Plug Load	One DVD/Blu-Ray Player meeting current ENERGY STAR Standards	One Market Average DVD/Blu-Ray Player
Energy Star Bathroom Ventilating Fan	Residential Ventilation and Circulation	Bathroom Exhaust Fan meeting current ENERGY STAR Standards	Bathroom Exhaust Fan meeting Federal Standard
Energy Star Ceiling Fan	Residential Miscellaneous	60" Ceiling Fan Meeting ENERGY STAR 3.1 Standards	Standard 60" Ceiling Fan
Energy Star Clothes Dryer	Clothes Dryers	One Electric Resistance Clothes Dryer meeting ENERGY STAR 1.1 Standards	One Clothes Dryer meeting Federal Standard

Measure	End-Use	Description	Baseline
Energy Star Clothes Washer	Clothes Washers	One Clothes Washer meeting ENERGY STAR 8.1 Standards	One Clothes Washer meeting Federal Standard
Energy Star Dehumidifier	Plug Load	One Dehumidifier meeting ENERGY STAR 5.0 Standards	One Dehumidifier meeting Federal Standard
Energy Star Dishwasher	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements (effective on July 19, 2023), electric water heating	One Dishwasher meeting Federal Standard
Energy Star Dishwasher (Gas Water Heating)	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements, gas water heating	One Dishwasher meeting Federal Standard; gas water heating
Energy Star Door	Residential Space Cooling, Residential Space Heating	100ft2 of Opaque Door meeting Energy Star Version 6.0 Requirements (U-Value: 0.17)	100ft2 of Opaque Door meeting current FL Code Requirements
ENERGY STAR EV supply equipment (level 2 charger)	Residential Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Freezer	Freezers	One Freezer meeting current ENERGY STAR 5.1 Standards	One Freezer meeting Federal Standard
Energy Star Ground Source Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star GSHP, 17.1 SEER, 12 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Energy Star Imaging Equipment	Plug Load	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star Monitor	Plug Load	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star Personal Computer	Plug Load	One Personal Computer meeting ENERGY STAR 8.0 Standards	One Personal Computer meeting ENERGY STARÂ® 3.0 Standards
Energy Star Refrigerator	Refrigerators	One Refrigerator/Freezer meeting ENERGY STAR 5.1 Standards	One Refrigerator/Freezer meeting Federal Standard
Energy Star Room AC	Residential Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star Set-Top Receiver	Plug Load	One Set-top Box meeting ENERGY STAR 4.1 Standards	One Market Average Set-top Box
Energy Star TV	Plug Load	One Television meeting ENERGY STAR 9.0 Standards	One non-ENERGY STAR Television
Energy Star Windows	Residential Space Cooling, Residential Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window current FL energy code requirements

Measure	End-Use	Description	Baseline
Exterior Wall Insulation	Residential Space Cooling, Residential Space Heating	Increased Exterior Above-Grade Wall Insulation (R-13)	Market Average Existing Exterior Above-Grade Wall Insulation
Filter Whistle	Residential Ventilation and Circulation	Install the Furnace Filter Alarm	No Furnace Filter Alarm on a Central Forced-Air Furnace
Floor Insulation	Residential Space Heating	Increased Floor Insulation (R-30)	Code-Compliant Floor Insulation
Freezer Recycling	Freezers	No Freezer	Current Market Freezer
Green Roof	Residential Space Cooling	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
Heat Pump Clothes Dryer	Clothes Dryers	One Heat Pump Clothes Dryer	One Clothes Dryer meeting Federal Standard
Heat Pump Pool Heater	Residential Miscellaneous	Heat Pump Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Heat Pump Tune Up	Residential Space Cooling, Residential Space Heating	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Standard Heating and Cooling System without Regular Maintenance/tune-up
Heat Pump Water Heater 50 Gallons-CEE Advaned Tier	Residential Domestic Hot Water	CEE Advanced Tier Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 50 Gallons-ENERGY STAR	Residential Domestic Hot Water	Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 80 Gallons-ENERGY STAR	Residential Domestic Hot Water	Energy Star Heat Pump Water Heater 80 Gallons	Code-Compliant 80 Gallon Electric Resistance Water Heater
Heat Trap	Residential Domestic Hot Water	Heat Trap	Existing Water Heater without heat trap
High Efficiency Convection Oven	Residential Cooking	One Full-Size Convection Oven meeting ENERGY STAR 3.0 Standards	One Standard Economy-Grade Full-Size Oven
High Efficiency Induction Cooktop	Residential Cooking	One residential induction cooktop	One standard residential electric cooktop
Home Energy Management System	Lighting|Plug Load|Residential Space Cooling, Residential Space Heating	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Hot Water Pipe Insulation	Residential Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-5	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
HVAC ECM Motor	Residential Ventilation and Circulation	A brushless permanent magnet (ECM) blower motor for electric furnace	Permanent Split Capacitor Motor for Electric Furnace

Measure	End-Use	Description	Baseline
HVAC Economizer	Residential Space Cooling	Install residential economizer	No economizer
HVAC Zoning System	Residential Space Cooling, Residential Space Heating	Install dampers in the ducts, dividing home into multiple zones, each controlled by its own thermostat	Single zone HVAC system
Indoor Daylight Sensor	Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Range	Residential Cooking	Residential induction range	Electric range
Instantaneous Hot Water System	Residential Domestic Hot Water	Instantaneous Hot Water System	Standard Efficiency Storage Tank Water Heater
Kitchen Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
LED - 9W_CFL Baseline	Lighting	LED (assume 9W) replacing CFL baseline lamp	14W CFL (60W equivalent)
LED - 9W_Halogen Baseline	Lighting	LED (assume 9W) replacing EISA-2020 compliant baseline lamp	EISA-2020 compliant baseline lamp (60W equivalent)
LED Specialty Lamps-5W Chandelier	Lighting	5 W Chandelier LED	Standard incandescent chandelier lamp
Linear LED	Lighting	Linear LED Lamps in Linear Fluorescent Fixture	Standard (32w) T8 lamps in Linear Fluorescent Fixture
Low Flow Showerhead	Residential Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
New Construction - Whole Home Improvements - Tier 1	Whole Home	Performance-based improvements in new homes - 20% savings	Residential New Construction (Baseline Efficiency)
New Construction - Whole Home Improvements - Tier 2	Whole Home	Performance-based improvements in new homes - 35% savings	Residential New Construction (Baseline Efficiency)
Occupancy Sensors Switch Mounted	Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Timer	Lighting	Timer on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Outdoor Motion Sensor	Lighting	Motion Sensor on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Ozone Laundry	Clothes Washers	Add a New, Single-Unit Ozone Laundry System to the Clothes Washer	One Clothes Washer meeting Federal Standard

Measure	End-Use	Description	Baseline
Programmable Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Properly Sized CAC	Residential Space Cooling	Properly Sized Central Air Conditioning	Standard Central Air Conditioning, Oversized
Radiant Barrier	Residential Space Cooling	Radiant Barrier	No radiant barrier
Reflective Roof	Residential Space Cooling	Reflective Roof Treatment	Standard dark shingle
Refrigerator Coil Cleaning	Refrigerators	Refrigerator Coil Cleaning	
Refrigerator Recycling	Refrigerators	No Refrigerator	Current Market Average Refrigerator
Residential Whole House Fan	Residential Space Cooling	Standard Central Air Conditioning with Whole House Fan	Standard Central Air Conditioning, No Whole House Fan
Sealed crawlspace	Residential Space Cooling, Residential Space Heating	Encapsulated and semi-conditioned crawlspace	Naturally vented, unconditioned crawlspace
Smart Breaker	Whole Home	Smart Breaker	standard electric breakers
Smart Panel	Whole Home	Multi-channel device that attaches to customer's circuit breaker to enable monitoring and control of major end-use appliances by customer	standard electric panel
Smart Power Strip	Plug Load	Smart plug strips for entertainment centers and home office	Standard entertainment center or home office usage, no smart strip controls
Smart Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Solar Attic Fan	Residential Space Cooling	Standard Central Air Conditioning with Solar Attic Fan	Standard Central Air Conditioning, No Solar Attic Fan
Solar Pool Heater	Residential Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pumps	Residential Miscellaneous	Solar Powered Pool Pump	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System	Residential Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Spray Foam Insulation(Base R11)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Spray Foam Insulation (Base R19)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R2)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R30)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Thermostatic Shower Restriction Valve	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Thermostatic Shower Valves	50 Gallon Electric Resistance Heater and Standard Shower Valves
Variable Refrigerant Flow (VRF) HVAC Systems	Residential Space Cooling, Residential Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Water Heater Blanket	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Insulated Tank Wrap	Code-Compliant 50 Gallon Electric Resistance Water Heater, No Tank Wrap
Water Heater Thermostat Setback	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Temperature Setpoint of 119°F	Code-Compliant 50 Gallon Electric Resistance Water Heater (Temp. Setpoint = 130Â°F)
Water Heater Timeclock	Residential Domestic Hot Water	Water Heater Timeclock	Existing Water Heater without time clock
Weather stripping	Residential Space Cooling, Residential Space Heating	Specific quantity of weather stripping to seal	
Window Caulking	Residential Space Cooling, Residential Space Heating	Window caulking	
Window Sun Protection	Residential Space Cooling	Window Film Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

Table 13: Commercial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency

Measure	End-Use	Description	Baseline
20HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
Advanced Rooftop Controller	Ventilation and Circulation	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Miscellaneous	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air Curtains	Space Cooling, Space Heating	Air Curtain across door opening	Door opening with no air curtain
Airside Economizer	Space Cooling	Airside Economizer	No economizer
Anti-Sweat Controls	Refrigeration	One Medium Temperature Reach-In Case with Anti-Sweat Heater Controls	One Medium Temperature Reach-In Case without Anti-Sweat Heater Controls
Auto Off Time Switch	Interior Lighting	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Automatic Door Closer for Walk-in Coolers and Freezers	Refrigeration	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Beverage Vending Machine Controls	Refrigeration	One non-ENERGY STAR beverage vending machine equipped with infrared occupancy sensing controls	One non-ENERGY STAR beverage vending machine, no controls
Bi-Level Lighting Control (Exterior)	Exterior Lighting	Bi-Level Controls on Exterior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Interior)	Interior Lighting	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ceiling Insulation (R19 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope,

Measure	End-Use	Description	Baseline
			residential style commercial building
Chilled Water Reset	Space Cooling	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Chiller maintenance	Space Cooling	O&M improvements to restore chiller performance	
CO Sensors for Parking Garage Exhaust	Miscellaneous	Enclosed Parking Garage Exhaust with CO Control	Constant Volume Enclosed Parking Garage Exhaust
Commercial Duct Sealing	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Commercial Strategic Energy Management	Whole Building	Commercial Strategic Energy Management	No active energy management
Custom measure - Non-lighting	Space Cooling, Space Heating	Custom Improvement to Facility's Operations	Baseline Technology/Process
Data Center Hot Cold Aisle	Office Equipment	Equipment configuration that saves HVAC	No hot, cold aisle containment
Dedicated Outside Air System (DOAS)	Space Cooling, Space Heating	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Circulating Systems	Domestic Hot Water	Recirculation Pump with Demand Control Mechanism	Uncontrolled Recirculation Pump
Demand Controlled Ventilation	Ventilation and Circulation	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Refrigeration	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Destratification Fans	Space Heating	Destratification Fans improve temperature distribution by circulating warmer air from the ceiling back down to the floor level	No destratification fan
Door Gasket (Cooler)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Door Gasket (Freezer)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Drain water heat recovery	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery

Measure	End-Use	Description	Baseline
Dual Enthalpy Economizer	Ventilation and Circulation	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
Duct Insulation	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork (R-8)	Standard Electric Heating and Central AC with Uninsulated Ductwork (R-4)
Ductless Mini-Split AC	Space Cooling	Ductless Mini-Split AC, 4 Ton, 16 SEER	Code-Compliant AC Unit, 4 Ton, 15 SEER
Ductless Mini-Split HP	Space Cooling, Space Heating	Ductless Mini-Split HP, 17 SEER, 9.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
DX Coil Cleaning	Space Cooling	DX Coil Cleaning	DX Coil Not Cleaned
ECM Motors on Furnaces	Space Heating	Variable Speed Electronically Commutated Motor for an Electric Furnace	Permanent Split Capacitor Motor for Electric Furnace
Efficient Battery Charger	Miscellaneous	Efficient Battery Charger	FR or SCR charging stations with power conversion efficiency < 89% or > 10 W
Efficient Exhaust Hood	Cooking	Kitchen ventilation with automatically adjusting fan controls	Kitchen ventilation with constant speed ventilation motor
Efficient Motor Belts	Miscellaneous	Synchronous belt, 98% efficiency	Standard V-belt drive
Efficient New Construction Lighting	Interior Lighting	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Energy Recovery Ventilation System (ERV)	Space Cooling	Unitary Cooling Equipment that Incorporates Energy Recovery	Current Market Packaged or Split DX Unit
Energy Star Combination Oven	Cooking	Energy Star Combination Oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade 10-Pan Combination Oven
Energy Star Commercial Clothes Washer	Miscellaneous	One Commercial Clothes Washer meeting current ENERGY STAR Version 8.1 Standards	One Commercial Clothes Washer meeting Federal Standard
Energy Star Commercial Dishwasher	Domestic Hot Water	One Commercial Dishwasher meeting ENERGY STAR Version 3.0 Standards	One Dishwasher meeting Federal Standard
Energy Star Commercial Glass Door Freezer	Refrigeration	One Glass Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Glass Door Freezer meeting Federal Standards
Energy Star Commercial Glass Door Refrigerator	Refrigeration	One Glass Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Glass Door Refrigerator meeting Federal Standards
Energy Star Commercial Solid Door Freezer	Refrigeration	One Solid Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Solid Door Freezer meeting Federal Standards

Measure	End-Use	Description	Baseline
Energy Star Commercial Solid Door Refrigerator	Refrigeration	One Solid Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Solid Door Refrigerator meeting Federal Standards
Energy Star convection oven	Cooking	Energy Star convection oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Full-Size Convection Oven
Energy Star EV Chargers	Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Fryer	Cooking	One Standard Vat Electric Fryer meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Standard Vat Electric Fryer
Energy Star Griddle	Cooking	One Griddle meeting current ENERGY STAR Version 1.2 Standards	One Conventional Griddle
Energy Star Hot Food Holding Cabinet	Cooking	One Hot Food Holding Cabinet meeting current ENERGY STAR Version 2.0 Standards	One Standard Hot Food Holding Cabinet
Energy Star Ice Maker	Refrigeration	One Continuous Self-Contained Ice Maker meeting ENERGY STAR Version 3.0 Standards	One Continuous Self-Contained Ice Maker meeting Federal Standard
ENERGY STAR Imaging Equipment	Office Equipment	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star LED Directional Lamp	Interior Lighting	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star Monitors	Office Equipment	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star PCs	Office Equipment	One Personal Computer (desktop or laptop) meeting current ENERGY STARÂ® Standards	One non-ENERGY STARÂ® Personal Computer
Energy Star room AC	Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC, 1 Ton, 10.9 CEER
Energy Star Servers	Office Equipment	One Server meeting ENERGY STAR 2.0 Standards	One Standard Server
Energy Star Steamer	Cooking	One 4-Pan Electric Steamer meeting ENERGY STARÂ® 2.0 Standards	One Standard Economy-Grade 4-Pan Steamer
Energy Star Uninterruptable Power Supply	Office Equipment	Standard Desktop Plugged into Energy Star Uninterruptable Power Supply at 25% Load	Standard Desktop Plugged into Average Rotary Uninterruptable Power Supply at 25% Load
Energy Star Vending Machine	Refrigeration	One Refrigerated Vending Machine meeting ENERGY STAR Version 4.0 Standards	One Refrigerated Vending Machine meeting ENERGY STARÂ® 1.0 Standards

Measure	End-Use	Description	Baseline
ENERGY STAR Water Cooler	Miscellaneous	One Storage Type Hot/Cold Water Cooler Unit meeting ENERGY STAR Version 3.0 Standards	One Standard Storage Type Hot/Cold Water Cooler Unit
Energy Star windows	Space Cooling, Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Miscellaneous	Plug-in timer that activates engine block timer to reduce unnecessary run time	Engine block heater (typically used for backup generators) running continuously
Escalator Motor Efficiency Controller	Miscellaneous	Install Escalator Motor Efficiency Controller	Escalator without Motor Efficiency Controller
Facility Commissioning	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility commissioning to optimize building operations in new facilities	Standard new construction facility with no commissioning
Facility Energy Management System	Space Cooling, Space Heating, Ventilation and Circulation	Typical HVAC by Building Type Controlled by Energy Management System	Standard/manual facility equipment controls
Faucet Aerator	Domestic Hot Water	Low-flow lavatory faucet aerator, flow rate: 1.0 gpm	Federal lavatory flow rate standard, 1994, flow rate: 2.2 gpm
Floating Head Pressure Controls	Refrigeration	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Floor Insulation	Space Cooling, Space Heating	Increased Floor Insulation (R-19)	Market Average Existing Floor Insulation
Geothermal Heat Pump	Space Cooling, Space Heating	Geothermal Heat Pump	Code-Compliant Air Source Heat Pump
Green roof	Space Cooling, Space Heating	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
HE Air Cooled Chiller - All Compressor Types - 100 Tons	Space Cooling	HE Air Cooled Chiller - Air Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE DX 11.25-20.0 Tons Elec Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER

Measure	End-Use	Description	Baseline
HE DX 5.4-11.25 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
Heat Pump Pool Heater Commercial	Miscellaneous	High Efficiency Pool Heater Eff. >=84%	Standard Efficiency Pool Heater 78% Eff.
Heat Pump Water Heater	Domestic Hot Water	Efficient 50 Gallon Electric Heat Pump Water Heater	Code-Compliant 50 Gallon Electric Heat Pump Water Heater
High Efficiency Air Compressor	Miscellaneous	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Data Center Cooling	Space Cooling	High Efficiency CRAC (computer room air conditioner)	Standard Efficiency CRAC
High Efficiency PTAC	Space Cooling	High Efficiency PTAC	Code-Compliant PTAC
High Efficiency PTHP	Space Cooling, Space Heating	High Efficiency PTHP	Code-Compliant PTHP
High Efficiency Refrigeration Compressor_Discus	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor

Measure	End-Use	Description	Baseline
High Efficiency Refrigeration Compressor_Scroll	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Speed Fans	Ventilation and Circulation	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
Hot water pipe insulation	Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-4	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
Hotel Card Energy Control Systems	Space Cooling, Space Heating	Guest Room HVAC Unit Controlled by Hotel-Key-Card Activated Energy Control System	Guest Room HVAC Unit, Manually Controlled by Guest
Indoor daylight sensor	Interior Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Cooktops	Cooking	Efficient Induction Cooktop	One Standard Electric Cooktop
Infiltration Reduction - Air Sealing	Space Cooling, Space Heating	Reduced leakage through caulking, weather-stripping	Standard Heating and Cooling System with Moderate Infiltration
Instantaneous Hot Water System Commercial	Domestic Hot Water	Instantaneous Hot Water System	Code-Compliant Electric Storage Water Heater
LED - 14W_CFL Baseline	Interior Lighting	LED (assume 14W) replacing CFL	100W equivalent CFL
LED - 9W Flood_CFL Baseline	Exterior Lighting	LED (assume 9W) replacing CFL	14W CFL
LED Canopy Lighting (Exterior)	Exterior Lighting	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Exit Sign	Interior Lighting	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting	2x4 LED Troffer	Lumen-Equivalent 32-Watt T8 Lamp
LED Linear - Lamp Replacement	Interior Lighting	Linear LED (16W)	Lumen-Equivalent 32-Watt T8 Lamp

Measure	End-Use	Description	Baseline
LED Parking Lighting	Exterior Lighting	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	Space Cooling, Space Heating	LEED New Construction Whole Building	Comparable facility, code-compliance construction
Light Tube	Interior Lighting	One 14" Light Tube, Delivering light to 250 S.F. of Commercial Space	250 S.F. of Commercial Space Lit by Typical Lighting Strategies
Low Flow Shower Head	Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.50 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
Low-Flow Pre-Rinse Sprayers	Domestic Hot Water	Low-Flow Pre-Rinse Sprayer with Flow Rate of 1.6 gpm	Pre-Rinse Sprayer with Federal Standard Flow Rate of 2.25 gpm
Network PC Power Management	Office Equipment	One computer and monitor attached to centralized energy management system that controls when desktop computers and monitors plugged into a n	One computer and monitor, manually controlled
Networked Lighting Controls	Interior Lighting	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Night Covers for Display Cases	Refrigeration	One Open Vertical Case with Night Covers	One Existing Open Vertical Case, No Night Covers
Occupancy Sensors, Ceiling Mounted	Interior Lighting	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy Sensors, Switch Mounted	Interior Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ozone Laundry Commercial	Miscellaneous	Add a new ozone laundry system onto a commercial clothes washer	One commercial clothes washer without ozone laundry system
Programmable thermostat	Space Cooling, Space Heating	Pre-set programmable thermostat that replaces manual thermostat	Standard Heating and Cooling System with Manual Thermostat
PSC to ECM Evaporator Fan Motor (Reach-In)	Refrigeration	Medium Temperature Reach-In Case with equivalent size Electronically	Medium Temperature Reach-In Case with Permanent Split Capacitor Evaporator Fan Motor

Measure	End-Use	Description	Baseline
		Commutated Evaporator Fan Motor	
PSC to ECM Evaporator Fan Motor (Walk-In, Refrigerator)	Refrigeration	Medium Temperature Walk-In Case with Electronically Commutated Evaporator Fan Motor	Medium Temperature Walk-In Case with Permanent Split Capacitor Evaporator Fan Motor
Q-Sync Evaporator Fan Motor	Refrigeration	Medium Temperature Reach-In Case with equivalent size Q-Sync Evaporator Fan Motor	Medium Temperature Reach-In Case with 20W Permanent Split Capacitor Fan Motor
Reflective Roof Treatment	Space Cooling	Reflective Roof Treatment	Standard Black Roof
Refrigerated Display Case LED Lighting	Refrigeration	60" Refrigerated Case LED Strip	Lumen-Equivalent 32-Watt T8 Fixture
Refrigerated Display Case Lighting Controls	Refrigeration	Occupancy Sensors for Refrigerated Case Lighting to reduce run time	Market-Share Weighted Existing Linear Fluorescent Fixture
Refrigeration Commissioning	Refrigeration	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Refrigeration Economizer	Refrigeration	Walk-in refrigerator with economizer	Walk-in refrigerator without economizer
Regenerative Drive Elevator Motor	Miscellaneous	Regenerative drive produced energy when motor in overhaul condition	Standard motor
Retro-Commissioning (Existing Construction)	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	
Roof Insulation	Space Cooling, Space Heating	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Server Virtualization	Office Equipment	2 Virtual Host Server	20 Single Application Servers
Smart Strip Plug Outlet	Office Equipment	One Smart Strip Plug Outlet	One Standard plug strip/outlet
Smart thermostat	Space Cooling, Space Heating	Thermostats that include "smart" features such as occupancy sensors, geo-fencing, multi-zone sensors	Standard Heating and Cooling System with Manual Thermostat
Solar Pool Heater Commercial	Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pump	Miscellaneous	Solar Powered Pool Pump Motor	Variable Speed Pool Pump Motor

Measure	End-Use	Description	Baseline
Solar Thermal Water Heating System Commercial	Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Strip Curtains - Freezers	Refrigeration	Walk-in freezer with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in freezer without strip curtains
Strip Curtains - Refrigerators	Refrigeration	Walk-in cooler with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in cooler without strip curtains
Suction Pipe Insulation - Freezers	Refrigeration	Suction Pipe Insulation - Freezers	Uninsulated freezer suction lines
Suction Pipe Insulation - Refrigerators	Refrigeration	Suction Pipe Insulation - Refrigerators	Uninsulated refrigeration suction lines
Thermal Energy Storage	Space Cooling	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Thermostatic Shower Restriction Valve Commercial	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Pressure Balance Shower Valves	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater and Standard Shower Valves
Time Clock Control	Interior Lighting	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Variable Refrigerant Flow (VRF) HVAC Systems	Space Cooling, Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant PTHP
VAV System	Ventilation and Circulation	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Cooling Tower Fans	Space Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Pump	Space Cooling, Space Heating	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VSD Controlled Compressor	Refrigeration	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Wall Insulation	Space Cooling, Space Heating	Increased Exterior Above-Grade Wall Insulation	Market Average Existing Exterior Above-Grade Wall Insulation
Warehouse Loading Dock Seals	Space Cooling, Space Heating	Seals to reduce infiltration losses at loading dock	Loading dock with no seals
Water Cooled Refrigeration Heat Recovery	Domestic Hot Water	The heat reclaim system transfers waste heat from refrigeration system to space heating or hot water	No heat recovery

Measure	End-Use	Description	Baseline
Water Heater Setback	Domestic Hot Water	A 50 gallon electric hot water tank with a thermostat setting reduced to no lower than 120 degrees.	A 50 gallon electric hot water tank with a thermostat setting that is higher than 120 degrees, typically hot water tanks with settings of 130 degrees or higher.
Water source heat pump	Space Cooling, Space Heating	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside Economizer	Space Cooling	Waterside Economizer	No economizer
Window shade film	Space Cooling	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC
Zero Energy Doors	Refrigeration	Install zero energy doors for a reach-in refrigerated cooler or freezer	Standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors

Table 14: Industrial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
3-phase High Frequency Battery Charger - 1 shift	Other	3-phase High Frequency Battery Charger	Standard Charger
Advanced Rooftop Controller	HVAC	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Compressed Air	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air curtains	HVAC	Air Curtain across door opening	Door opening with no air curtain
Airside economizer	HVAC	Airside Economizer	No economizer

Measure	End-Use	Description	Baseline
Auto Closer on Refrigerator Door	Process Cooling	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Auto Off Time Switch	Interior Lighting High Bay	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Exterior)	Exterior Lighting Industrial	Install Exterior Bi-Level Lighting Control, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Bi-Level Lighting Control (Interior)	Interior Lighting High Bay	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Chilled Water Reset	HVAC	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Cogged Belt on 15hp ODP Motor	Motors Pumps	15HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	15HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Cogged Belt on 40hp ODP Motor	Motors Pumps	40HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	40HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Compressed Air Desiccant Dryer	Process Specific	heated regenerative desiccant dryer without dew point demand controls	heatless regenerative desiccant dryer without dew point demand controls
Compressed Air No-Loss Condensate Drains	Process Specific	Install no-loss condensate drains	Install standard condensate drains
Compressed Air Storage Tank	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Receiver Tank	20 HP Inlet Modulation Fixed-Speed Compressor, No Receiver Tank
Custom Measure - Non-Lighting	HVAC	Custom Improvement to Facility's Operations	Baseline Technology/Process
Dairy Refrigeration Heat Recovery	Other	refrigeration equipment with refrigeration heat recovery tank installed	existing dairy farm with refrigeration equipment and a water heater unit without an RHR unit
Dedicated Outside Air System (DOAS)	HVAC	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Ventilation	HVAC	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Process Cooling	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Dew Point Sensor Control for Dessicant CA Dryer	Compressed Air	1000 CFM Heated Desicant Air Dryer with Dew Point Controls	1000 CFM Modulating Heated Desicant Air Dryer

Measure	End-Use	Description	Baseline
Drip Irrigation Nozzles	Other	Flow Control Nozzles	Standard Irrigation Nozzles
Dual Enthalpy Economizer	Process Cooling	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
DX Coil Cleaning	HVAC	DX Coil Cleaning	DX Coil Not Cleaned
Efficient Compressed Air Nozzles	Compressed Air	1/4" Engineered Air Nozzle	1/4" Open-End Air Nozzle
Efficient New Construction Lighting	Interior Lighting High Bay	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Electric Actuators	Other	Electric Actuator	Pneumatic Actuator
Energy Efficient Laboratory Fume Hood	HVAC	Variable Air Volume High Performance Fume Hood	Constant Volume Conventional Bypass Fume Hood
Energy Efficient Transformers	Other	Energy Efficient Dry Type Transformer (CSL-3)	Standard Transformer (TP-1)
Energy Recovery Ventilation System	HVAC	Unitary Cooling Equipment that Incorporates Energy Recovery	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11.2 EER
Energy Star LED Directional Lamp	Interior Lighting Other	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star room ac	HVAC	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star windows	HVAC	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Other	An engine block heater operated by an outdoor plug-in timer	An engine block heater that is manually plugged in
Facility Commissioning	HVAC	Perform facility commissioning	Comparable facility, no commissioning
Facility Energy Management System	HVAC	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Fan Thermostat Controller	HVAC	Typical HVAC by Building Type with Fan Thermostat Controller Installed	Typical HVAC by Building Type with Programmable Thermostat
Floating Head Pressure Controller	Process Cooling	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Grain Bin Aeration Control System	Process Specific	Grain Storage Fan System with Automatic Controls	Grain Storage Fan System with Manual Controls

Measure	End-Use	Description	Baseline
HE Air Cooled Chiller - All Compressor Types - 100 Tons	HVAC	HE Air Cooled Chiller - All Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE Air Cooled Chiller - All Compressor Types - 300 Tons	HVAC	Air Cooled Positive Displacement Chiller with Integral VFD, 300 Tons, 13.7 EER	Code-Compliant Air Cooled Positive Displacement Chiller, 300 Tons, 12.5 EER
HE DX 11.25-20.0 Tons Elec Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
High Bay Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 800 Watts Controlled	800 Watts of Lighting, Manually Controlled

Measure	End-Use	Description	Baseline
High Efficiency Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Refrigeration Compressor - Discus	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor - Scroll	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Welder	Process Specific	High Efficiency Welder	Standard Welding Practices
High Speed Fans	HVAC	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
High Volume Low Speed Fan (HVLS)	Motors Fans Blowers	20' High Volume Low Speed Fan	Conventional Circulating Fan
Indoor Agriculture - LED Grow Lights	Interior Lighting High Bay	LED grow light	1000W High Pressure Sodium
Indoor daylight sensor	Interior Lighting High Bay	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Industrial Duct Sealing	HVAC	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Injection Mold and Extruder Barrel Wraps	Other	2' Diameter, 20' Long Machine Barrel with 1" Insulation	2' Diameter, 20' Long Machine Barrel with no Insulation
Insulated Pellet Dryer Tanks and Ducts	Process Heating	Insulation for Pellet Tank and Duct	Uninsulated Pellet Tank and Duct
LED - 14W_CFL Baseline	Interior Lighting Other	LED (assume 14W) replacing CFL	100W equivalent CFL
LED Canopy Lighting (Exterior)	Exterior Lighting Industrial	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting Industrial	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting Other	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED exit sign	Interior Lighting Other	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting Industrial	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture

Measure	End-Use	Description	Baseline
LED Linear - Fixture Replacement	Interior Lighting Linear Fluorescent	2x4 LED Troffer Fixture	Lumen-Equivalent 32-Watt T8 Fixture
LED Linear - Lamp Replacement	Interior Lighting Linear Fluorescent	Linear LED	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting Industrial	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	HVAC	LEED Qualifying New Construction	Comparable facility, code-compliance construction
Light Tube	Interior Lighting Other	One 14" Light Tube, Delivering light to 250 S.F. of Industrial Space	250 S.F. of Industrial Space Lit by Typical Lighting Strategies
Low Energy Livestock Waterer	Motors Pumps	Install Thermostatically Controlled Livestock Watering System	Standard Livestock Watering System
Low Pressure Sprinkler Nozzles	Motors Pumps	Low Pressure Irrigation Nozzles operate at 35 psi or lower	Standard high pressure irrigation nozzles that operate at 50 psi or greater
Low Pressure-drop Filters	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Low Pressure Drop Filter	20 HP Inlet Modulation Fixed-Speed Compressor, No Particulate Removal
Milk Pre-Cooler	Other	Installed pre-cooler heat exchanger	no pre-cooler heat exchanger installed
Networked Lighting Controls	Interior Lighting Linear Fluorescent	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy sensors, switch mounted	Interior Lighting Linear Fluorescent	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting Industrial	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting Industrial	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Packaged Terminal AC	HVAC	High Efficiency Packaged Terminal AC	Code-Compliant PTAC, 10.9 EER
Process Cooling Ventilation Reduction	Process Cooling	Standard Process Cooling with Reduced Ventilation	Standard Process Cooling
Programmable thermostat	HVAC	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat

Measure	End-Use	Description	Baseline
Reflective Roof Treatment	HVAC	Reflective Roof Treatment	Standard Black Roof
Refrigeration Commissioning	Process Cooling	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Retro-Commissioning (Existing Construction)	HVAC	Perform Facility Retro-commissioning	
Roof insulation	HVAC	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Smart thermostat	HVAC	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Strategic Energy Management	HVAC	SEM goal setting and tracking	No active energy management
Synchronous Belt on 15hp ODP Motor	Motors Pumps	15 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	15 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 5hp ODP Motor	Motors Pumps	5 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	5 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 75hp ODP Motor	Motors Pumps	75 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	75 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Thermal energy storage	HVAC	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Time Clock Control	Interior Lighting High Bay	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
VAV System	HVAC	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
VFD on Cooling Tower Fans	Process Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Fan	Motors Fans Blowers	5 HP HVAC Fan Motor, with VFD Control	5 HP HVAC Fan Motor, no VFD Control
VFD on HVAC Pump	Motors Pumps	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VFD on process pump	Motors Pumps	20 HP Process Pump Equipped with VFD Control	20 HP Process Pump, Constant Speed
VSD Controlled Compressor	Process Cooling	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System

Measure	End-Use	Description	Baseline
Water source heat pump	HVAC	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside economizer	HVAC	Waterside Economizer	No economizer
Window shade film	HVAC	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

The following EE measures from the 2019 Technical Potential Study were eliminated from the current study[8]:

Table 15: 2019 EE Measures Eliminated from Current Study

Sector	Measure	End-Use	Reason for Removal
Residential	CFL – 15W Flood	Lighting	Better technology (LED) available
Residential	CFL – 15W Flood (Exterior)	Lighting	Better technology (LED) available
Residential	CFL – 13W	Lighting	Better technology (LED) available
Residential	CFL – 23W	Lighting	Better technology (LED) available
Residential	Low Wattage T8 Fixture	Lighting	Better technology (LED) available
Residential	15 SEER Central AC	Space Cooling	Updated Federal Standard
Residential	15 SEER Air Source Heat Pump	Space Cooling, Space Heating	Updated Federal Standard
Residential	14 SEER ASHP from base electric resistance heating	Space Cooling, Space Heating	Updated Federal Standard
Residential	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Residential	Storm Door	Space Cooling, Space Heating	Minimal/uncertain energy savings
Commercial	CFL – 15W Flood	Exterior Lighting	Better technology (LED) available
Commercial	High Efficiency HID Lighting	Exterior Lighting	Better technology (LED) available

[8] Additional measures from the 2019 study were updated to reflect current vintage/technology for the current study.

Sector	Measure	End-Use	Reason for Removal
Commercial	LED Street Lights	Exterior Lighting	Market standard
Commercial	LED Traffic and Crosswalk Lighting	Exterior Lighting	Market standard
Commercial	CFL-23W	Interior Lighting	Better technology (LED) available
Commercial	High Bay Fluorescent (T5)	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Fixture Replacement	Interior Lighting	Better technology (LED) available
Commercial	Premium T8 - Lamp Replacement	Interior Lighting	Better technology (LED) available
Commercial	Two Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Variable Speed Pool Pump	Miscellaneous	Updated Florida Energy Code
Commercial	Tank Wrap on Water Heater	Domestic Hot Water	Limited applicability
Commercial	Ceiling Insulation (R12 to R38)	Space Cooling, Space Heating	Consolidated measure baseline assumptions
Commercial	Ceiling Insulation (R30 to R38)	Miscellaneous	Consolidated measure baseline assumptions

Appendix B DR Measure List

Table 16: Residential DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Water heater control	Direct load control	Summer and Winter	Load control installed on a water heater (integrated or external switch)
Pool pump switches	Direct load control	Summer and Winter	Load control program with switch installed on pool pump
Room AC	Direct load control	Summer	Load control program that is focused on room AC units rather than central AC
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 17: Small C&I DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 18: Large C&I DR Measures

Measure	Type	Season	Description
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of

Measure	Type	Season	Description
			CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Auto DR	Utility-controlled loads	Summer and Winter	Custom load control of specific end-uses/processes that is triggered by utility signal to building management system; customer can sometimes opt-out of specific events
Firm Service Level	Contractual	Summer and Winter	Customer commits to a maximum usage level during peak periods and, when notified by the utility, agrees to cut usage to that level.
Guaranteed Load Drop	Contractual	Summer and Winter	Customer agrees to reduce usage by an agreed upon amount when notified

No DR measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix C DSRE Measure List

Table 19: Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation

Table 20: Non-Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation
CHP – Fuel Cell	An electrochemical cell-based generator that reacts hydrogen fuel with oxygen
CHP – Micro Turbine	Small combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Gas Turbine	A combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Reciprocating Engine	An engine that uses one or more pistons to convert pressure into rotational motion
CHP - Steam Turbine	A turbine that extracts thermal energy from pressured steam to drive a generator

No DSRE measures from the 2019 Technical Potential Study were eliminated from the current study.

Appendix D External Measure Suggestions

Table 21: External Measure Suggestions and Actions

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Efficient Electrification Measures	All measures that can produce substantial site energy savings by converting from natural gas or other fossil fuels should be included in the Florida electric utilities' next efficiency potential study. Key examples include efficient heat pumps to displace gas furnaces and efficient heat pump water heaters to displace gas water heaters. It is important to note that these electrification measures provide not only heating energy savings and water heating energy savings, but can also potentially provide cooling efficiency benefits as well. In the case of heat pumps, that can occur because efficient heat pumps can operate in cooling mode more efficiently than standard central air conditioners. In the case of heat pump water heaters, cooling and dehumidification benefits can occur when/if the water heater is in conditioned space because they transfer heat (particularly latent heat) from the air around them to the water they are heating. A growing number of jurisdictions – including Illinois, Minnesota and some northeastern states – have begun to include efficient electrification measures in their efficiency programs portfolios.	Fuel-switching and electrification are outside the scope of this study
Networked Lighting Controls	LED lighting technology has become increasingly accepted and installed in commercial buildings. The next big efficiency opportunity in commercial lighting efficiency is in sophisticated controls integrated into the light fixtures themselves – both luminaire level lighting controls and networked lighting controls. For example, a 2017 report for both the Northwest Energy Efficiency Alliance and the Design Lights Consortium, a non-profit that works with utilities and manufacturers of lighting products (and which many utilities across the country reference for determination of eligibility of lighting products for efficiency program rebates), found that networked lighting controls can provide on the order of 50% additional savings after LED conversion. Other studies have also found the national savings potential from such products to be enormous. Moreover, these products can be designed to provide not only lighting energy savings but also a number of other non-energy benefits (e.g., asset tracking, such as the ability of hospitals to know the location of all wheel chairs). Numerous utilities across the country now actively promote this technology through their efficiency programs. For example, Commonwealth Edison, the utility serving Chicago and other parts of northern Illinois, is currently getting a significant portion of its commercial lighting savings from promotion of networked lighting controls	Added to measure list for 2024 study

Docket Nos. 20240012-EG to 20240017-EG
TPS for Orlando Utilities Commission
Exhibit JH-7, Page 78 of 82

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Ductless mini-split heat pumps to displace inefficient electric baseboard heating	While most Florida residential buildings with electric heat provide that heat with heat pumps, at least some (perhaps most likely being older multi-family rental buildings) still use inefficient electric resistance heat. Ductless mini- split heat pump retrofits can very efficiently displace such inefficient electric heat and should be added to the residential measure list.	Added to measure list for 2024 study
Air Source Heat Pump baseline assumptions	There are seven air source heat pump (ASHP) measures included in the residential measure list. Two of them – one at SEER 14 and a second at SEER 21 – are listed as relative to an electric resistance baseline. Five of them – SEER 15, SEER 16, SEER 17, SEER 18 and SEER 21 – appear to be relative to a baseline of a standard new ASHP. Are we interpreting this correctly? If so, we have a couple of comments/questions/suggestions: • The efficiency standards assessed need to be modified to be consistent with new federal standards, including new testing procedures. • For cases where the baseline is "electric resistance", why only assessing two efficiency tiers (i.e., fewer than for standard ASHP baselines)? The same number of efficiency tiers should be assessed for both baselines.	Incorporated suggestions into 2024 study, including updated baseline standard and assessing same efficiency tiers for both baselines
Heat Pump Water Heater Efficiency	The Res EE tab of the utilities draft measure list suggests that the efficiency of a heat pump water heater is an EF of 2.50. That is unrealistically low. In fact, of the 222 products listed on the Energy Star website, none had UEFs less than 2.80 and only 29 (13%) had UEFs that were less than 3.4; the average was 3.57. Indeed, the first product listed on a search of heat pump water heaters on Home Depot's website is a 50 gallon, Rheem (Pro Terra) product with a UEF of 3.75 and a cost of $1699.	Incorporated suggestion into 2024 study
New Construction Measure Packages	The measures lists did not appear to include packages of measures for building new residential and/or new commercial buildings to levels of efficiency beyond those required by code. Utilities in many jurisdictions run new construction efficiency programs supporting such measure packages. In the residential sector, many base their programs on the long-standing Federal Energy Star standard. However, increasingly utility programs are promoting additional efficiency tiers – often as part of all-electric new construction program offerings – that go well beyond the Energy Star standard. For example, Consumers Energy (Michigan) offers $1000 rebates to builders who construct Energy Star single family homes	Incorporated suggestion into 2024 study with 2 tiers of residential new construction whole-home improvement measures.

Docket Nos. 20240012-EG to 20240017-EG
TPS for Orlando Utilities Commission
Exhibit JH-7, Page 79 of 82

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
	with a Home Energy Rating (HERS) score of 57 or less, but offer higher rebates for more efficient buildings – up to $4000 for all electric homes with a HERS score of 40 or less. The Florida utilities potential study should assess savings potential for both the Energy Star level and a tier or two of additional efficiency beyond that level. Similar assessments of new commercial building savings potential should also be assessed.	
Custom Industrial Measures	The utilities' list of industrial efficiency measures addresses common industrial efficiency opportunities. However, it does not address efficiency opportunities that may be unique to individual industries or even to individual industrial facilities. That can include such things as changes in types of materials used in manufacturing, reductions in waste streams, improved use of water delivered by agricultural irrigation systems, and/or other things that are not directly related to energy using equipment or controls of such equipment. It is obviously not possible to list all such measures. However, a potential study will understate savings potential if it does not include a way of capturing such potential in its estimates. One potential way to get a sense of such potential is to review results of comprehensive industrial efficiency programs run by other utilities to identify the portion of actual program savings from such unique custom measures – and then assume that portion of custom savings could be added to the savings estimated in the study for named measures.	Added to measure list for 2024 study
Electric Vehicle measures	Some EV chargers are more efficient than others. The Federal Energy Star program has a standard for them. Savings potential may not be huge, but should be considered in the study. With a growing number of EV sales, the study should also consider the potential savings from promoting the most efficient EVs within different size/style categories	Added to measure list for 2024 study
Removing screw-based LEDs	The screw-based LEDs on both the Residential and Commercial measure lists should now be considered baseline due to federal efficiency standards adopted earlier this year. Utility load forecasts for IRPs should reflect resulting improvements in end use efficiency.	Screw-based LEDs were included in the study but with limited applicability to reflect current market
Removing Commercial fluorescent lighting	LED technology – for both fixtures and lamps – has advanced significantly in recent years, to the point where it should be the only technology considered for commercial lighting. Measures such as high performance T-8 fluorescent fixtures and high bay T-5 fluorescent fixtures should be replaced with LED alternatives in the study.	Updated measure list for 2024 study to only include LED-based lamps for linear fluorescent replacements

Measure Suggestion	Stakeholder Comments	Action taken for FEECA Study
Removing fossil-gas fueled CHP	Fossil-fuel fired CHP systems should not be considered "renewable" and have questionable benefits if electric generation is expected to get increasingly more renewable and clean. Biogas-fueled CHP – such as systems installed in wastewater treatment facilities that use methane byproducts of processing waste – should be included in the study.	2024 study will continue to assess all CHP options
Adding livestock methane power generation to renewables list	For example, see the "cow power" program currently being run by Green Mountain Power, Vermont's largest electric utility	2024 study will continue to assess DSRE options consistent with prior study, including customer-sited solar, solar plus storage, and CHP
Adding EV managed charging to DR list	With national market shares for EVs growing, it is important that utilities consider programs for managing when charging occurs. Numerous utilities are currently running managed charging programs. This does not currently appear to be on the measure list and should be added to the Florida utilities' potential study.	Added to measure list for 2024 study
Residential "smart thermostat" measure can provide both efficiency savings and demand response potential	This is recognized in the inclusion of smart thermostats in both the Res EE and DR tabs of the measure list spreadsheet. We simply want to flag that it is important when assessing cost-effectiveness of this measure that these two potential benefits are considered together. In other words, the cost should be considered compared to the combined efficiency and DR potential rather than separately considered relative to just EE savings and then separately again compared to just DR potential	2024 study will include interactive impacts of EE and DR opportunities
Emerging Technologies	The efficiency potential study measure list appears to be somewhat outdated. It does not include a number of new and emerging technologies. The potential list of such technologies is long. We suggest reviewing the attached list of emerging technologies developed almost two years ago by Consumers Energy (Michigan) and including them in the study.	Consumers Energy study was reviewed and commercially available measures were added to measure list for 2024 study, including heat pump water heaters - CEE advanced tier, heat pump clothes dryers, ozone laundry systems, and 21+ SEER HVAC units

Exhibit JH-8
2024 Measure Lists

EE Measure Lists

Table 1: Residential EE Measures

Measure	End-Use	Description	Baseline
120v Heat Pump Water Heater 50 Gallons	Residential Domestic Hot Water	120v Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Air Sealing-Infiltration Control	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Improved Infiltration Control	Standard Heating and Cooling System with Standard Infiltration Control
Air-to-Water Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star Air-to-Water Heat Pump, 25 SEER, 13 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - 15 SEER/14.3 SEER2 from base electric resistance	Residential Space Cooling, Residential Space Heating	ASHP 15 SEER from base electric resistance	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2 (from elec resistance)	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - 24 SEER/22.9 SEER2, 10.5 HSPF	Residential Space Cooling, Residential Space Heating	ASHP: 24/22.9 SEER/SEER2, 10.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Advanced Tier ASHP:17.8/17 SEER/SEER2; 10.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF (from elec resistance)	Residential Space Cooling, Residential Space Heating	CEE Tier 2 ASHP: 16.8/16 SEER/SEER2; 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Base AC, 15 SEER, Electric resistance heating

Measure	End-Use	Description	Baseline
(from elect resistance)			
ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF	Residential Space Cooling, Residential Space Heating	ENERGY STAR/CEE Tier 1 ASHP: 16/15.2 SEER/SEER2, 9.0 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF (updated)
Basement or Crawlspace Wall Insulation R-15	Residential Space Cooling, Residential Space Heating	Increased Basement or Crawlspace Wall Insulation (R-15)	Code-Compliant Exterior Below-Grade Wall Insulation (R-10)
Bathroom Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
CEE Advanced Tier Clothes Dryer	Clothes Dryers	CEE Advanced Tier Clothes Dryer	One Clothes Dryer meeting Federal Standard
CEE Advanced Tier Clothes Washer	Clothes Washers	Tier 3 CEE Clothes washer	One Clothes Washer meeting Federal Standard
CEE Tier 3 Refrigerator	Refrigerators	Residential Tier 3 Refrigerator	One Refrigerator meeting Federal Standard
Ceiling Insulation (R11 to R30)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes, bring to current code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R11 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-1985) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R30)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes, bring to current code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R19 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1982-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R30)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes, bring to current code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R2 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, older (pre-1982) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R38)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R30 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction
Ceiling Insulation (R38 to R49)	Residential Space Cooling, Residential Space Heating	Blown-in insulation in ceiling cavity/attic, existing (1986-2020) homes - Beyond Code	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Residential Space Cooling	Central AC - CEE Tier 2: 16.8 SEER/16 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - 24 SEER/22.9 SEER2	Residential Space Cooling	Central AC - 24 SEER/22.9 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Residential Space Cooling	Central AC - CEE Advanced Tier: 17.8 SEER/17 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Residential Space Cooling	Central AC - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2	Code-Compliant Central AC, 15 SEER (updated)
Central AC Tune Up	Residential Space Cooling	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Existing Typical Central AC without Regular Maintenance/tune-up
Dehumidifier Recycling	Plug Load	No dehumidifier	One Dehumidifier meeting Federal Standard
Drain Water Heat Recovery	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Duct Insulation	Residential Space Cooling, Residential Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork	Standard Electric Heating and Central AC with Uninsulated Ductwork
Duct Repair	Residential Space Cooling, Residential Space Heating	Duct Repair to eliminate/minimize leaks, includes testing and sealing	Standard Electric Heating and Central AC with typical duct leakage
ECM Circulator Pump	Residential Miscellaneous	Install ECM Circulator Pump	Install Standard Circulator Pump
Energy Star Air Purifier	Plug Load	One Air Purifier meeting ENERGY STAR 2.0 Standards	One Standard Conventional Air Purifier
Energy Star Audio-Video Equipment	Plug Load	One DVD/Blu-Ray Player meeting current ENERGY STAR Standards	One Market Average DVD/Blu-Ray Player
Energy Star Bathroom Ventilating Fan	Residential Ventilation and Circulation	Bathroom Exhaust Fan meeting current ENERGY STAR Standards	Bathroom Exhaust Fan meeting Federal Standard
Energy Star Ceiling Fan	Residential Miscellaneous	60" Ceiling Fan Meeting ENERGY STAR 3.1 Standards	Standard 60" Ceiling Fan
Energy Star Clothes Dryer	Clothes Dryers	One Electric Resistance Clothes Dryer meeting ENERGY STAR 1.1 Standards	One Clothes Dryer meeting Federal Standard
Energy Star Clothes Washer	Clothes Washers	One Clothes Washer meeting ENERGY STAR 8.1 Standards	One Clothes Washer meeting Federal Standard
Energy Star Dehumidifier	Plug Load	One Dehumidifier meeting ENERGY STAR 5.0 Standards	One Dehumidifier meeting Federal Standard
Energy Star Dishwasher	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements (effective on July 19, 2023), electric water heating	One Dishwasher meeting Federal Standard
Energy Star Dishwasher (Gas Water Heating)	Dishwashers	One Dishwasher meeting ENERGY STAR 7.0 Requirements, gas water heating	One Dishwasher meeting Federal Standard; gas water heating
Energy Star Door	Residential Space Cooling, Residential Space Heating	100ft2 of Opaque Door meeting Energy Star Version 6.0 Requirements (U-Value: 0.17)	100ft2 of Opaque Door meeting current FL Code Requirements

Measure	End-Use	Description	Baseline
ENERGY STAR EV supply equipment (level 2 charger)	Residential Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Freezer	Freezers	One Freezer meeting current ENERGY STAR 5.1 Standards	One Freezer meeting Federal Standard
Energy Star Ground Source Heat Pump	Residential Space Cooling, Residential Space Heating	Energy Star GSHP, 17.1 SEER, 12 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Energy Star Imaging Equipment	Plug Load	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star Monitor	Plug Load	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star Personal Computer	Plug Load	One Personal Computer meeting ENERGY STAR 8.0 Standards	One Personal Computer meeting ENERGY STARÂ® 3.0 Standards
Energy Star Refrigerator	Refrigerators	One Refrigerator/Freezer meeting ENERGY STAR 5.1 Standards	One Refrigerator/Freezer meeting Federal Standard
Energy Star Room AC	Residential Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star Set-Top Receiver	Plug Load	One Set-top Box meeting ENERGY STAR 4.1 Standards	One Market Average Set-top Box
Energy Star TV	Plug Load	One Television meeting ENERGY STAR 9.0 Standards	One non-ENERGY STAR Television
Energy Star Windows	Residential Space Cooling, Residential Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window current FL energy code requirements
Exterior Wall Insulation	Residential Space Cooling, Residential Space Heating	Increased Exterior Above-Grade Wall Insulation (R-13)	Market Average Existing Exterior Above-Grade Wall Insulation
Filter Whistle	Residential Ventilation and Circulation	Install the Furnace Filter Alarm	No Furnace Filter Alarm on a Central Forced-Air Furnace
Floor Insulation	Residential Space Heating	Increased Floor Insulation (R-30)	Code-Compliant Floor Insulation
Freezer Recycling	Freezers	No Freezer	Current Market Freezer
Green Roof	Residential Space Cooling	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof
Heat Pump Clothes Dryer	Clothes Dryers	One Heat Pump Clothes Dryer	One Clothes Dryer meeting Federal Standard
Heat Pump Pool Heater	Residential Miscellaneous	Heat Pump Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Heat Pump Tune Up	Residential Space Cooling, Residential Space Heating	System tune-up, including coil cleaning, refrigerant charging, and other diagnostics	Standard Heating and Cooling System without Regular Maintenance/tune-up
Heat Pump Water Heater 50 Gallons-CEE Advanced Tier	Residential Domestic Hot Water	CEE Advanced Tier Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater
Heat Pump Water Heater 50 Gallons-ENERGY STAR	Residential Domestic Hot Water	Heat Pump Water Heater 50 Gallons	Code-Compliant 50 Gallon Electric Resistance Water Heater

Measure	End-Use	Description	Baseline
Heat Pump Water Heater 80 Gallons- ENERGY STAR	Residential Domestic Hot Water	Energy Star Heat Pump Water Heater 80 Gallons	Code-Compliant 80 Gallon Electric Resistance Water Heater
Heat Trap	Residential Domestic Hot Water	Heat Trap	Existing Water Heater without heat trap
High Efficiency Convection Oven	Residential Cooking	One Full-Size Convection Oven meeting ENERGY STAR 3.0 Standards	One Standard Economy-Grade Full-Size Oven
High Efficiency Induction Cooktop	Residential Cooking	One residential induction cooktop	One standard residential electric cooktop
Home Energy Management System	Lighting, Plug Load, Residential Space Cooling, Residential Space Heating	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Hot Water Pipe Insulation	Residential Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-5	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
HVAC ECM Motor	Residential Ventilation and Circulation	A brushless permanent magnet (ECM) blower motor for electric furnace	Permanent Split Capacitor Motor for Electric Furnace
HVAC Economizer	Residential Space Cooling	Install residential economizer	No economizer
HVAC Zoning System	Residential Space Cooling, Residential Space Heating	Install dampers in the ducts, dividing home into multiple zones, each controlled by its own thermostat	Single zone HVAC system
Indoor Daylight Sensor	Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Range	Residential Cooking	Residential induction range	Electric range
Instantaneous Hot Water System	Residential Domestic Hot Water	Instantaneous Hot Water System	Standard Efficiency Storage Tank Water Heater
Kitchen Faucet Aerators	Residential Domestic Hot Water	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Faucet Aerator with Federal Standard Flow Rate of 2.2 gpm
LED - 9W_CFL Baseline	Lighting	LED (assume 9W) replacing CFL baseline lamp	14W CFL (60W equivalent)
LED - 9W_Halogen Baseline	Lighting	LED (assume 9W) replacing EISA-2020 compliant baseline lamp	EISA-2020 compliant baseline lamp (60W equivalent)
LED Specialty Lamps-5W Chandelier	Lighting	5 W Chandelier LED	Standard incandescent chandelier lamp
Linear LED	Lighting	Linear LED Lamps in Linear Fluorescent Fixture	Standard (32w) T8 lamps in Linear Fluorescent Fixture
Low Flow Showerhead	Residential Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
New Construction - Whole Home Improvements - Tier 1	Whole Home	Performance-based improvements in new homes - 20% savings	Residential New Construction (Baseline Efficiency)
New Construction - Whole Home Improvements - Tier 2	Whole Home	Performance-based improvements in new homes - 35% savings	Residential New Construction (Baseline Efficiency)

Measure	End-Use	Description	Baseline
Occupancy Sensors Switch Mounted	Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Timer	Lighting	Timer on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Outdoor Motion Sensor	Lighting	Motion Sensor on Outdoor Lighting, Controlling 120 Watts	120 Watts of Lighting, Manually Controlled
Ozone Laundry	Clothes Washers	Add a New, Single-Unit Ozone Laundry System to the Clothes Washer	One Clothes Washer meeting Federal Standard
Programmable Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Properly Sized CAC	Residential Space Cooling	Properly Sized Central Air Conditioning	Standard Central Air Conditioning, Oversized
Radiant Barrier	Residential Space Cooling	Radiant Barrier	No radiant barrier
Reflective Roof	Residential Space Cooling	Reflective Roof Treatment	Standard dark shingle
Refrigerator Coil Cleaning	Refrigerators	Refrigerator Coil Cleaning	
Refrigerator Recycling	Refrigerators	No Refrigerator	Current Market Average Refrigerator
Residential Whole House Fan	Residential Space Cooling	Standard Central Air Conditioning with Whole House Fan	Standard Central Air Conditioning, No Whole House Fan
Sealed crawlspace	Residential Space Cooling, Residential Space Heating	Encapsulated and semi-conditioned crawlspace	Naturally vented, unconditioned crawlspace
Smart Breaker	Whole Home	Smart Breaker	standard electric breakers
Smart Panel	Whole Home	Multi-channel device that attaches to customer's circuit breaker to enable monitoring and control of major end-use appliances by customer	standard electric panel
Smart Power Strip	Plug Load	Smart plug strips for entertainment centers and home office	Standard entertainment center or home office usage, no smart strip controls
Smart Thermostat	Residential Space Cooling, Residential Space Heating	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Solar Attic Fan	Residential Space Cooling	Standard Central Air Conditioning with Solar Attic Fan	Standard Central Air Conditioning, No Solar Attic Fan
Solar Pool Heater	Residential Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pumps	Residential Miscellaneous	Solar Powered Pool Pump	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System	Residential Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Spray Foam Insulation (Base R11)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction

Measure	End-Use	Description	Baseline
Spray Foam Insulation (Base R19)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1982-1985) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R2)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in older (pre-1982) homes	Existing ceiling insulation based on building code at time of construction
Spray Foam Insulation (Base R30)	Residential Space Cooling, Residential Space Heating	Open cell spray foam along roofline in existing (1986-2020) homes	Existing ceiling insulation based on building code at time of construction
Thermostatic Shower Restriction Valve	Residential Domestic Hot Water	50 Gallon Electric Resistance Heater and Thermostatic Shower Valves	50 Gallon Electric Resistance Heater and Standard Shower Valves
Variable Refrigerant Flow (VRF) HVAC Systems	Residential Space Cooling, Residential Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
Water Heater Blanket	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Insulated Tank Wrap	Code-Compliant 50 Gallon Electric Resistance Water Heater, No Tank Wrap
Water Heater Thermostat Setback	Residential Domestic Hot Water	50 Gallon Electric Resistance Water Heater with Temperature Setpoint of 119°F	Code-Compliant 50 Gallon Electric Resistance Water Heater (Temp. Setpoint = 130Â°F)
Water Heater Timeclock	Residential Domestic Hot Water	Water Heater Timeclock	Existing Water Heater without time clock
Weather stripping	Residential Space Cooling, Residential Space Heating	Specific quantity of weather stripping to seal	
Window Caulking	Residential Space Cooling, Residential Space Heating	Window caulking	
Window Sun Protection	Residential Space Cooling	Window Film Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

Table 2: Commercial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Ventilation and Circulation	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
Advanced Rooftop Controller	Ventilation and Circulation	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Miscellaneous	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor

Measure	End-Use	Description	Baseline
Air Curtains	Space Cooling, Space Heating	Air Curtain across door opening	Door opening with no air curtain
Airside Economizer	Space Cooling	Airside Economizer	No economizer
Anti-Sweat Controls	Refrigeration	One Medium Temperature Reach-In Case with Anti-Sweat Heater Controls	One Medium Temperature Reach-In Case without Anti-Sweat Heater Controls
Auto Off Time Switch	Interior Lighting	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Automatic Door Closer for Walk-in Coolers and Freezers	Refrigeration	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Beverage Vending Machine Controls	Refrigeration	One non-ENERGY STAR beverage vending machine equipped with infrared occupancy sensing controls	One non-ENERGY STAR beverage vending machine, no controls
Bi-Level Lighting Control (Exterior)	Exterior Lighting	Bi-Level Controls on Exterior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Interior)	Interior Lighting	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ceiling Insulation (R19 to R30)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R19 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R30)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R38)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Ceiling Insulation (R2 to R49)	Space Cooling, Space Heating	Blown-in insulation in ceiling cavity/attic - Beyond Code	Market Average Existing Ceiling Insulation in older steep slope, residential style commercial building
Chilled Water Reset	Space Cooling	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Chiller maintenance	Space Cooling	O&M improvements to restore chiller performance	
CO Sensors for Parking Garage Exhaust	Miscellaneous	Enclosed Parking Garage Exhaust with CO Control	Constant Volume Enclosed Parking Garage Exhaust

Measure	End-Use	Description	Baseline
Commercial Duct Sealing	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Commercial Strategic Energy Management	Whole Building	Commercial Strategic Energy Management	No active energy management
Custom measure - Non-lighting	Space Cooling, Space Heating	Custom Improvement to Facility's Operations	Baseline Technology/Process
Data Center Hot Cold Aisle	Office Equipment	Equipment configuration that saves HVAC	No hot, cold aisle containment
Dedicated Outside Air System (DOAS)	Space Cooling, Space Heating	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Circulating Systems	Domestic Hot Water	Recirculation Pump with Demand Control Mechanism	Uncontrolled Recirculation Pump
Demand Controlled Ventilation	Ventilation and Circulation	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Refrigeration	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Destratification Fans	Space Heating	Destratification Fans improve temperature distribution by circulating warmer air from the ceiling back down to the floor level	No destratification fan
Door Gasket (Cooler)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Door Gasket (Freezer)	Refrigeration	New Door Gasket on One-Door Medium Temperature Reach-In Case	Worn or Damaged Door Gasket on One-Door Medium Temperature Reach-In Case
Drain water heat recovery	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Drain Water Heat Exchanger	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater, No Drain Water Heat Recovery
Dual Enthalpy Economizer	Ventilation and Circulation	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
Duct Insulation	Space Cooling, Space Heating	Standard Electric Heating and Central AC with Insulated Ductwork (R-8)	Standard Electric Heating and Central AC with Uninsulated Ductwork (R-4)
Ductless Mini-Split AC	Space Cooling	Ductless Mini-Split AC, 4 Ton, 16 SEER	Code-Compliant AC Unit, 4 Ton, 15 SEER
Ductless Mini-Split HP	Space Cooling, Space Heating	Ductless Mini-Split HP, 17 SEER, 9.5 HSPF	Code-Compliant ASHP, 15 SEER, 8.8 HSPF
DX Coil Cleaning	Space Cooling	DX Coil Cleaning	DX Coil Not Cleaned
ECM Motors on Furnaces	Space Heating	Variable Speed Electronically Commutated Motor for an Electric Furnace	Permanent Split Capacitor Motor for Electric Furnace
Efficient Battery Charger	Miscellaneous	Efficient Battery Charger	FR or SCR charging stations with power conversion efficiency < 89% or > 10 W

Measure	End-Use	Description	Baseline
Efficient Exhaust Hood	Cooking	Kitchen ventilation with automatically adjusting fan controls	Kitchen ventilation with constant speed ventilation motor
Efficient Motor Belts	Miscellaneous	Synchronous belt, 98% efficiency	Standard V-belt drive
Efficient New Construction Lighting	Interior Lighting	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Energy Recovery Ventilation System (ERV)	Space Cooling	Unitary Cooling Equipment that Incorporates Energy Recovery	Current Market Packaged or Split DX Unit
Energy Star Combination Oven	Cooking	Energy Star Combination Oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade 10-Pan Combination Oven
Energy Star Commercial Clothes Washer	Miscellaneous	One Commercial Clothes Washer meeting current ENERGY STAR Version 8.1 Standards	One Commercial Clothes Washer meeting Federal Standard
Energy Star Commercial Dishwasher	Domestic Hot Water	One Commercial Dishwasher meeting ENERGY STAR Version 3.0 Standards	One Dishwasher meeting Federal Standard
Energy Star Commercial Glass Door Freezer	Refrigeration	One Glass Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Glass Door Freezer meeting Federal Standards
Energy Star Commercial Glass Door Refrigerator	Refrigeration	One Glass Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Glass Door Refrigerator meeting Federal Standards
Energy Star Commercial Solid Door Freezer	Refrigeration	One Solid Door Freezer meeting ENERGY STAR Version 5.0 Standards	One Solid Door Freezer meeting Federal Standards
Energy Star Commercial Solid Door Refrigerator	Refrigeration	One Solid Door Refrigerator meeting ENERGY STAR Version 5.0 Standards	One Solid Door Refrigerator meeting Federal Standards
Energy Star convection oven	Cooking	Energy Star convection oven meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Full-Size Convection Oven
Energy Star EV Chargers	Miscellaneous	Level 2 Electric Vehicle Supply Equipment (EVSE)	Level 1 Electric Vehicle Supply Equipment (EVSE)
Energy Star Fryer	Cooking	One Standard Vat Electric Fryer meeting ENERGY STAR Version 3.0 Standards	One Standard Economy-Grade Standard Vat Electric Fryer
Energy Star Griddle	Cooking	One Griddle meeting current ENERGY STAR Version 1.2 Standards	One Conventional Griddle
Energy Star Hot Food Holding Cabinet	Cooking	One Hot Food Holding Cabinet meeting current ENERGY STAR Version 2.0 Standards	One Standard Hot Food Holding Cabinet
Energy Star Ice Maker	Refrigeration	One Continuous Self-Contained Ice Maker meeting ENERGY STAR Version 3.0 Standards	One Continuous Self-Contained Ice Maker meeting Federal Standard
ENERGY STAR Imaging Equipment	Office Equipment	One imaging device meeting current ENERGY STAR Standards	One non-ENERGY STAR imaging device
Energy Star LED Directional Lamp	Interior Lighting	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp

Measure	End-Use	Description	Baseline
Energy Star Monitors	Office Equipment	One Monitor meeting ENERGY STAR 8.0 Standards	One Standard Monitor
Energy Star PCs	Office Equipment	One Personal Computer (desktop or laptop) meeting current ENERGY STARÂ® Standards	One non-ENERGY STARÂ® Personal Computer
Energy Star room AC	Space Cooling	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC, 1 Ton, 10.9 CEER
Energy Star Servers	Office Equipment	One Server meeting ENERGY STAR 2.0 Standards	One Standard Server
Energy Star Steamer	Cooking	One 4-Pan Electric Steamer meeting ENERGY STARÂ® 2.0 Standards	One Standard Economy-Grade 4-Pan Steamer
Energy Star Uninterruptable Power Supply	Office Equipment	Standard Desktop Plugged into Energy Star Uninterruptable Power Supply at 25% Load	Standard Desktop Plugged into Average Rotary Uninterruptable Power Supply at 25% Load
Energy Star Vending Machine	Refrigeration	One Refrigerated Vending Machine meeting ENERGY STAR Version 4.0 Standards	One Refrigerated Vending Machine meeting ENERGY STARÂ® 1.0 Standards
ENERGY STAR Water Cooler	Miscellaneous	One Storage Type Hot/Cold Water Cooler Unit meeting ENERGY STAR Version 3.0 Standards	One Standard Storage Type Hot/Cold Water Cooler Unit
Energy Star windows	Space Cooling, Space Heating	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Miscellaneous	Plug-in timer that activates engine block timer to reduce unnecessary run time	Engine block heater (typically used for backup generators) running continuously
Escalator Motor Efficiency Controller	Miscellaneous	Install Escalator Motor Efficiency Controller	Escalator without Motor Efficiency Controller
Facility Commissioning	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility commissioning to optimize building operations in new facilities	Standard new construction facility with no commissioning
Facility Energy Management System	Space Cooling, Space Heating, Ventilation and Circulation	Typical HVAC by Building Type Controlled by Energy Management System	Standard/manual facility equipment controls
Faucet Aerator	Domestic Hot Water	Low-flow lavatory faucet aerator, flow rate: 1.0 gpm	Federal lavatory flow rate standard, 1994, flow rate: 2.2 gpm
Floating Head Pressure Controls	Refrigeration	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Floor Insulation	Space Cooling, Space Heating	Increased Floor Insulation (R-19)	Market Average Existing Floor Insulation
Geothermal Heat Pump	Space Cooling, Space Heating	Geothermal Heat Pump	Code-Compliant Air Source Heat Pump
Green roof	Space Cooling, Space Heating	Vegetated Roof Surface on top of Standard Roof	Standard Black Roof

Measure	End-Use	Description	Baseline
HE Air Cooled Chiller - All Compressor Types - 100 Tons	Space Cooling	HE Air Cooled Chiller - Air Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE DX 11.25-20.0 Tons Elec Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	Space Cooling, Space Heating	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	Space Cooling	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	Space Cooling	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	Space Cooling	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
Heat Pump Pool Heater Commercial	Miscellaneous	High Efficiency Pool Heater Eff. >=84%	Standard Efficiency Pool Heater 78% Eff.
Heat Pump Water Heater	Domestic Hot Water	Efficient 50 Gallon Electric Heat Pump Water Heater	Code-Compliant 50 Gallon Electric Heat Pump Water Heater
High Efficiency Air Compressor	Miscellaneous	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Data Center Cooling	Space Cooling	High Efficiency CRAC (computer room air conditioner)	Standard Efficiency CRAC
High Efficiency PTAC	Space Cooling	High Efficiency PTAC	Code-Compliant PTAC
High Efficiency PTHP	Space Cooling, Space Heating	High Efficiency PTHP	Code-Compliant PTHP
High Efficiency Refrigeration Compressor_Discus	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor_Scroll	Refrigeration	High Efficiency Refrigeration Compressors	Standard Compressor
High Speed Fans	Ventilation and Circulation	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter

Measure	End-Use	Description	Baseline
Hot water pipe insulation	Domestic Hot Water	1' of Insulated Pipe in Unconditioned Spaces, Insulation of R-4	1' of Pipe in Unconditioned Spaces with Code Minimum of 1"of Insulation
Hotel Card Energy Control Systems	Space Cooling, Space Heating	Guest Room HVAC Unit Controlled by Hotel-Key-Card Activated Energy Control System	Guest Room HVAC Unit, Manually Controlled by Guest
Indoor daylight sensor	Interior Lighting	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Induction Cooktops	Cooking	Efficient Induction Cooktop	One Standard Electric Cooktop
Infiltration Reduction - Air Sealing	Space Cooling, Space Heating	Reduced leakage through caulking, weather-stripping	Standard Heating and Cooling System with Moderate Infiltration
Instantaneous Hot Water System Commercial	Domestic Hot Water	Instantaneous Hot Water System	Code-Compliant Electric Storage Water Heater
LED - 14W_CFL Baseline	Interior Lighting	LED (assume 14W) replacing CFL	100W equivalent CFL
LED - 9W Flood_CFL Baseline	Exterior Lighting	LED (assume 9W) replacing CFL	14W CFL
LED Canopy Lighting (Exterior)	Exterior Lighting	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Exit Sign	Interior Lighting	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture
LED High Bay_LF Baseline	Interior Lighting	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting	2x4 LED Troffer	Lumen-Equivalent 32-Watt T8 Lamp
LED Linear - Lamp Replacement	Interior Lighting	Linear LED (16W)	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	Space Cooling, Space Heating	LEED New Construction Whole Building	Comparable facility, code-compliance construction
Light Tube	Interior Lighting	One 14" Light Tube, Delivering light to 250 S.F. of Commercial Space	250 S.F. of Commercial Space Lit by Typical Lighting Strategies
Low Flow Shower Head	Domestic Hot Water	Low-Flow Handheld Showerhead, Flow Rate: 1.50 gpm	Standard Handheld Showerhead, Flow Rate: 2.50 gpm
Low-Flow Pre-Rinse Sprayers	Domestic Hot Water	Low-Flow Pre-Rinse Sprayer with Flow Rate of 1.6 gpm	Pre-Rinse Sprayer with Federal Standard Flow Rate of 2.25 gpm
Network PC Power Management	Office Equipment	One computer and monitor attached to centralized energy	One computer and monitor, manually controlled

Measure	End-Use	Description	Baseline
		management system that controls when desktop computers and monitors plugged into a n	
Networked Lighting Controls	Interior Lighting	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Night Covers for Display Cases	Refrigeration	One Open Vertical Case with Night Covers	One Existing Open Vertical Case, No Night Covers
Occupancy Sensors, Ceiling Mounted	Interior Lighting	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy Sensors, Switch Mounted	Interior Lighting	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Ozone Laundry Commercial	Miscellaneous	Add a new ozone laundry system onto a commercial clothes washer	One commercial clothes washer without ozone laundry system
Programmable thermostat	Space Cooling, Space Heating	Pre-set programmable thermostat that replaces manual thermostat	Standard Heating and Cooling System with Manual Thermostat
PSC to ECM Evaporator Fan Motor (Reach-In)	Refrigeration	Medium Temperature Reach-In Case with equivalent size Electronically Commutated Evaporator Fan Motor	Medium Temperature Reach-In Case with Permanent Split Capacitor Evaporator Fan Motor
PSC to ECM Evaporator Fan Motor (Walk-In, Refrigerator)	Refrigeration	Medium Temperature Walk-In Case with Electronically Commutated Evaporator Fan Motor	Medium Temperature Walk-In Case with Permanent Split Capacitor Evaporator Fan Motor
Q-Sync Evaporator Fan Motor	Refrigeration	Medium Temperature Reach-In Case with equivalent size Q-Sync Evaporator Fan Motor	Medium Temperature Reach-In Case with 20W Permanent Split Capacitor Fan Motor
Reflective Roof Treatment	Space Cooling	Reflective Roof Treatment	Standard Black Roof
Refrigerated Display Case LED Lighting	Refrigeration	60" Refrigerated Case LED Strip	Lumen-Equivalent 32-Watt T8 Fixture
Refrigerated Display Case Lighting Controls	Refrigeration	Occupancy Sensors for Refrigerated Case Lighting to reduce run time	Market-Share Weighted Existing Linear Fluorescent Fixture
Refrigeration Commissioning	Refrigeration	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Refrigeration Economizer	Refrigeration	Walk-in refrigerator with economizer	Walk-in refrigerator without economizer
Regenerative Drive Elevator Motor	Miscellaneous	Regenerative drive produced energy when motor in overhaul condition	Standard motor
Retro-Commissioning (Existing Construction)	Space Cooling, Space Heating, Ventilation and Circulation	Perform facility retro-commissioning, including assessment, process improvements, and optimization of energy-consuming equipment and systems	

Measure	End-Use	Description	Baseline
Roof Insulation	Space Cooling, Space Heating	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof
Server Virtualization	Office Equipment	2 Virtual Host Server	20 Single Application Servers
Smart Strip Plug Outlet	Office Equipment	One Smart Strip Plug Outlet	One Standard plug strip/outlet
Smart thermostat	Space Cooling, Space Heating	Thermostats that include "smart" features such as occupancy sensors, geo-fencing, multi-zone sensors	Standard Heating and Cooling System with Manual Thermostat
Solar Pool Heater Commercial	Miscellaneous	Solar Swimming Pool Heater	Electric Resistance Swimming Pool Heater
Solar Powered Pool Pump	Miscellaneous	Solar Powered Pool Pump Motor	Variable Speed Pool Pump Motor
Solar Thermal Water Heating System Commercial	Domestic Hot Water	Solar Thermal System with Electric Backup	Code-Compliant 50 Gallon Electric Resistance Water Heater
Strip Curtains - Freezers	Refrigeration	Walk-in freezer with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in freezer without strip curtains
Strip Curtains - Refrigerators	Refrigeration	Walk-in cooler with strip curtains at least 0.06 inches thick covering the entire area of the doorway	Walk-in cooler without strip curtains
Suction Pipe Insulation - Freezers	Refrigeration	Suction Pipe Insulation - Freezers	Uninsulated freezer suction lines
Suction Pipe Insulation - Refrigerators	Refrigeration	Suction Pipe Insulation - Refrigerators	Uninsulated refrigeration suction lines
Thermal Energy Storage	Space Cooling	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Thermostatic Shower Restriction Valve Commercial	Domestic Hot Water	Hot Water Loop with 50 Gallon Electric Resistance Heater and Pressure Balance Shower Valves	Standard Hot Water Loop with 50 Gallon Electric Resistance Heater and Standard Shower Valves
Time Clock Control	Interior Lighting	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Variable Refrigerant Flow (VRF) HVAC Systems	Space Cooling, Space Heating	Variable Refrigerant Flow (VRF) HVAC Systems	Code-Compliant PTHP
VAV System	Ventilation and Circulation	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Cooling Tower Fans	Space Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Pump	Space Cooling, Space Heating	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VSD Controlled Compressor	Refrigeration	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Wall Insulation	Space Cooling, Space Heating	Increased Exterior Above-Grade Wall Insulation	Market Average Existing Exterior Above-Grade Wall Insulation

Measure	End-Use	Description	Baseline
Warehouse Loading Dock Seals	Space Cooling, Space Heating	Seals to reduce infiltration losses at loading dock	Loading dock with no seals
Water Cooled Refrigeration Heat Recovery	Domestic Hot Water	The heat reclaim system transfers waste heat from refrigeration system to space heating or hot water	No heat recovery
Water Heater Setback	Domestic Hot Water	A 50 gallon electric hot water tank with a thermostat setting reduced to no lower than 120 degrees.	A 50 gallon electric hot water tank with a thermostat setting that is higher than 120 degrees, typically hot water tanks with settings of 130 degrees or higher.
Water source heat pump	Space Cooling, Space Heating	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside Economizer	Space Cooling	Waterside Economizer	No economizer
Window shade film	Space Cooling	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC
Zero Energy Doors	Refrigeration	Install zero energy doors for a reach-in refrigerated cooler or freezer	Standard vertical reach-in refrigerated cooler or freezer with anti-sweat heaters on the glass surface of the doors

Table 3: Industrial EE Measures

Measure	End-Use	Description	Baseline
1.5HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 1.5 HP Open-Drip Proof Motor	1.5HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
10HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 10 HP Open-Drip Proof Motor	10HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
20HP Open Drip-Proof (ODP) Motor	Motors Pumps	High Efficiency 20 HP Open-Drip Proof Motor	20HP Open-Drip Proof Motor with Current Minimum EPACT Efficiency
3-phase High Frequency Battery Charger - 1 shift	Other	3-phase High Frequency Battery Charger	Standard Charger
Advanced Rooftop Controller	HVAC	Advanced Rooftop Controller	Without Advanced Rooftop Controller
Air Compressor Optimization	Compressed Air	Performing Routine Maintenance on 20HP Inlet Modulation Fixed-Speed Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
Air curtains	HVAC	Air Curtain across door opening	Door opening with no air curtain
Airside economizer	HVAC	Airside Economizer	No economizer
Auto Closer on Refrigerator Door	Process Cooling	One Medium Temperature Walk-In Refrigerator Door with Auto-Closer	One Medium Temperature Walk-In Refrigerator Door without Auto-Closer
Auto Off Time Switch	Interior Lighting High Bay	Auto-Off Time Switch on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Bi-Level Lighting Control (Exterior)	Exterior Lighting Industrial	Install Exterior Bi-Level Lighting Control, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting

Measure	End-Use	Description	Baseline
Bi-Level Lighting Control (Interior)	Interior Lighting High Bay	Bi-Level Controls on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, No Dim Setting
Chilled Water Reset	HVAC	One Chiller with Reset of Chilled Water Temperature Setpoint	One Chiller with Fixed Chilled Water Temperature
Cogged Belt on 15hp ODP Motor	Motors Pumps	15HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	15HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Cogged Belt on 40hp ODP Motor	Motors Pumps	40HP ODP Motor with Cogged Belts Installed on Supply and/or Return Air Fans	40HP ODP Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Compressed Air Desiccant Dryer	Process Specific	heated regenerative desiccant dryer without dew point demand controls	heatless regenerative desiccant dryer without dew point demand controls
Compressed Air No-Loss Condensate Drains	Process Specific	Install no-loss condensate drains	Install standard condensate drains
Compressed Air Storage Tank	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Receiver Tank	20 HP Inlet Modulation Fixed-Speed Compressor, No Receiver Tank
Custom Measure - Non-Lighting	HVAC	Custom Improvement to Facility's Operations	Baseline Technology/Process
Dairy Refrigeration Heat Recovery	Other	refrigeration equipment with refrigeration heat recovery tank installed	existing dairy farm with refrigeration equipment and a water heater unit without an RHR unit
Dedicated Outside Air System (DOAS)	HVAC	Install Dedicated Outside Air System (DOAS)	Typical HVAC by Building Type
Demand Controlled Ventilation	HVAC	Return Air System with CO2 Sensors	Standard Return Air System, No Sensors
Demand Defrost	Process Cooling	Walk-In Freezer System with Demand-Controlled Electric Defrost Cycle	Walk-In Freezer System with Timer-Controlled Electric Defrost Cycle
Dew Point Sensor Control for Dessicant CA Dryer	Compressed Air	1000 CFM Heated Desicant Air Dryer with Dew Point Controls	1000 CFM Modulating Heated Desicant Air Dryer
Drip Irrigation Nozzles	Other	Flow Control Nozzles	Standard Irrigation Nozzles
Dual Enthalpy Economizer	Process Cooling	Standard HVAC Unit with an economizer and dual enthalpy differential control	HVAC unit with no economizer or with a non-functional disabled economizer
DX Coil Cleaning	HVAC	DX Coil Cleaning	DX Coil Not Cleaned
Efficient Compressed Air Nozzles	Compressed Air	1/4" Engineered Air Nozzle	1/4" Open-End Air Nozzle
Efficient New Construction Lighting	Interior Lighting High Bay	Efficient New Construction Lighting, 15% Better than Code	New Construction with Lighting Power Density meeting Code Minimum
Electric Actuators	Other	Electric Actuator	Pneumatic Actuator
Energy Efficient Laboratory Fume Hood	HVAC	Variable Air Volume High Performance Fume Hood	Constant Volume Conventional Bypass Fume Hood
Energy Efficient Transformers	Other	Energy Efficient Dry Type Transformer (CSL-3)	Standard Transformer (TP-1)

Measure	End-Use	Description	Baseline
Energy Recovery Ventilation System	HVAC	Unitary Cooling Equipment that Incorporates Energy Recovery	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11.2 EER
Energy Star LED Directional Lamp	Interior Lighting Other	Energy Star 7.6W Directional LED lamp	50W Incandescent lamp
Energy Star room ac	HVAC	Room AC meeting current ENERGY STAR standards	Code-Compliant Room AC
Energy Star windows	HVAC	100ft2 of Window meeting Energy Star Version 6.0 Requirements (U-Value: 0.27, SHGC: 0.21)	100ft2 of Window meeting Energy Star Version 5.0 Requirements (U-Value: 0.3, SHGC: 0.3)
Engine Block Timer	Other	An engine block heater operated by an outdoor plug-in timer	An engine block heater that is manually plugged in
Facility Commissioning	HVAC	Perform facility commissioning	Comparable facility, no commissioning
Facility Energy Management System	HVAC	Typical HVAC by Building Type Controlled by Energy Management System	Typical HVAC by Building Type, Manually Controlled
Fan Thermostat Controller	HVAC	Typical HVAC by Building Type with Fan Thermostat Controller Installed	Typical HVAC by Building Type with Programmable Thermostat
Floating Head Pressure Controller	Process Cooling	Medium-Temperature Refrigeration System with 5HP Compressor and Adjustable Condenser Head Pressure Control Valve	Medium-Temperature Refrigeration System with 5 HP Compressor without Adjustable Condenser Head Pressure Control Valve
Grain Bin Aeration Control System	Process Specific	Grain Storage Fan System with Automatic Controls	Grain Storage Fan System with Manual Controls
HE Air Cooled Chiller - All Compressor Types - 100 Tons	HVAC	HE Air Cooled Chiller - All Compressor Types - 100 Tons	Code-Compliant Air Cooled Positive Displacement Chiller, 100 Tons
HE Air Cooled Chiller - All Compressor Types - 300 Tons	HVAC	Air Cooled Positive Displacement Chiller with Integral VFD, 300 Tons, 13.7 EER	Code-Compliant Air Cooled Positive Displacement Chiller, 300 Tons, 12.5 EER
HE DX 11.25-20.0 Tons Elec Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 11.25-20.0 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 15 Tons, 11.5 SEER	Code-Compliant Packaged or Split DX Unit, 15 Tons, 11 SEER
HE DX 5.4-11.25 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX 5.4-11.25 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 7.5 Tons, 12 SEER	Code-Compliant Packaged or Split DX Unit, 7.5 Tons, 11 SEER
HE DX Less than 5.4 Tons Elect Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE DX Less than 5.4 Tons Other Heat	HVAC	High Efficiency Packaged or Split DX Unit, 5 Tons, 14.5 SEER	Code-Compliant Packaged or Split DX Unit, 5 Tons, 13 SEER
HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 200 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 200 Tons
HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons	HVAC	Water Cooled Centrifugal Chiller with Integral VFD, 500 Tons	Code-Compliant Water Cooled Centrifugal Chiller, 500 Tons

Measure	End-Use	Description	Baseline
HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 175 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 175 Tons
HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons	HVAC	Water Cooled Positive Displacement Chiller with Integral VFD, 50 Tons	Code-Compliant Water Cooled Positive Displacement Chiller, 50 Tons
High Bay Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 800 Watts Controlled	800 Watts of Lighting, Manually Controlled
High Efficiency Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
High Efficiency Refrigeration Compressor - Discus	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Refrigeration Compressor - Scroll	Process Cooling	High Efficiency Refrigeration Compressors	Standard Compressor
High Efficiency Welder	Process Specific	High Efficiency Welder	Standard Welding Practices
High Speed Fans	HVAC	High Speed Fan, 24" - 35" Blade Diameter	Standard Speed Fan, 24" - 35" Blade Diameter
High Volume Low Speed Fan (HVLS)	Motors Fans Blowers	20' High Volume Low Speed Fan	Conventional Circulating Fan
Indoor Agriculture - LED Grow Lights	Interior Lighting High Bay	LED grow light	1000W High Pressure Sodium
Indoor daylight sensor	Interior Lighting High Bay	Install Indoor Daylight Sensors, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Industrial Duct Sealing	HVAC	Standard Electric Heating and Central AC with Improved Duct Sealing	Standard Electric Heating and Central AC, Standard Duct Sealing
Injection Mold and Extruder Barrel Wraps	Other	2' Diameter, 20' Long Machine Barrel with 1" Insulation	2' Diameter, 20' Long Machine Barrel with no Insulation
Insulated Pellet Dryer Tanks and Ducts	Process Heating	Insulation for Pellet Tank and Duct	Uninsulated Pellet Tank and Duct
LED - 14W_CFL Baseline	Interior Lighting Other	LED (assume 14W) replacing CFL	100W equivalent CFL
LED Canopy Lighting (Exterior)	Exterior Lighting Industrial	One 67.2W LED Canopy Light	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED Display Lighting (Exterior)	Exterior Lighting Industrial	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED Display Lighting (Interior)	Interior Lighting Other	One Letter of LED Signage, < 2ft in Height	One Letter of Neon or Argon-mercury Signage, < 2ft in Height
LED exit sign	Interior Lighting Other	One 5W Single-Sided LED Exit Sign	One 9W Single-Sided CFL Exit Sign
LED Exterior Wall Packs	Exterior Lighting Industrial	One 35W LED Wall Pack	Average Lumen Equivalent Exterior Incandescent Area Lighting
LED High Bay_HID Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent HID High Bay Fixture

Measure	End-Use	Description	Baseline
LED High Bay_LF Baseline	Interior Lighting High Bay	One 140W High Bay LED Fixture	Lumen-Equivalent Linear Fluorescent High Bay Fixture
LED Linear - Fixture Replacement	Interior Lighting Linear Fluorescent	2x4 LED Troffer Fixture	Lumen-Equivalent 32-Watt T8 Fixture
LED Linear - Lamp Replacement	Interior Lighting Linear Fluorescent	Linear LED	Lumen-Equivalent 32-Watt T8 Lamp
LED Parking Lighting	Exterior Lighting Industrial	One 160W LED Area Light	Average Lumen Equivalent Exterior HID Area Lighting
LEED New Construction Whole Building	HVAC	LEED Qualifying New Construction	Comparable facility, code-compliance construction
Light Tube	Interior Lighting Other	One 14" Light Tube, Delivering light to 250 S.F. of Industrial Space	250 S.F. of Industrial Space Lit by Typical Lighting Strategies
Low Energy Livestock Waterer	Motors Pumps	Install Thermostatically Controlled Livestock Watering System	Standard Livestock Watering System
Low Pressure Sprinkler Nozzles	Motors Pumps	Low Pressure Irrigation Nozzles operate at 35 psi or lower	Standard high pressure irrigation nozzles that operate at 50 psi or greater
Low Pressure-drop Filters	Compressed Air	20 HP Inlet Modulation Fixed-Speed Compressor with Low Pressure Drop Filter	20 HP Inlet Modulation Fixed-Speed Compressor, No Particulate Removal
Milk Pre-Cooler	Other	Installed pre-cooler heat exchanger	no pre-cooler heat exchanger installed
Networked Lighting Controls	Interior Lighting Linear Fluorescent	Install Networked Lighting Controls System on Interior Lighting, 500 Watts Controlled	500 Watts of Lighting, Controlled either Manually or by Sensor as Specified by Code
Occupancy Sensors, Ceiling Mounted	Interior Lighting High Bay	Ceiling Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Occupancy sensors, switch mounted	Interior Lighting Linear Fluorescent	Switch Mounted Occupancy Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor Lighting Controls	Exterior Lighting Industrial	Install Exterior Photocell Dimming Controls, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Outdoor motion sensor	Exterior Lighting Industrial	Install Exterior Motion Sensor, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
Packaged Terminal AC	HVAC	High Efficiency Packaged Terminal AC	Code-Compliant PTAC, 10.9 EER
Process Cooling Ventilation Reduction	Process Cooling	Standard Process Cooling with Reduced Ventilation	Standard Process Cooling
Programmable thermostat	HVAC	Standard Heating and Cooling System with Programmable Thermostat	Standard Heating and Cooling System with Manual Thermostat
Reflective Roof Treatment	HVAC	Reflective Roof Treatment	Standard Black Roof
Refrigeration Commissioning	Process Cooling	Commissioned Refrigeration System	Non-Commissioned Refrigeration System
Retro-Commissioning (Existing Construction)	HVAC	Perform Facility Retro-commissioning	
Roof insulation	HVAC	Roof Insulation (built-up roof applicable to flat/low slope roofs)	Code-Compliant Flat Roof

Measure	End-Use	Description	Baseline
Smart thermostat	HVAC	Standard Heating and Cooling System with Smart Thermostat	Standard Heating and Cooling System with Manual Thermostat
Strategic Energy Management	HVAC	SEM goal setting and tracking	No active energy management
Synchronous Belt on 15hp ODP Motor	Motors Pumps	15 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	15 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 5hp ODP Motor	Motors Pumps	5 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	5 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Synchronous Belt on 75hp ODP Motor	Motors Pumps	75 HP Open-Drip Proof Motor with Synchronous Belts Installed on Supply and/or Return Air Fans	75 HP Open-Drip Proof Motor with Smooth V-Belts Installed on Supply and/or Return Air Fans
Thermal energy storage	HVAC	Deploy thermal energy storage technology (ice harvester, etc.) to shift load	Code compliant chiller
Time Clock Control	Interior Lighting High Bay	Time Clock Controlled Lighting, 500 Watts Controlled	500 Watts of Lighting, Manually Controlled
VAV System	HVAC	Variable Air Volume Distribution System	Constant Air Volume Distribution System
VFD on Air Compressor	Compressed Air	20 HP VFD Air Compressor	20 HP Inlet Modulation Fixed-Speed Compressor
VFD on Cooling Tower Fans	Process Cooling	Cooling Tower Fans with VFD Control	Cooling Tower Fans without VFD Control
VFD on HVAC Fan	Motors Fans Blowers	5 HP HVAC Fan Motor, with VFD Control	5 HP HVAC Fan Motor, no VFD Control
VFD on HVAC Pump	Motors Pumps	VFD on HVAC Pump	7.5 HP HVAC Pump Motor, no VFD Control
VFD on process pump	Motors Pumps	20 HP Process Pump Equipped with VFD Control	20 HP Process Pump, Constant Speed
VSD Controlled Compressor	Process Cooling	Refrigeration System with VSD Control	Refrigeration System with Standard Slide-Valve Control System
Water source heat pump	HVAC	Water Source Heat Pump, 2.5 Tons, 17.4 EER, 4.4 COP	Code-Compliant ASHP
Waterside economizer	HVAC	Waterside Economizer	No economizer
Window shade film	HVAC	Window Film with SHGC of 0.35 Applied to Standard Window	Standard Window with below Code Required Minimum SHGC

DR Measure Lists

Table 4: Residential DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central Heating - Load Shed	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Water heater control	Direct load control	Summer and Winter	Load control installed on a water heater (integrated or external switch)
Pool pump switches	Direct load control	Summer and Winter	Load control program with switch installed on pool pump
Room AC	Direct load control	Summer	Load control program that is focused on room AC units rather than central AC
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 5: Small C&I DR Measures

Measure	Type	Season	Description
Central air conditioner - Load Shed	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.

Measure	Type	Season	Description
Central Heating - Load Shed*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to shed AC unit load during peak usage period.
Central air conditioner - 50% cycling	Direct load control	Summer	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Central Heating - 50% cycling*	Direct load control	Winter	Direct load control program where utility provides day ahead notification that it will send remote signal to cycle AC unit during peak usage period
Smart thermostats - Utility Installation*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
Smart thermostats – BYOT*	Direct load control	Summer and Winter	Similar to AC load control program, but allows customers to participate using a compatible smart thermostat rather than an AC switch
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Managed EV Charging – switch	Direct load control	Summer and Winter	Load control switch that is installed on an EV charger
Managed EV Charging – telematics	Direct load control	Summer and Winter	Direct load control program leveraging EV smart charging software
Battery Storage with PV	Pricing/Direct load control	Summer and Winter	PV charges battery and battery discharges to grid

Table 6: Large C&I DR Measures

Measure	Type	Season	Description
CPP + Tech	Pricing	Summer and Winter	Electricity rate that varies based on time of day. Can be same rate schedule for every day during a given season (time of use, or TOU) and with critical peak pricing (CPP) days when peak period rates are substantially higher for a limited number of days per year (customers receive advance notification of CPP event). Customers also receive technology that they can pre-program to curtail load when an event is called.
Auto DR	Utility-controlled loads	Summer and Winter	Custom load control of specific end-uses/processes that is triggered by utility signal to building management system; customer can sometimes opt-out of specific events
Firm Service Level	Contractual	Summer and Winter	Customer commits to a maximum usage level during peak periods and, when notified by the utility, agrees to cut usage to that level.
Guaranteed Load Drop	Contractual	Summer and Winter	Customer agrees to reduce usage by an agreed upon amount when notified

DSRE Measure Lists

Table 7: Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation

Table 8: Non-Residential DSRE Measures

Measure	Description
PV System	Roof-mounted system, including multiple panels, AC/DC inverter, racking system, and electrical system interconnections
Battery Storage from PV System	Lithium-ion battery system designed to integrate with an on-site PV system to store and discharge excess energy from PV generation
CHP – Fuel Cell	An electrochemical cell-based generator that reacts hydrogen fuel with oxygen
CHP – Micro Turbine	Small combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Gas Turbine	A combustion turbine that burns gaseous or liquid fuel to drive a generator
CHP – Reciprocating Engine	An engine that uses one or more pistons to convert pressure into rotational motion
CHP - Steam Turbine	A turbine that extracts thermal energy from pressured steam to drive a generator

Exhibit JH-9
Comparison of 2019 Measure List and 2024 Measure List

EE Measure Lists

EE Measures Added Since 2019 Study

Sector	Measure
Residential	CEE Advanced Tier Clothes Dryer
Residential	CEE Advanced Tier Clothes Washer
Residential	Ozone Laundry
Residential	Energy Star Dishwasher (Gas Water Heating)
Residential	Freezer Recycling
Residential	LED - 9W_Halogen Baseline
Residential	Occupancy Sensors Switch Mounted
Residential	Outdoor Motion Sensor
Residential	Dehumidifier Recycling
Residential	Energy Star Monitor
Residential	Energy Star Set-Top Receiver
Residential	CEE Tier 3 Refrigerator
Residential	Refrigerator Coil Cleaning
Residential	Induction Range
Residential	120v Heat Pump Water Heater 50 Gallons
Residential	Bathroom Faucet Aerators
Residential	Heat Pump Water Heater 50 Gallons-ENERGY STAR
Residential	Heat Pump Water Heater 80 Gallons-ENERGY STAR
Residential	ECM Circulator Pump
Residential	ENERGY STAR EV supply equipment (level 2 charger)
Residential	HVAC Economizer
Residential	Properly Sized CAC
Residential	Residential Whole House Fan
Residential	Air-to-Water Heat Pump
Residential	ASHP - 15 SEER/14.3 SEER2 from base electric resistance
Residential	ASHP - CEE Advanced Tier: 17.8 SEER/17 SEER2; 10.0 HSPF (from elec resistance)
Residential	ASHP - CEE Tier 2: 16.8 SEER/16 SEER2; 9.0 HSPF (from elec resistance)
Residential	ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2 (from elect resistance)

Sector	Measure
Residential	ASHP - ENERGY STAR/CEE Tier 1: 16 SEER/15.2 SEER2, 9.0 HSPF
Residential	Ceiling Insulation (R11 to R30)
Residential	Ceiling Insulation (R11 to R49)
Residential	Ceiling Insulation (R19 to R30)
Residential	Ceiling Insulation (R19 to R49)
Residential	Ceiling Insulation (R2 to R30)
Residential	Ceiling Insulation (R2 to R49)
Residential	Ceiling Insulation (R30 to R49)
Residential	Ceiling Insulation (R38 to R49)
Residential	HVAC Zoning System
Residential	Weather stripping
Residential	Window Caulking
Residential	Filter Whistle
Residential	New Construction - Whole Home Improvements - Tier 1
Residential	New Construction - Whole Home Improvements - Tier 2
Residential	Smart Breaker
Residential	Smart Panel
Commercial	Energy Star convection oven
Commercial	Water Heater Setback
Commercial	LED Canopy Lighting (Exterior)
Commercial	Outdoor motion sensor
Commercial	Auto Off Time Switch
Commercial	Efficient New Construction Lighting
Commercial	Energy Star LED Directional Lamp
Commercial	Indoor daylight sensor
Commercial	LED Exit Sign
Commercial	LED High Bay_LF Baseline
Commercial	Light Tube
Commercial	Occupancy Sensors, Ceiling Mounted
Commercial	Occupancy Sensors, Switch Mounted
Commercial	Time Clock Control
Commercial	Air Compressor Optimization
Commercial	Energy Star EV Chargers
Commercial	High Efficiency Air Compressor
Commercial	Ozone Laundry Commercial
Commercial	Regenerative Drive Elevator Motor
Commercial	Data Center Hot Cold Aisle

Sector	Measure
Commercial	Energy Star Monitors
Commercial	Beverage Vending Machine Controls
Commercial	Door Gasket (Freezer)
Commercial	High Efficiency Refrigeration Compressor_Scroll
Commercial	Q-Sync Evaporator Fan Motor
Commercial	Refrigeration Commissioning
Commercial	Refrigeration Economizer
Commercial	Strip Curtains - Refrigerators
Commercial	Suction Pipe Insulation - Freezers
Commercial	Suction Pipe Insulation - Refrigerators
Commercial	Ductless Mini-Split AC
Commercial	Energy Star room AC
Commercial	HE DX 5.4-11.25 Tons Other Heat
Commercial	HE DX Less than 5.4 Tons Other Heat
Commercial	HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons
Commercial	HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons
Commercial	Ceiling Insulation (R19 to R30)
Commercial	Ceiling Insulation (R19 to R49)
Commercial	Ceiling Insulation (R2 to R30)
Commercial	Ceiling Insulation (R2 to R49)
Commercial	Custom measure - Non-lighting
Commercial	Ductless Mini-Split HP
Commercial	HE DX 11.25-20.0 Tons Elec Heat
Commercial	HE DX 5.4-11.25 Tons Elect Heat
Commercial	HE DX Less than 5.4 Tons Elect Heat
Commercial	LEED New Construction Whole Building
Commercial	VFD on HVAC Pump
Commercial	Water source heat pump
Commercial	1.5HP Open Drip-Proof (ODP) Motor
Commercial	20HP Open Drip-Proof (ODP) Motor
Commercial	Advanced Rooftop Controller
Commercial	Dual Enthalpy Economizer
Commercial	Commercial Strategic Energy Management
Industrial	Compressed Air Storage Tank
Industrial	Efficient Compressed Air Nozzles
Industrial	Low Pressure-drop Filters
Industrial	VFD on Air Compressor

Sector	Measure
Industrial	Bi-Level Lighting Control (Exterior)
Industrial	LED Display Lighting (Exterior)
Industrial	LED Exterior Wall Packs
Industrial	LED Parking Lighting
Industrial	Outdoor motion sensor
Industrial	Air curtains
Industrial	Airside economizer
Industrial	Chilled Water Reset
Industrial	Custom Measure - Non-Lighting
Industrial	Dedicated Outside Air System (DOAS)
Industrial	Demand Controlled Ventilation
Industrial	DX Coil Cleaning
Industrial	Energy Efficient Laboratory Fume Hood
Industrial	Energy Recovery Ventilation System
Industrial	Energy Star room ac
Industrial	Energy Star windows
Industrial	Facility Commissioning
Industrial	Facility Energy Management System
Industrial	Fan Thermostat Controller
Industrial	HE Air Cooled Chiller - All Compressor Types - 300 Tons
Industrial	HE DX 11.25-20.0 Tons Elec Heat
Industrial	HE DX 11.25-20.0 Tons Other Heat
Industrial	HE DX 5.4-11.25 Tons Elect Heat
Industrial	HE DX 5.4-11.25 Tons Other Heat
Industrial	HE DX Less than 5.4 Tons Elect Heat
Industrial	HE DX Less than 5.4 Tons Other Heat
Industrial	HE Water Cooled Chiller - Centrifugal Compressor - 200 Tons
Industrial	HE Water Cooled Chiller - Centrifugal Compressor - 500 Tons
Industrial	HE Water Cooled Chiller - Rotary or Screw Compressor - 175 Tons
Industrial	HE Water Cooled Chiller - Rotary or Screw Compressor - 50 Tons
Industrial	High Speed Fans
Industrial	Industrial Duct Sealing
Industrial	LEED New Construction Whole Building
Industrial	Packaged Terminal AC
Industrial	Programmable thermostat
Industrial	Reflective Roof Treatment
Industrial	Smart thermostat

Sector	Measure
Industrial	Thermal energy storage
Industrial	VAV System
Industrial	Water source heat pump
Industrial	Waterside economizer
Industrial	Window shade film
Industrial	Auto Off Time Switch
Industrial	Bi-Level Lighting Control (Interior)
Industrial	Efficient New Construction Lighting
Industrial	High Bay Occupancy Sensors, Ceiling Mounted
Industrial	Indoor Agriculture - LED Grow Lights
Industrial	Indoor daylight sensor
Industrial	LED High Bay_LF Baseline
Industrial	Occupancy Sensors, Ceiling Mounted
Industrial	Time Clock Control
Industrial	LED Linear - Lamp Replacement
Industrial	Occupancy sensors, switch mounted
Industrial	Energy Star LED Directional Lamp
Industrial	LED - 14W_CFL Baseline
Industrial	LED Display Lighting (Interior)
Industrial	LED exit sign
Industrial	Light Tube
Industrial	High Volume Low Speed Fan (HVLS)
Industrial	20HP Open Drip-Proof (ODP) Motor
Industrial	Cogged Belt on 40hp ODP Motor
Industrial	Low Energy Livestock Waterer
Industrial	Low Pressure Sprinkler Nozzles
Industrial	Synchronous Belt on 15hp ODP Motor
Industrial	Synchronous Belt on 5hp ODP Motor
Industrial	Synchronous Belt on 75hp ODP Motor
Industrial	3-phase High Frequency Battery Charger - 1 shift
Industrial	Dairy Refrigeration Heat Recovery
Industrial	Drip Irrigation Nozzles
Industrial	Electric Actuators
Industrial	Energy Efficient Transformers
Industrial	Engine Block Timer
Industrial	Injection Mold and Extruder Barrel Wraps
Industrial	Milk Pre-Cooler

Sector	Measure
Industrial	Auto Closer on Refrigerator Door
Industrial	Demand Defrost
Industrial	Dual Enthalpy Economizer
Industrial	High Efficiency Refrigeration Compressor - Scroll
Industrial	Process Cooling Ventilation Reduction
Industrial	VFD on Cooling Tower Fans
Industrial	VSD Controlled Compressor
Industrial	Compressed Air Desiccant Dryer
Industrial	Compressed Air No-Loss Condensate Drains

EE Measures Eliminated Since 2019 Study

Sector	Measure
Residential	CFL – 15W Flood
Residential	CFL – 15W Flood (Exterior)
Residential	CFL – 13W
Residential	CFL – 23W
Residential	Low Wattage T8 Fixture
Residential	15 SEER Central AC
Residential	15 SEER Air Source Heat Pump
Residential	14 SEER ASHP from base electric resistance heating
Residential	Two Speed Pool Pump
Residential	Variable Speed Pool Pump
Residential	Storm Door
Commercial	CFL – 15W Flood
Commercial	High Efficiency HID Lighting
Commercial	LED Street Lights
Commercial	LED Traffic and Crosswalk Lighting
Commercial	CFL-23W
Commercial	High Bay Fluorescent (T5)
Commercial	Premium T8 - Fixture Replacement
Commercial	Premium T8 - Lamp Replacement
Commercial	Two Speed Pool Pump
Commercial	Variable Speed Pool Pump
Commercial	Tank Wrap on Water Heater
Commercial	Ceiling Insulation(R12 to R38)
Commercial	Ceiling Insulation(R30 to R38)

DR Measure Lists

DR Measures Added Since 2019 Study

Sector	Measure
Residential	Managed EV Charging – switch
Residential	Managed EV Charging – telematics
Residential	Battery Storage with PV
Commercial	Managed EV Charging – switch
Commercial	Managed EV Charging – telematics
Commercial	Battery Storage with PV

DR Measures Eliminated Since 2019 Study

Sector	Measure
None	

DSRE Measure Lists

DSRE Measures Added Since 2019 Study

Sector	Measure
None	

DSRE Measures Eliminated Since 2019 Study

Sector	Measure
None	

Exhibit JH-10
DEF Measure Screening and Economic Sensitivities

Measure Screening

The program development process was initiated with 395 EE measures, 33 DR measures, and 9 DSRE measures contributing to the technical potential, which are detailed in Exhibit JH-8. Table 1 summarizes the number of measures by category and the number of measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (*i.e.*, a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed)

Table 1. TP Measure Counts

Category	Sector	Measures	Permutations
EE	Residential	119	1,173
EE	Commercial	164	5,798
EE	Industrial	112	2,564
DR	Residential	16	48
DR	Small-Medium Business	13	52
DR	Large Commercial & Industrial	4	16
DSRE	Residential	2	2
DSRE	Non-Residential	7	42

The subsequent program development process included the following steps that refined the measure lists for the RIM scenario and TRC scenario. The following tables summarize the count of measures and permutations **excluded** at each step:

Economic Analysis – Cost-effectiveness screening

Measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Individual measures did not include any utility program costs (program administrative or incentive costs), and therefore were evaluated on the basis of measure cost-effectiveness without any utility intervention. Table 2 summarizes the count of unique measures and measure permutations excluded at this step:

Table 2: Measures Excluded – Economic Analysis, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	52	641	84	815
EE	Commercial	53	3,117	121	5,021
EE	Industrial	38	1,034	112	2,564
DR	Residential	3	N/A*	0	N/A*
DR	Small-Medium Business	2	N/A*	0	N/A*
DR	Large Commercial & Industrial	0	N/A*	0	N/A*
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

*Screening for the DR economic analysis was done at the measure level, not by permutation

Measure Adoption Forecast – Cost-effectiveness screening

All technical potential measures were re-screened in the development of the measure adoption forecasts. Associated program costs, including program administrative costs and customer incentives, were included in the economic analysis used for estimating measure adoption forecasts. Because this step occurred prior to each utility developing specific programs aligned with their proposed goals, representative administrative costs were developed using average FEECA Utility program cost data, where available from current programs, and supplemented with other utility program cost data where needed. In order to evenly apply these representative costs to measures with a variety of savings impacts, typical costs were estimated on a variable basis per kWh saved.

Measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Table 3 summarizes the count of unique measures and measure permutations excluded at this step:

Table 3: Measures Excluded – Measure Adoption Forecast, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	47	535	80	717
EE	Commercial	53	3,005	117	4,931
EE	Industrial	40	1,089	112	2,564
DR	Residential	4	14	5	17
DR	Small-Medium Business	4	29	6	35
DR	Large Commercial & Industrial	0	0	0	0
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

Measure Adoption Forecast – Free ridership screening

Consistent with prior DSM analyses in Florida, free ridership was addressed by applying a two-year payback criterion, which eliminated measures having a simple payback of less than two years. In addition to the measures and permutations excluded based on the cost-effectiveness screening summarized in Table 3 above, Table 4 summarizes the count of unique measures and measure permutations excluded at this step:

Table 4: Measures Excluded – Measure Adoption Forecast, 2-year payback screening (additional exclusions)

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	22	171	2	47
EE	Commercial	25	1,054	0	89
EE	Industrial	38	881	0	0
DR	Residential	0	0	0	0
DR	Small-Medium Business	0	0	0	0
DR	Large Commercial & Industrial	0	0	0	0
DSRE	Residential	0	0	0	0
DSRE	Non-Residential	0	0	0	0

Economic Sensitivities

As part of the economic analysis, the study included development of sensitivities related to free ridership, future fuel costs, as follows:

Sensitivity #1: Higher Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "high fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 5: Economic Sensitivity #1 – Passing Measures, Higher Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	68	535	36	360
EE	Commercial	114	2,753	44	893
EE	Industrial	76	1,585	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #2: Lower Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "low fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 6: Economic Sensitivity #2 – Passing Measures, Lower Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	66	523	35	358
EE	Commercial	108	2,575	39	611
EE	Industrial	72	1,467	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #3: Shorter free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was reduced to one year or longer:

Table 7: Economic Sensitivity #3 – Passing Measures, Shorter free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	53	436	32	328
EE	Commercial	98	2,061	43	739
EE	Industrial	48	873	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #4: Longer free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was increased to three years or longer:

Table 8: Economic Sensitivity #4 – Passing Measures, Longer free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	41	290	29	234
EE	Commercial	72	1,065	41	550
EE	Industrial	23	396	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Exhibit JH-11
FPUC Measure Screening and Economic Sensitivities

Measure Screening

The program development process was initiated with 395 EE measures, 29 DR measures, and 9 DSRE measures contributing to the technical potential, which are detailed in Exhibit JH-8. Table 1 summarizes the number of measures by category and the number of measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (*i.e.*, a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed)

Table 1. TP Measure Counts

Category	Sector	Measures	Permutations
EE	Residential	119	1,173
EE	Commercial	164	5,798
EE	Industrial	112	2,564
DR	Residential	14	14
DR	Small-Medium Business	11	11
DR	Large Commercial & Industrial	4	4
DSRE	Residential	2	2
DSRE	Non-Residential	7	42

The subsequent program development process included the following steps that refined the measure lists for the RIM scenario and TRC scenario. The following tables summarize the count of measures and permutations **excluded** at each step:

Economic Analysis – Cost-effectiveness screening

Technical potential measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Individual measures did not include any utility program costs (program administrative or incentive costs), and therefore were evaluated on the basis of measure cost-effectiveness without any utility intervention. Table 2 summarizes the count of unique measures and measure permutations excluded at this step:

Table 2: Measures Excluded – Economic Analysis, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	68	771	119	1,173
EE	Commercial	68	3,516	164	5,798
EE	Industrial	40	1,093	112	2,564
DR	Residential	12	N/A*	1	N/A*
DR	Small-Medium Business	9	N/A*	1	N/A*
DR	Large Commercial & Industrial	4	N/A*	0	N/A*
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

*Screening for the DR economic analysis was done at the measure level, not by permutation

Measure Adoption Forecast – Cost-effectiveness screening

All technical potential measures were re-screened in the development of the measure adoption forecasts. Associated program costs, including program administrative costs and customer incentives, were included in the economic analysis used for estimating measure adoption forecasts. Because this step occurred prior to each utility developing specific programs aligned with their proposed goals, representative administrative costs were developed using average FEECA Utility program cost data, where available from current programs, and supplemented with other utility program cost data where needed. In order to evenly apply these representative costs to measures with a variety of savings impacts, typical costs were estimated on a variable basis per kWh saved.

Measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Table 3 summarizes the count of unique measures and measure permutations excluded at this step:

Table 3: Measures Excluded – Measure Adoption Forecast, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	71	803	119	1,173
EE	Commercial	70	3,632	164	5,798
EE	Industrial	42	1,142	112	2,564
DR	Residential	14	14	14	14
DR	Small-Medium Business	11	11	11	11
DR	Large Commercial & Industrial	4	4	4	4
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

Measure Adoption Forecast – Free ridership screening

Consistent with prior DSM analyses in Florida, free ridership was addressed by applying a two-year payback criterion, which eliminated measures having a simple payback of less than two years. In addition to the measures and permutations excluded based on the cost-effectiveness screening summarized in Table 3 above, Table 4 summarizes the count of unique measures and measure permutations excluded at this step:

Table 4: Measures Excluded – Measure Adoption Forecast, 2-year payback screening (additional exclusions)

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	18	140	0	0
EE	Commercial	38	1,268	0	0
EE	Industrial	39	836	0	0
DR	Residential	0	0	0	0
DR	Small-Medium Business	0	0	0	0
DR	Large Commercial & Industrial	0	0	0	0
DSRE	Residential	0	0	0	0
DSRE	Non-Residential	0	0	0	0

DSM Program Development – Cost-effectiveness screening

As described in Exhibit No. JH-14, RI worked collaboratively with FPUC on the DSM program development process, resulting in a Proposed Goals Scenario, a RIM Scenario, and a TRC Scenario. All technical potential measures were re-analyzed in the DSM program development process.

For the RIM Scenario and TRC Scenario program development, updated non-incentive costs specific to FPUC were developed and applied in the updated cost-effectiveness screening of technical potential measures, which included the following criteria for each scenario:

- RIM-scenario – measures that failed the RIM-scenario criteria (RIM test, PCT, and payback period of at least 2 years) were excluded from the initial measure bundling analysis
- TRC-scenario – measures that failed the TRC-scenario criteria (TRC test, PCT, and payback period of at least 2 years) were excluded from the initial measure bundling analysis

Table 5 summarizes the count of unique measures and measure permutations excluded for each scenario at this step:

Table 5: Measures Excluded – DSM Program Development, TRC Scenario and RIM Scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	91	972	119	1,173
EE	Commercial	110	4,910	164	5,798
EE	Industrial	81	1,979	112	2,564
DR	Residential	14	14	14	14
DR	Small-Medium Business	11	11	11	11
DR	Large Commercial & Industrial	4	4	4	4
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

The development of the Proposed Goals Scenario started with assessment of technical potential measures study that passed, or were close to passing, the economic analysis, as well as measures included in current FPUC programs or that may be logical additions to current FPUC programs. Therefore, all individual EE measures were included in the initial analysis. Due to the DSM program development cost-effectiveness screening resulting in no DSRE measures or DR measures passing the RIM or TRC scenarios, these measures were excluded in the Proposed Goals Scenario analysis.

Economic Sensitivities

As part of the economic analysis, the study included development of sensitivities related to future fuel costs and free ridership, as follows:

Sensitivity #1: Higher Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "high fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 6: Economic Sensitivity #1 – Passing Measures, Higher Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	59	444	9	60
EE	Commercial	107	2,586	0	0
EE	Industrial	77	1,587	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #2: Lower Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "low fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 7: Economic Sensitivity #2 – Passing Measures, Lower Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	46	349	0	0
EE	Commercial	90	2,112	0	0
EE	Industrial	68	1,372	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #3: Shorter free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was reduced to one year or longer:

Table 8: Economic Sensitivity #3 – Passing Measures, Shorter free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	38	312	0	0
EE	Commercial	79	1,522	0	0
EE	Industrial	45	824	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #4: Longer free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was increased to three years or longer:

Table 9: Economic Sensitivity #4 – Passing Measures, Longer free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	26	153	0	0
EE	Commercial	39	422	0	0
EE	Industrial	22	349	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Exhibit JH-12
JEA Measure Screening and Economic Sensitivities

Measure Screening

The program development process was initiated with 395 EE measures, 33 DR measures, and 9 DSRE measures contributing to the technical potential, which are detailed in Exhibit JH-8. Table 1 summarizes the number of measures by category and the number of measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (*i.e.*, a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed)

Table 1. TP Measure Counts

Category	Sector	Measures	Permutations
EE	Residential	119	1,173
EE	Commercial	164	5,798
EE	Industrial	112	2,564
DR	Residential	16	16
DR	Small-Medium Business	13	52
DR	Large Commercial & Industrial	4	16
DSRE	Residential	2	2
DSRE	Non-Residential	7	42

The subsequent program development process included the following steps that refined the measure lists for the RIM scenario and TRC scenario. The following tables summarize the count of measures and permutations <u>**excluded**</u> at each step:

Economic Analysis – Cost-effectiveness screening

Technical potential measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Individual measures did not include any utility program costs (program administrative or incentive costs), and therefore were evaluated on the basis of measure cost-effectiveness without any utility intervention. Table 2 summarizes the count of unique measures and measure permutations excluded at this step:

Table 2: Measures Excluded – Economic Analysis, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	66	755	110	1,109
EE	Commercial	70	3,592	164	5,798
EE	Industrial	42	1,143	112	2,564
DR	Residential	3	N/A*	0	N/A*
DR	Small-Medium Business	2	N/A*	1	N/A*
DR	Large Commercial & Industrial	0	N/A*	0	N/A*
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

*Screening for the DR economic analysis was done at the measure level, not by permutation

Measure Adoption Forecast – Cost-effectiveness screening

All technical potential measures were re-screened in the development of the measure adoption forecasts. Associated program costs, including program administrative costs and customer incentives, were included in the economic analysis used for estimating measure adoption forecasts. Because this step occurred prior to each utility developing specific programs aligned with their proposed goals, representative administrative costs were developed using average FEECA Utility program cost data, where available from current programs, and supplemented with other utility program cost data where needed. In order to evenly apply these representative costs to measures with a variety of savings impacts, typical costs were estimated on a variable basis per kWh saved.

Measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Table 3 summarizes the count of unique measures and measure permutations excluded at this step:

Table 3: Measures Excluded – Measure Adoption Forecast, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	71	804	114	1,125
EE	Commercial	79	3,874	164	5,798
EE	Industrial	48	1,294	112	2,564
DR	Residential	14	14	14	14
DR	Small-Medium Business	10	47	10	47
DR	Large Commercial & Industrial	0	8	0	8
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

Measure Adoption Forecast – Free ridership screening

Consistent with prior DSM analyses in Florida, free ridership was addressed by applying a two-year payback criterion, which eliminated measures having a simple payback of less than two years. In addition to the measures and permutations excluded based on the cost-effectiveness screening summarized in Table 3 above, Table 4 summarizes the count of unique measures and measure permutations excluded at this step:

Table 4: Measures Excluded – Measure Adoption Forecast, 2-year payback screening (additional exclusions)

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	18	134	0	0
EE	Commercial	25	842	0	0
EE	Industrial	29	661	0	0
DR	Residential	0	0	0	0
DR	Small-Medium Business	0	0	0	0
DR	Large Commercial & Industrial	0	0	0	0
DSRE	Residential	0	0	0	0
DSRE	Non-Residential	0	0	0	0

DSM Program Development – Cost-effectiveness screening

As described in Exhibit No. JH-15, RI worked collaboratively with JEA on the DSM program development process, resulting in a Proposed Goals Scenario, a RIM Scenario, and a TRC Scenario. All technical potential measures were re-analyzed in the DSM program development process.

For the RIM Scenario and TRC Scenario program development, updated non-incentive costs specific to JEA were developed and applied in the updated cost-effectiveness screening of technical potential measures, which included the following criteria for each scenario:

- RIM Scenario – measures that failed the RIM Scenario criteria (RIM test, PCT, and payback period of at least 2 years) were excluded from the initial measure bundling analysis
- TRC Scenario – measures that failed the TRC Scenario criteria (TRC test, PCT, and payback period of at least 2 years) were excluded from the initial measure bundling analysis

Table 5 summarizes the count of unique measures and measure permutations excluded for each scenario at this step:

Table 5: Measures Excluded – DSM Program Development, TRC Scenario and RIM Scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	92	956	114	1,125
EE	Commercial	104	4,718	164	5,798
EE	Industrial	77	1,955	112	2,564
DR	Residential	16	16	16	16
DR	Small-Medium Business	13	52	13	52
DR	Large Commercial & Industrial	0	12	0	12
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

The development of the Proposed Goals Scenario started with assessment of technical potential measures study that passed, or were close to passing, the economic analysis, as well as measures included in current JEA programs or that may be logical additions to current JEA programs. Therefore, all individual EE measures were included in the initial analysis, as well as Large Commercial DR measures. Due to the DSM program development cost-effectiveness screening resulting in no DSRE measures or DR measures for Residential or Small-Medium Businesses passing the RIM or TRC scenarios, these measures were excluded in the Proposed Goals Scenario analysis.

Economic Sensitivities

As part of the economic analysis, the study included development of sensitivities related to future fuel costs and free ridership, as follows:

Sensitivity #1: Higher Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "high fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 6: Economic Sensitivity #1 – Passing Measures, Higher Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	57	443	20	152
EE	Commercial	99	2,387	0	0
EE	Industrial	72	1,478	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #2: Lower Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "low fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 7: Economic Sensitivity #2 – Passing Measures, Lower Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	45	355	2	8
EE	Commercial	81	1,846	0	0
EE	Industrial	63	1,266	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #3: Shorter free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was reduced to one year or longer:

Table 8: Economic Sensitivity #3 – Passing Measures, Shorter free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	41	334	9	64
EE	Commercial	80	1,646	0	0
EE	Industrial	53	1,014	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #4: Longer free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was increased to three years or longer:

Table 9: Economic Sensitivity #4 – Passing Measures, Longer free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	34	257	9	64
EE	Commercial	56	928	0	0
EE	Industrial	34	643	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Exhibit JH-13
OUC Measure Screening and Economic Sensitivities

Measure Screening

The program development process was initiated with 395 EE measures, 33 DR measures, and 9 DSRE measures contributing to the technical potential, which are detailed in Exhibit JH-8. Table 1 summarizes the number of measures by category and the number of measure permutations, which are the application of individual measures to various customer segments, construction types, and end-uses (*i.e.*, a single air-source heat pump "measure" can be installed in single family, multi-family, and manufactured homes, as well as new and existing vintages of each home type, and impacts both space cooling and space heating end-uses, resulting in twelve separate measure "permutations" analyzed)

Table 1. TP Measure Counts

Category	Sector	Measures	Permutations
EE	Residential	119	1,173
EE	Commercial	164	5,798
EE	Industrial	112	2,564
DR	Residential	16	48
DR	Small-Medium Business	13	52
DR	Large Commercial & Industrial	4	16
DSRE	Residential	2	2
DSRE	Non-Residential	7	42

The subsequent program development process included the following steps that refined the measure lists for the RIM scenario and TRC scenario. The following tables summarize the count of measures and permutations **excluded** at each step:

Economic Analysis – Cost-effectiveness screening

Technical potential measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Individual measures did not include any utility program costs (program administrative or incentive costs), and therefore were evaluated on the basis of measure cost-effectiveness without any utility intervention. Table 2 summarizes the count of unique measures and measure permutations excluded at this step:

Table 2: Measures Excluded – Economic Analysis, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	76	857	119	1,173
EE	Commercial	84	4,079	163	5,784
EE	Industrial	52	1,354	112	2,564
DR	Residential	4	N/A*	0	N/A*
DR	Small-Medium Business	2	N/A*	0	N/A*
DR	Large Commercial & Industrial	0	N/A*	0	N/A*
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

*Screening for the DR economic analysis was done at the measure level, not by permutation

Measure Adoption Forecast – Cost-effectiveness screening

All technical potential measures were re-screened in the development of the measure adoption forecasts. Associated program costs, including program administrative costs and customer incentives, were included in the economic analysis used for estimating measure adoption forecasts. Because this step occurred prior to each utility developing specific programs aligned with their proposed goals, representative administrative costs were developed using average FEECA Utility program cost data, where available from current programs, and supplemented with other utility program cost data where needed. In order to evenly apply these representative costs to measures with a variety of savings impacts, typical costs were estimated on a variable basis per kWh saved.

Measures that did not achieve a cost-effectiveness ratio of 1.0 for the TRC test and PCT were excluded from the TRC scenario. Measures that did not achieve a ratio of 1.0 for the RIM test and PCT were excluded from the RIM scenario for the economic analysis. Table 3 summarizes the count of unique measures and measure permutations excluded at this step:

Table 3: Measures Excluded – Measure Adoption Forecast, TRC scenario and RIM scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	76	865	119	1,173
EE	Commercial	95	4,390	163	5,784
EE	Industrial	59	1,509	112	2,564
DR	Residential	16	48	16	48
DR	Small-Medium Business	5	42	6	43
DR	Large Commercial & Industrial	0	7	0	7
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

Measure Adoption Forecast – Free ridership screening

Consistent with prior DSM analyses in Florida, free ridership was addressed by applying a two-year payback criterion, which eliminated measures having a simple payback of less than two years. In addition to the measures and permutations excluded based on the cost-effectiveness screening summarized in Table 3 above, Table 4 summarizes the count of unique measures and measure permutations excluded at this step:

Table 4: Measures Excluded – Measure Adoption Forecast, 2-year payback screening (additional exclusions)

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	18	140	0	0
EE	Commercial	27	860	0	0
EE	Industrial	37	802	0	0
DR	Residential	0	0	0	0
DR	Small-Medium Business	0	0	0	0
DR	Large Commercial & Industrial	0	0	0	0
DSRE	Residential	0	0	0	0
DSRE	Non-Residential	0	0	0	0

DSM Program Development – Cost-effectiveness screening

As described in Exhibit No. JH-16, RI worked collaboratively with OUC on the DSM program development process, resulting in a Proposed Goals Scenario, a RIM Scenario, and a TRC Scenario. All technical potential measures were re-analyzed in the DSM program development process.

For the RIM Scenario and TRC Scenario program development, updated non-incentive costs specific to OUC were developed and applied in the updated cost-effectiveness screening of technical potential measures, which included the following criteria for each scenario:

- RIM Scenario – measures that failed the RIM Scenario criteria (RIM test, PCT, and payback period of at least 2 years) were excluded from the initial measure bundling analysis
- TRC Scenario – measures that failed the TRC Scenario criteria (TRC test, PCT, and payback period of at least 2 years) were excluded from the initial measure bundling analysis

Table 5 summarizes the count of unique measures and measure permutations excluded for each scenario at this step:

Table 5: Measures Excluded – DSM Program Development, TRC Scenario and RIM Scenario

Category	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	101	1,061	119	1,173
EE	Commercial	118	5,165	163	5,784
EE	Industrial	93	2,237	112	2,564
DR	Residential	16	48	16	48
DR	Small-Medium Business	13	52	13	52
DR	Large Commercial & Industrial	0	12	0	12
DSRE	Residential	2	2	2	2
DSRE	Non-Residential	7	42	7	42

The development of the Proposed Goals Scenario started with assessment of technical potential measures study that passed, or were close to passing, the economic analysis, as well as measures included in current OUC programs or that may be logical additions to current OUC programs. Therefore, all individual EE measures were included in the initial analysis, as well as Large Commercial DR measures. Due to the DSM program development cost-effectiveness screening resulting in no DSRE measures or DR measures for Residential or Small-Medium Businesses passing the RIM or TRC scenarios, these measures were excluded in the Proposed Goals Scenario analysis.

Economic Sensitivities

As part of the economic analysis, the study included development of sensitivities related to free ridership, future fuel costs, and carbon cost scenarios, as follows:

Sensitivity #1: Higher Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "high fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 6: Economic Sensitivity #1 – Passing Measures, Higher Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	46	349	0	0
EE	Commercial	85	2,011	1	14
EE	Industrial	67	1,338	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #2: Lower Fuel Prices

For this sensitivity, both the RIM and TRC scenarios were screened using electric utility supply costs adjusted to a "low fuel" cost scenario. The following table summarizes the number of unique measures and measure permutations that are cost effective under each scenario:

Table 7: Economic Sensitivity #2 – Passing Measures, Lower Fuel Prices

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	41	304	0	0
EE	Commercial	69	1,360	1	14
EE	Industrial	53	1,049	0	0

*DR measures were not included in the economic sensitivities as fuel prices do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #3: Shorter free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was reduced to one year or longer:

Table 8: Economic Sensitivity #3 – Passing Measures, Shorter free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	32	238	0	0
EE	Commercial	65	1,141	1	14
EE	Industrial	36	615	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #4: Longer free-ridership exclusion periods

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the simple payback screening criteria was increased to three years or longer:

Table 9: Economic Sensitivity #4 – Passing Measures, Longer free-ridership exclusion period

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	19	85	0	0
EE	Commercial	33	426	0	0
EE	Industrial	14	212	0	0

*DR measures were not included in the economic sensitivities as there is negligible customer incremental cost for DR measures and therefore differences in simple payback do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Sensitivity #5: Carbon dioxide (CO_2) costs

For this sensitivity, both the RIM and TRC scenarios were screened as described above for the Economic Analysis, but the avoided electric utility supply costs forecast was adjusted to include consideration of an additional impact for emissions assuming that there was an economic charge for carbon dioxide.

Table 10: Economic Sensitivity #5 – Passing Measures, Carbon dioxide costs

Category*	Sector	TRC Scenario		RIM Scenario	
		Measures	Permutations	Measures	Permutations
EE	Residential	43	316	0	0
EE	Commercial	82	1,835	1	14
EE	Industrial	65	1,288	0	0

*DR measures were not included in the economic sensitivities as the estimated carbon dioxide costs do not affect DR results.

*No DSRE measures passed the economic screening for this sensitivity.

Exhibit JH-14
FPUC Program Development Summary

Overview

RI worked collaboratively with FPUC on the DSM program development process to develop impacts under three scenarios: 1) potential DSM programs that contribute to proposed DSM goals (Proposed Goals Scenario), 2) potential DSM programs that pass the Participant and Rate Impact Measure Tests (RIM Scenario), and 3) potential DSM programs that pass the Participant and Total Resource Cost Tests (TRC Scenario).

Methodology

The development of DSM programs for each scenario included incorporating the measures and measure impacts developed for the Technical Potential (TP) study, reviewing FPUC's current program offerings, collaboration with FPUC on program concepts that are beneficial for their customers, and analysis of economic impacts and market adoption to create potential DSM programs. This process included the following steps:

Program Review and Measure Bundling

The analysis began with the measures from the TP study. This measure list was initially refined for program development for each scenario as follows:

1. Proposed Goals scenario – measures that passed, or were close to passing, either the TRC or RIM tests were prioritized in the initial measure bundling analysis. Measures included in current FPUC programs were also identified and included in the initial measure bundling.
2. RIM Scenario – measures that passed the RIM Scenario criteria (RIM test, PCT, and payback period of at least 2 years) were included in the initial measure bundling analysis
3. TRC Scenario – measures that passed the TRC Scenario criteria (TRC test, PCT, and payback period of at least 2 years) were included in the initial measure bundling analysis

Resource Innovations then reviewed current FPUC programs and eligible measures, and mapped individual measures to the appropriate programs for each scenario. Resource Innovations worked collaboratively with FPUC to collect program information (e.g. program manuals, participation records, energy and demand savings, budgets) and review the existing programs to determine which measures should be included in the initial program portfolios. In addition, a gap analysis was conducted to identify measures included in each scenario that are not currently offered by FPUC. These measures were either included in existing programs where there was a logical fit, or included as a new program concept.

Program Refinement and Modeling

After identifying the preliminary measure bundles and programs, Resource Innovations worked collaboratively with FPUC to develop incentive amounts and non-incentive costs. Non-incentive costs, which include costs to manage, administer, and market the program, were developed based on current FPUC program costs as well as secondary data on similar programs offered by other utilities, and refined as needed based on the proposed program delivery structure. Incentive costs were developed for each scenario as follows:

1. Proposed Goals scenario – preliminary incentive rates were informed by current incentives offered by FPUC as well as typical incentive levels offered by similar programs regionally and nationally.
2. RIM Scenario – incentive rates were developed based on the available net benefits for each measure, based on total RIM benefits minus RIM costs. Next, the incentive amount that would result in a simple payback period of two years for each measure was calculated. The final incentive applied for the measure was based on the lower of these two values.
3. TRC Scenario – the incentive amount required to result in a simple payback period of two years for each measure was used as the final incentive for the measure.

Measures included in the initial program concepts for each scenario were analyzed in RI's TEA-POT model to update the economic analysis based on the FPUC-specific non-incentive and incentive costs, and to estimate market adoption for each measure. The economic analysis included calculating updated RIM, TRC, and PCT costs and benefits for each measure and re-screening measures for each scenario.

RI's market adoption estimates use a payback acceptance criterion to estimate long-run market shares for measures as a function of measure incremental costs and expected bill savings over the measures' effective useful life (inclusive of utility incentives). Incremental adoption estimates are based on the Bass Diffusion Model, which is a mathematical description of how the rate of new product diffusion changes over time. For this study, adoption curve input parameters were developed for each measure based on specific criteria, including measure maturity in the market, overall measure cost, and whether the measure was currently offered through a utility program. RI's TEA-POT model then calculated demand and energy savings by applying estimated adoption rates to each cost-effective measure.

The TEA-POT modeling results were exported into RI's Program Planner workbook that aggregated the individual measure results into program and portfolio impacts for each scenario. For the TRC Scenario and RIM Scenario no further refinements to the programs were made. For the Proposed Goals scenario, RI continued to work collaboratively with FPUC to identify the measures and program concepts that comprise the proposed DSM goals. These impacts for each scenario are provided below.

Results

Proposed Goals Scenario

The Proposed Goals Scenario is described in more detail in Witness Craig's testimony. The following tables include the program-level details for this scenario.

Table 1. Proposed DSM Goals – Annual MWh Targets

Annual MWh	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	77	79	80	81	82	84	84	86	87	88
Res Heating & Cooling Upgrade	216	226	237	247	251	248	237	219	199	182
Res Low Income	70	70	70	70	70	70	70	70	70	70
Res Equipment Rebates	1	2	2	3	4	4	5	5	5	5
Residential Total	365	377	390	401	407	406	396	380	361	345
Com Heating & Cooling Upgrade	25	29	32	36	39	42	45	46	47	47
Com Chiller Upgrade	4	4	5	5	6	6	6	7	7	7
Com Lighting	70	96	125	157	188	216	236	247	247	240
Non-Residential Total	100	129	163	198	233	264	287	300	301	294
Portfolio Total	465	507	553	599	641	671	683	679	663	638

Table 2. Proposed DSM Goals – Annual summer MW Targets

Annual Summer MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Res Heating & Cooling Upgrade	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.04	0.03	0.03
Res Low Income	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Res Equipment Rebates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Total	0.05	0.05	0.06	0.06	0.07	0.07	0.07	0.06	0.05	0.04
Com Heating & Cooling Upgrade	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Com Chiller Upgrade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Lighting	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
Non-Residential Total	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.04
Portfolio Total	0.06	0.07	0.09	0.10	0.10	0.11	0.11	0.10	0.10	0.09

Table 3. Proposed DSM Goals – Annual winter MW Targets

Annual Winter MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Res Heating & Cooling Upgrade	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.09
Res Low Income	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Res Equipment Rebates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Total	0.15	0.15	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14
Com Heating & Cooling Upgrade	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Com Chiller Upgrade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Lighting	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Non-Residential Total	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Portfolio Total	0.17	0.17	0.18	0.18	0.19	0.19	0.19	0.19	0.18	0.18

Table 4. Proposed DSM Goals – Annual Participation Targets

Annual Participation (# measures)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	110	112	114	115	117	119	120	122	124	125
Res Heating & Cooling Upgrade	159	192	227	259	278	277	255	214	169	130
Res Low Income	100	100	100	100	100	100	100	100	100	100
Res Equipment Rebates	6	8	11	13	15	17	18	20	21	21
Residential Total	375	412	452	487	510	513	493	456	414	376
Com Heating & Cooling Upgrade	47	53	61	68	74	81	86	88	87	86
Com Chiller Upgrade	3	3	3	3	3	3	3	3	3	3
Com Lighting	228	307	398	495	587	671	733	770	782	770
Non-Residential Total	278	363	462	566	664	755	822	861	872	859
Portfolio Total	653	775	914	1,053	1,174	1,268	1,315	1,317	1,286	1,235

Table 5. Proposed DSM Goals – Annual Program Budget Estimates

Budgets ($ in thousands)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	$42	$43	$44	$44	$45	$46	$46	$47	$47	$48
Res Heating & Cooling Upgrade	$343	$352	$361	$368	$373	$372	$365	$353	$341	$329
Res Low Income	$38	$38	$38	$38	$38	$38	$38	$38	$38	$38
Res Equipment Rebates	$6	$9	$11	$14	$17	$19	$21	$23	$24	$24
Residential Total	$430	$442	$454	$465	$472	$475	$470	$461	$450	$440
Com Heating & Cooling Upgrade	$7	$8	$9	$10	$11	$12	$13	$13	$13	$13
Com Chiller Upgrade	$5	$6	$7	$7	$8	$8	$8	$9	$9	$10
Com Lighting	$22	$30	$39	$49	$59	$67	$73	$77	$78	$76
Non-Residential Total	$35	$44	$55	$66	$77	$87	$94	$99	$100	$99
Portfolio Total	$465	$486	$509	$531	$550	$561	$564	$559	$550	$539

Table 6. Proposed DSM Goals – Cost-Effectiveness Results

	TRC		PCT		RIM	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio
Res Audits/EE Kits	-20,710	1.0	737,550	11.0	-758,260	0.4
Res Heating & Cooling Upgrade	244,618	1.1	2,390,828	4.9	-2,146,210	0.4
Res Low Income	-17,581	1.0	626,103	11.0	-643,684	0.4
Res Equipment Rebates	-878	1.0	27,633	2.6	-28,511	0.5
Residential Total	**205,449**	**1.08**	**3,782,114**	**5.91**	**-3,576,665**	**0.41**
Com Heating & Cooling Upgrade	38,818	1.2	325,422	2.7	-286,605	0.5
Com Chiller Upgrade	-18,437	0.8	71,567	3.2	-90,003	0.4
Com Lighting	81,939	1.1	1,987,725	3.6	-1,905,787	0.4
Non-Residential Total	**102,319**	**1.07**	**2,384,714**	**3.43**	**-2,282,395**	**0.40**
Portfolio Total	**307,769**	**1.08**	**6,166,829**	**4.52**	**-5,859,060**	**0.41**

RIM Scenario

The RIM Scenario is comprised of measures and programs that achieved a cost-effectivess ratio of 1.0 or higher for the PCT and RIM test, and measures that had a simple payback of two years or more (without consideration of incentives).

FPUC did not have any measures or programs that passed the cost-effectiveness screening for the RIM Scenario.

TRC Scenario

The TRC Scenario is comprised of measures and programs that achieved a cost-effectivess ratio of 1.0 or higher for the PCT and TRC test, and measures that had a simple payback of two years or more (without consideration of incentives). Incentive rates were based on the maximum incentive amount that would result in a simple payback period of two years for each measure. The following tables include the program-level details for this scenario.

Table 7. TRC Scenario – Annual MWh Targets

Annual MWh	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	1	2	3	3	4	5	5	5	5	4
Res Heating & Cooling Upgrade	82	88	93	99	104	109	112	114	115	115
Res New Home	34	46	60	75	89	101	111	118	122	125
Res Low Income	0	0	1	1	1	1	1	1	1	1
Res Building Envelope	16	17	18	20	21	23	24	26	27	29
Res Water Heating	109	137	167	198	228	255	277	295	308	317
Res Equipment Rebates	17	22	29	37	45	52	57	58	54	48
Res HVAC Improvements	14	15	17	19	20	21	22	23	24	25
Residential Total	272	328	389	451	512	566	609	639	657	663
Com Heating & Cooling Upgrade	40	45	50	55	59	63	66	69	70	71
Com Reflective Roof	0	0	0	0	0	0	0	0	0	0
Com Chiller Upgrade	6	7	7	8	8	9	9	10	10	10
Com Small Business	8	11	15	18	22	25	27	29	30	30
Com Custom	171	191	215	243	272	301	324	339	342	332
Com Lighting	68	93	121	152	182	208	228	238	239	231
Com Prescriptive	59	74	91	109	127	143	156	166	171	173
Non-Residential Total	351	420	499	584	670	749	811	850	862	848
Portfolio Total	624	748	888	1,035	1,182	1,314	1,420	1,490	1,519	1,511

Table 8. TRC Scenario – Annual summer MW Targets

Annual Summer MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Heating & Cooling Upgrade	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Res New Home	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04
Res Low Income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Building Envelope	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Res Water Heating	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Res Equipment Rebates	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Res HVAC Improvements	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residential Total	0.05	0.06	0.07	0.08	0.10	0.11	0.11	0.12	0.12	0.13
Com Heating & Cooling Upgrade	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Com Reflective Roof	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Chiller Upgrade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Small Business	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Custom	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.05
Com Lighting	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03
Com Prescriptive	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Non-Residential Total	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.13	0.13
Portfolio Total	0.11	0.13	0.15	0.18	0.20	0.22	0.24	0.25	0.25	0.25

Table 9. TRC Scenario – Annual winter MW Targets

Annual Winter MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Heating & Cooling Upgrade	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
Res New Home	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Res Low Income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Building Envelope	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Res Water Heating	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.07	0.08	0.08
Res Equipment Rebates	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00
Res HVAC Improvements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Total	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.15	0.15
Com Heating & Cooling Upgrade	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Com Reflective Roof	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Chiller Upgrade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Small Business	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Custom	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.04
Com Lighting	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.02
Com Prescriptive	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Non-Residential Total	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.12	0.12	0.12
Portfolio Total	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.27	0.27	0.27

Table 10. TRC Scenario – Annual Participation Targets

Annual Participation (# measures)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	29	40	52	66	81	94	103	103	94	78
Res Heating & Cooling Upgrade	73	82	92	100	109	116	122	126	127	125
Res New Home	8	11	13	16	19	22	24	25	27	27
Res Low Income	8	10	13	17	21	24	26	26	24	20
Res Building Envelope	35	38	41	44	46	50	53	56	60	63
Res Water Heating	113	143	176	209	241	269	290	309	321	328
Res Equipment Rebates	172	229	302	383	467	541	588	591	545	459
Res HVAC Improvements	24	27	30	32	34	36	38	40	41	43
Residential Total	462	580	719	867	1,018	1,152	1,244	1,276	1,239	1,143
Com Heating & Cooling Upgrade	66	74	78	83	88	91	95	97	100	103
Com Reflective Roof	1	1	1	1	1	1	1	1	1	1
Com Chiller Upgrade	4	4	4	4	4	4	4	4	4	4
Com Small Business	40	52	67	82	96	109	119	126	130	134
Com Custom	40	45	52	61	67	77	82	87	90	88
Com Lighting	218	290	376	470	557	636	694	729	739	728
Com Prescriptive	61	71	83	95	107	119	128	134	134	137
Non-Residential Total	430	537	661	796	920	1,037	1,123	1,178	1,198	1,195
Portfolio Total	892	1,117	1,380	1,663	1,938	2,189	2,367	2,454	2,437	2,338

Table 11. TRC Scenario – Annual Program Budget Estimates

Budgets ($ in thousands)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audits/EE Kits	$1	$1	$1	$1	$2	$2	$2	$2	$2	$2
Res Heating & Cooling Upgrade	$89	$98	$105	$113	$119	$125	$129	$133	$136	$138
Res New Home	$13	$18	$23	$29	$34	$39	$42	$45	$47	$48
Res Low Income	$0	$0	$0	$0	$0	$0	$1	$1	$0	$0
Res Building Envelope	$24	$26	$28	$30	$32	$34	$37	$39	$42	$44
Res Water Heating	$236	$291	$351	$412	$471	$525	$571	$608	$638	$660
Res Equipment Rebates	$3	$4	$5	$6	$8	$9	$9	$10	$9	$9
Res HVAC Improvements	$4	$4	$5	$5	$6	$6	$6	$7	$7	$7
Residential Total	$369	$442	$519	$597	$672	$740	$798	$845	$881	$907
Com Heating & Cooling Upgrade	$14	$16	$18	$19	$21	$22	$23	$24	$25	$25
Com Reflective Roof	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Com Chiller Upgrade	$6	$7	$8	$8	$9	$10	$10	$10	$11	$11
Com Small Business	$3	$4	$5	$6	$7	$8	$9	$9	$9	$10
Com Custom	$36	$39	$43	$47	$52	$56	$60	$62	$62	$60
Com Lighting	$21	$29	$38	$48	$57	$65	$71	$75	$75	$74
Com Prescriptive	$11	$14	$18	$21	$24	$27	$30	$31	$32	$32
Non-Residential Total	$92	$109	$129	$149	$170	$188	$203	$212	$215	$212
Portfolio Total	$462	$551	$647	$746	$842	$928	$1,001	$1,057	$1,096	$1,120

Table 12. TRC Scenario – Cost-Effectiveness Results

	TRC		**PCT**		**RIM**	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio
Res Audits/EE Kits	475	1.0	32,626	3.4	-32,151	0.4
Res Heating & Cooling Upgrade	463,150	1.3	2,014,437	3.1	-1,551,287	0.3
Res New Home	371,130	1.7	982,183	3.8	-611,053	0.6
Res Low Income	119	1.0	8,156	3.4	-8,038	0.4
Res Building Envelope	98,763	1.3	461,433	2.4	-362,670	0.4
Res Water Heating	10,014,754	2.8	15,834,646	3.9	-5,819,893	0.2
Res Equipment Rebates	30,657	1.2	237,813	2.7	-207,156	0.5
Res HVAC Improvements	110,285	2.1	179,830	3.1	-69,545	0.7
Residential Total	**11,089,333**	**2.36**	**19,751,125**	**3.71**	**-8,661,792**	**0.32**
Com Heating & Cooling Upgrade	71,682	1.2	585,797	2.9	-514,115	0.5
Com Reflective Roof	38	1.7	123	3.4	-85	0.5
Com Chiller Upgrade	1,693	1.0	116,310	3.3	-114,617	0.4
Com Small Business	21,509	1.2	250,843	3.5	-229,334	0.4

	TRC		PCT		RIM	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio
Com Custom	715,191	1.6	4,255,057	5.3	-3,539,866	0.3
Com Lighting	79,182	1.1	1,970,849	3.7	-1,891,668	0.4
Com Prescriptive	281,726	1.5	1,544,942	4.2	-1,263,216	0.4
Non-Residential Total	**1,171,020**	**1.35**	**8,723,921**	**4.30**	**-7,552,900**	**0.37**
Portfolio Total	**12,260,353**	**2.07**	**28,475,046**	**3.87**	**-16,214,692**	**0.35**

Exhibit JH-15
JEA Program Development Summary

Overview

RI worked collaboratively with JEA on the DSM program development process to develop impacts under three scenarios: 1) potential DSM programs that contribute to proposed DSM goals (Proposed Goals Scenario), 2) potential DSM programs that pass the Participant and Rate Impact Measure Tests (RIM Scenario), and 3) potential DSM programs that pass the Participant and Total Resource Cost Tests (TRC Scenario).

Methodology

The development of DSM programs for each scenario included incorporating the measures and measure impacts developed for the Technical Potential (TP) study, reviewing JEA's current program offerings, collaboration with JEA on program concepts that are beneficial for their customers, and analysis of economic impacts and market adoption to create potential DSM programs. This process included the following steps:

Program Review and Measure Bundling

The analysis began with the measures from the TP study. This measure list was initially refined for program development for each scenario as follows:

1. Proposed Goals scenario – measures that passed, or were close to passing, either the TRC or RIM tests were prioritized in the initial measure bundling analysis. Measures included in current JEA programs were also identified and included in the initial measure bundling.
2. RIM Scenario – measures that passed the RIM Scenario criteria (RIM test, PCT, and payback period of at least 2 years) were included in the initial measure bundling analysis
3. TRC Scenario – measures that passed the TRC Scenario criteria (TRC test, PCT, and payback period of at least 2 years) were included in the initial measure bundling analysis

Resource Innovations then reviewed current JEA programs and eligible measures, and mapped individual measures to the appropriate programs for each scenario. Resource Innovations worked collaboratively with JEA to collect program information (e.g. program manuals, participation records, energy and demand savings, budgets) and review the existing programs to determine which measures should be included in the initial program portfolios. In addition, a gap analysis was conducted to identify measures included in each scenario that are not currently offered by JEA. These measures were either included in existing programs where there was a logical fit, or included as a new program concept.

Program Refinement and Modeling

After identifying the preliminary measure bundles and programs, Resource Innovations worked collaboratively with JEA to develop incentive amounts and non-incentive costs. Non-incentive costs, which include costs to manage, administer, and market the program, were developed based on current JEA program costs as well as secondary data on similar programs offered by other utilities, and refined as needed based on the proposed program delivery structure. Incentive costs were developed for each scenario as follows:

1. Proposed Goals scenario – preliminary incentive rates were informed by current incentives offered by JEA as well as typical incentive levels offered by similar programs regionally and nationally.
2. RIM Scenario – incentive rates were developed based on the available net benefits for each measure, based on total RIM benefits minus RIM costs. Next, the incentive amount that would result in a simple payback period of two years for each measure was calculated. The final incentive applied for the measure was based on the lower of these two values.
3. TRC Scenario – the incentive amount required to result in a simple payback period of two years for each measure was used as the final incentive for the measure.

Measures included in the initial program concepts for each scenario were analyzed in RI's TEA-POT model to update the economic analysis based on the JEA-specific non-incentive and incentive costs, and to estimate market adoption for each measure. The economic analysis included calculating updated RIM, TRC, and PCT costs and benefits for each measure and re-screening measures for each scenario.

RI's market adoption estimates use a payback acceptance criterion to estimate long-run market shares for measures as a function of measure incremental costs and expected bill savings over the measures' effective useful life (inclusive of utility incentives). Incremental adoption estimates are based on the Bass Diffusion Model, which is a mathematical description of how the rate of new product diffusion changes over time. For this study, adoption curve input parameters were developed for each measure based on specific criteria, including measure maturity in the market, overall measure cost, and whether the measure was currently offered through a utility program. RI's TEA-POT model then calculated demand and energy savings by applying estimated adoption rates to each cost-effective measure.

The TEA-POT modeling results were exported into RI's Program Planner workbook that aggregated the individual measure results into program and portfolio impacts for each scenario. For the TRC Scenario and RIM Scenario no further refinements to the programs were made. For the Proposed Goals scenario, RI continued to work collaboratively with JEA to identify the measures and program concepts that comprise the proposed DSM goals. These impacts for each scenario are provided below.

Results

Proposed Goals Scenario

The Proposed Goals Scenario is described in more detail in Witness Pippin's testimony. The following tables include the program-level details for this scenario.

Table 1. Proposed DSM Goals – Annual MWh Targets

Annual MWh	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	1,039	1,196	1,363	1,535	1,702	1,854	1,983	2,088	2,171	2,237
Res EE Products	1,055	1,389	1,800	2,281	2,797	3,279	3,625	3,730	3,537	3,088
Res Neighborhood	1,078	1,086	1,094	1,101	1,109	1,117	1,125	1,133	1,141	1,149
Residential Total	3,172	3,670	4,257	4,917	5,608	6,250	6,733	6,951	6,850	6,474
Com Lighting	3,346	3,562	3,771	3,975	4,169	4,334	4,444	4,470	4,403	4,257
Non-Residential Total	3,346	3,562	3,771	3,975	4,169	4,334	4,444	4,470	4,403	4,257
Portfolio Total	6,518	7,232	8,028	8,893	9,777	10,584	11,176	11,422	11,252	10,731

Table 2. Proposed DSM Goals – Annual summer MW Targets

Annual Summer MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.26	0.28	0.29
Res EE Products	0.40	0.54	0.72	0.92	1.14	1.35	1.50	1.55	1.46	1.26
Res Neighborhood	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Residential Total	0.68	0.84	1.03	1.26	1.50	1.73	1.90	1.96	1.89	1.70
Com Lighting	0.44	0.47	0.50	0.53	0.56	0.58	0.60	0.60	0.59	0.57
Non-Residential Total	0.44	0.47	0.50	0.53	0.56	0.58	0.60	0.60	0.59	0.57
Portfolio Total	1.12	1.31	1.53	1.79	2.06	2.31	2.50	2.56	2.48	2.27

Table 3. Proposed DSM Goals – Annual winter MW Targets

Annual Winter MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	0.45	0.50	0.55	0.61	0.66	0.70	0.74	0.77	0.79	0.81
Res EE Products	0.17	0.23	0.30	0.38	0.47	0.55	0.60	0.61	0.57	0.49
Res Neighborhood	0.26	0.26	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.27
Residential Total	0.88	0.99	1.11	1.25	1.38	1.51	1.60	1.65	1.63	1.57
Com Lighting	0.37	0.39	0.41	0.42	0.44	0.45	0.46	0.46	0.46	0.45
Non-Residential Total	0.37	0.39	0.41	0.42	0.44	0.45	0.46	0.46	0.46	0.45
Portfolio Total	1.24	1.37	1.51	1.67	1.82	1.96	2.07	2.11	2.09	2.02

Table 4. Proposed DSM Goals – Annual Participation Targets

Annual Participation (# measures)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	351	431	519	612	700	783	853	909	950	981
Res EE Products	2,680	3,438	4,353	5,409	6,536	7,587	8,349	8,603	8,229	7,317
Res Neighborhood	1,273	1,281	1,289	1,298	1,307	1,316	1,325	1,335	1,344	1,350
Residential Total	4,304	5,150	6,161	7,319	8,543	9,686	10,527	10,847	10,523	9,648
Com Lighting	11,203	11,898	12,503	13,037	13,500	13,874	14,133	14,244	14,199	14,029
Non-Residential Total	11,203	11,898	12,503	13,037	13,500	13,874	14,133	14,244	14,199	14,029
Portfolio Total	15,507	17,048	18,664	20,356	22,043	23,560	24,660	25,091	24,722	23,677

Table 5. Proposed DSM Goals – Annual Program Budget Estimates

Budgets ($ in thousands)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	$1,112	$1,340	$1,588	$1,845	$2,096	$2,325	$2,520	$2,680	$2,805	$2,904
Res EE Products	$280	$366	$472	$595	$728	$852	$941	$968	$920	$806
Res Neighborhood	$444	$446	$448	$450	$452	$454	$456	$458	$460	$462
Residential Total	$1,836	$2,153	$2,509	$2,891	$3,276	$3,630	$3,917	$4,106	$4,185	$4,172
Com Lighting	$900	$974	$1,044	$1,111	$1,174	$1,228	$1,266	$1,281	$1,270	$1,238
Non-Residential Total	$900	$974	$1,044	$1,111	$1,174	$1,228	$1,266	$1,281	$1,270	$1,238
Portfolio Total	$2,736	$3,127	$3,553	$4,002	$4,450	$4,858	$5,182	$5,386	$5,455	$5,409

Table 6. Proposed DSM Goals – Cost-Effectiveness Results

	TRC		PCT		RIM	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio
Res Home Efficiency Upgrade	9,026,783	1.6	18,157,755	2.6	-9,130,972	0.6
Res EE Products	5,361,319	1.4	18,094,140	3.5	-12,732,821	0.6
Res Neighborhood	975,832	1.2	9,031,701	6.4	-8,055,869	0.4
Residential Total	**15,363,935**	**1.48**	**45,283,597**	**3.22**	**-29,919,662**	**0.56**
Com Lighting	3,616,165	1.2	55,998,344	4.5	-52,382,179	0.3
Non-Residential Total	**3,616,165**	**1.19**	**55,998,344**	**4.46**	**-52,382,179**	**0.30**
Portfolio Total	**18,980,100**	**1.38**	**101,281,941**	**3.77**	**-82,301,841**	**0.42**

RIM Scenario

The RIM Scenario is comprised of measures and programs that achieved a cost-effectivess ratio of 1.0 or higher for the PCT and RIM test, and measures that had a simple payback of two years or more (without consideration of incentives). Incentive rates were calculated from the RIM net benefit available and the incentive amount that would result in a simple payback period of two years for each measure. The maximum incentive was based on the lower of these two values. The following tables include the program-level details for this scenario.

Energy Efficiency Programs

Table 7. RIM Scenario – Annual MWh Targets

Annual MWh	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	12.39	12.06	11.72	11.36	10.99	10.61	10.23	9.84	9.46	9.08
Residential Total	12.39	12.06	11.72	11.36	10.99	10.61	10.23	9.84	9.46	9.08
Non-Residential Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Portfolio Total	12.39	12.06	11.72	11.36	10.99	10.61	10.23	9.84	9.46	9.08

Table 8. RIM Scenario – Annual summer MW Targets

Annual Summer MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residential Total	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Non-Residential Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Portfolio Total	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 9. RIM Scenario – Annual winter MW Targets

Annual Winter MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Residential Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Portfolio Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 10. RIM Scenario – Annual Participation Targets

Annual Participation (# measures)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	8	8	7	7	7	7	7	7	6	6
Residential Total	8	8	7	7	7	7	7	7	6	6
Non-Residential Total	0	0	0	0	0	0	0	0	0	0
Portfolio Total	8	8	7	7	7	7	7	7	6	6

Table 11. RIM Scenario – Annual Program Budget Estimates

Budgets ($ in thousands)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Efficiency Upgrade	$3.03	$2.95	$2.86	$2.78	$2.69	$2.59	$2.50	$2.40	$2.31	$2.22
Residential Total	$3.03	$2.95	$2.86	$2.78	$2.69	$2.59	$2.50	$2.40	$2.31	$2.22
Non-Residential Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Portfolio Total	$3.03	$2.95	$2.86	$2.78	$2.69	$2.59	$2.50	$2.40	$2.31	$2.22

Table 12. RIM Scenario – Cost-Effectiveness Results

	TRC		**PCT**		**RIM**	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio
Res Home Efficiency Upgrade	124,743	3.0	124,733	3.9	10	1.0
Residential Total	**124,743**	**2.98**	**124,733**	**3.93**	**10**	**1.00**
Non-Residential Total	**0**	**0.00**	**0**	**0.00**	**0**	**0.00**
Portfolio Total	**124,743**	**2.98**	**124,733**	**3.93**	**10**	**1.00**

Demand Response Programs

The RIM Scenario analysis resulted in four cost-effective demand response measures for the largest commercial and industrial segment, which includes customers over 500 kW. The four DR measures are presented as individual potential program options in the following tables. Each's program's cost and impact estimates were developed independent of the other programs; therefore, because the measures apply to the same target population of large commercial and industrial customers, the savings and participation are not additive.

Table 13. RIM Scenario – Commercial Demand Response - Automated DR Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.4	20.2	27.2	32.6	36.8	40.1	42.6	44.6	46.2	47.4
Winter MW (Cumulative)	8.9	15.8	21.2	25.5	28.8	31.3	33.3	34.9	36.1	37.1
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$3,671	$1,885	$2,049	$2,176	$2,276	$2,353	$2,414	$2,461	$2,498	$2,527

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,483,023	1.38
RIM	$8,483,023	1.38

Table 14. RIM Scenario – Commercial Demand Response – Critical Peak Pricing (CPP) Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	9.4	16.8	22.5	27.0	30.4	33.2	35.3	36.9	38.2	39.2
Winter MW (Cumulative)	7.4	15.8	21.2	25.5	28.8	31.3	33.3	34.9	36.1	37.1
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$3,671	$1,740	$1,875	$1,981	$2,063	$2,127	$2,177	$2,217	$2,247	$2,271

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$4,935,709	1.24
RIM	$4,935,709	1.24

Table 15. RIM Scenario – Commercial Demand Response – Firm Service Level Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	9.4	16.8	22.5	27.0	30.4	33.2	35.3	36.9	38.2	39.2
Winter MW (Cumulative)	7.4	13.1	17.6	21.1	23.8	25.9	27.6	28.9	29.9	30.7
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$1,721	$1,674	$1,759	$1,825	$1,876	$1,916	$1,947	$1,972	$1,991	$2,006

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,454,026	1.50
RIM	$8,454,026	1.50

Table 16. RIM Scenario – Commercial Demand Response – Guaranteed Load Drop Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	9.4	16.8	22.5	27.0	30.4	33.2	35.3	36.9	38.2	39.2
Winter MW (Cumulative)	7.4	13.1	17.6	21.1	23.8	25.9	27.6	28.9	29.9	30.7
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$1,721	$1,674	$1,759	$1,825	$1,876	$1,916	$1,947	$1,972	$1,991	$2,006

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,454,026	1.50
RIM	$8,454,026	1.50

Demand-Side Renewable Energy Programs

JEA did not have any DSRE measures or programs that passed the cost-effectiveness screening for the RIM Scenario.

TRC Scenario

The TRC Scenario is comprised of measures and programs that achieved a cost-effectivess ratio of 1.0 or higher for the PCT and TRC test, and measures that had a simple payback of two years or more (without consideration of incentives). Incentive rates were based on the maximum incentive amount that would result in a simple payback period of two years for each measure. The following tables include the program-level details for this scenario.

Energy Efficiency Programs

Table 17. TRC Scenario – Annual MWh Targets

Annual MWh	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audit	0	0	0	0	0	0	0	0	0	0
Res Home Efficiency Upgrade	4,760	5,843	7,045	8,307	9,544	10,667	11,615	12,368	12,939	13,364
Res EE Products	165	186	206	224	241	256	270	283	295	305
Res Marketplace	915	1,258	1,688	2,195	2,743	3,254	3,621	3,731	3,525	3,047
Res New Home	663	922	1,222	1,543	1,859	2,146	2,385	2,572	2,711	2,814
Res Neighborhood	43	58	78	102	127	149	165	168	156	132
Res Solar Water Heating	478	536	589	637	679	716	748	776	800	820
Residential Total	7,023	8,804	10,828	13,007	15,192	17,188	18,804	19,897	20,426	20,483
Com Audit	0	0	0	0	0	0	0	0	0	0
Com Prescriptive	3,683	4,378	5,131	5,927	6,729	7,472	8,070	8,443	8,552	8,424
Com Lighting	2,888	3,029	3,165	3,296	3,419	3,522	3,585	3,590	3,529	3,414
Com Custom	7,874	8,258	8,765	9,356	9,973	10,535	10,952	11,154	11,108	10,833
Com Small Business	869	958	1,057	1,167	1,279	1,377	1,441	1,448	1,389	1,277
Non-Residential Total	15,314	16,623	18,118	19,746	21,400	22,905	24,048	24,636	24,578	23,948
Portfolio Total	22,338	25,427	28,946	32,753	36,592	40,093	42,852	44,533	45,003	44,430

Table 18. TRC Scenario – Annual summer MW Targets

Annual Summer MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Home Efficiency Upgrade	0.71	0.85	1.02	1.19	1.36	1.51	1.64	1.75	1.83	1.90
Res EE Products	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.06
Res Marketplace	0.38	0.53	0.71	0.92	1.16	1.38	1.54	1.58	1.49	1.28
Res New Home	0.18	0.25	0.33	0.42	0.51	0.60	0.67	0.72	0.77	0.80
Res Neighborhood	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01
Res Solar Water Heating	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.09
Residential Total	1.36	1.74	2.18	2.66	3.17	3.63	4.00	4.22	4.26	4.14
Com Audit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Prescriptive	0.77	0.90	1.05	1.19	1.34	1.48	1.59	1.67	1.71	1.70
Com Lighting	0.39	0.41	0.43	0.45	0.47	0.49	0.50	0.50	0.49	0.48
Com Custom	1.00	1.06	1.13	1.22	1.32	1.40	1.47	1.51	1.50	1.46
Com Small Business	0.10	0.11	0.12	0.13	0.14	0.15	0.15	0.15	0.15	0.14
Non-Residential Total	2.26	2.48	2.73	3.00	3.27	3.52	3.72	3.83	3.85	3.78
Portfolio Total	3.62	4.22	4.91	5.67	6.44	7.15	7.72	8.05	8.11	7.93

Table 19. TRC Scenario – Annual winter MW Targets

Annual Winter MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Home Efficiency Upgrade	1.53	1.80	2.11	2.42	2.73	3.00	3.24	3.42	3.56	3.66
Res EE Products	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Res Marketplace	0.16	0.22	0.29	0.38	0.47	0.56	0.61	0.63	0.58	0.50
Res New Home	0.08	0.11	0.15	0.18	0.22	0.25	0.28	0.30	0.31	0.32
Res Neighborhood	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.03
Res Solar Water Heating	0.12	0.13	0.15	0.16	0.17	0.18	0.18	0.19	0.20	0.20
Residential Total	1.91	2.30	2.73	3.19	3.64	4.05	4.38	4.60	4.72	4.74
Com Audit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Prescriptive	0.56	0.67	0.79	0.92	1.06	1.19	1.28	1.33	1.32	1.26
Com Lighting	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.36	0.35	0.34
Com Custom	1.01	1.06	1.13	1.21	1.29	1.38	1.44	1.48	1.48	1.44
Com Small Business	0.10	0.11	0.13	0.14	0.16	0.17	0.18	0.18	0.18	0.16
Non-Residential Total	1.97	2.15	2.37	2.61	2.86	3.09	3.27	3.35	3.33	3.21
Portfolio Total	3.88	4.45	5.10	5.80	6.50	7.14	7.64	7.95	8.04	7.95

Table 20. TRC Scenario – Annual Participation Targets

Annual Participation (# measures)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audit	0	0	0	0	0	0	0	0	0	0
Res Home Efficiency Upgrade	3,573	4,430	5,372	6,361	7,328	8,212	8,964	9,569	10,036	10,395
Res EE Products	700	787	867	942	1,009	1,071	1,127	1,178	1,224	1,267
Res Marketplace	4,554	6,352	8,513	10,947	13,476	15,827	17,693	18,809	19,068	18,603
Res New Home	140	193	256	322	388	448	498	536	565	586
Res Neighborhood	612	838	1,122	1,456	1,813	2,142	2,366	2,411	2,239	1,887
Res Solar Water Heating	323	362	398	430	458	483	505	524	540	554
Residential Total	9,902	12,962	16,528	20,458	24,472	28,183	31,153	33,027	33,672	33,292
Com Audit	0	0	0	0	0	0	0	0	0	0
Com Prescriptive	5,470	6,257	7,072	7,892	8,718	9,463	10,062	10,432	10,534	10,414
Com Lighting	8,633	9,080	9,461	9,794	10,076	10,293	10,437	10,488	10,439	10,314
Com Custom	1,147	1,372	1,630	1,908	2,188	2,440	2,649	2,800	2,891	2,941
Com Small Business	3,438	4,007	4,667	5,412	6,181	6,866	7,315	7,377	6,991	6,233
Non-Residential Total	18,688	20,716	22,830	25,006	27,163	29,062	30,463	31,097	30,855	29,902
Portfolio Total	28,590	33,678	39,358	45,464	51,635	57,245	61,616	64,124	64,527	63,194

Table 21. TRC Scenario – Annual Program Budget Estimates

Budgets ($ in thousands)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Audit	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Res Home Efficiency Upgrade	$4,445	$5,556	$6,783	$8,068	$9,326	$10,468	$11,433	$12,202	$12,789	$13,229
Res EE Products	$50	$56	$62	$67	$72	$77	$81	$85	$89	$92
Res Marketplace	$385	$534	$716	$924	$1,143	$1,347	$1,504	$1,581	$1,566	$1,471
Res New Home	$185	$258	$342	$432	$521	$601	$669	$721	$760	$789
Res Neighborhood	$12	$16	$22	$28	$35	$41	$45	$46	$43	$36
Res Solar Water Heating	$2,891	$3,244	$3,564	$3,851	$4,106	$4,329	$4,523	$4,691	$4,836	$4,962
Residential Total	$7,967	$9,663	$11,488	$13,370	$15,203	$16,864	$18,255	$19,327	$20,083	$20,578
Com Audit	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Com Prescriptive	$856	$1,028	$1,218	$1,425	$1,636	$1,831	$1,984	$2,068	$2,068	$1,994
Com Lighting	$659	$700	$737	$773	$806	$833	$851	$857	$848	$827
Com Custom	$1,535	$1,626	$1,745	$1,883	$2,027	$2,159	$2,260	$2,315	$2,315	$2,265
Com Small Business	$244	$269	$296	$326	$355	$382	$399	$402	$388	$361
Non-Residential Total	$3,294	$3,623	$3,998	$4,407	$4,824	$5,205	$5,495	$5,641	$5,619	$5,447
Portfolio Total	$11,261	$13,286	$15,485	$17,777	$20,027	$22,069	$23,750	$24,968	$25,701	$26,025

Table 22. TRC Scenario – Cost-Effectiveness Results

	TRC		**PCT**		**RIM**	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio	Net Benefits ($)	Benefit/ Cost Ratio
Res Audit	0	0.0	0	0.0	0	0.0
Res Home Efficiency Upgrade	48,391,423	1.4	173,407,418	2.8	-125,015,995	0.4
Res EE Products	249,064	1.2	1,927,784	3.5	-1,678,719	0.5
Res Marketplace	70,134,223	5.3	86,243,142	8.6	-16,108,920	0.5
Res New Home	9,542,239	2.2	20,594,117	3.8	-11,051,878	0.6
Res Neighborhood	254,297	1.5	1,030,818	4.3	-776,521	0.5
Res Solar Water Heating	153,748,769	4.6	197,514,152	5.8	-43,765,384	0.1
Residential Total	**282,320,014**	**2.55**	**480,717,432**	**4.07**	**-198,397,417**	**0.37**
Com Audit	0	0.0	0	0.0	0	0.0
Com Prescriptive	12,628,405	1.5	88,818,228	4.9	-76,189,823	0.3
Com Lighting	4,982,096	1.4	50,986,863	5.6	-46,004,767	0.3
Com Custom	21,485,142	1.6	242,017,859	9.6	-220,532,717	0.2
Com Small Business	865,840	1.2	16,379,322	5.2	-15,513,482	0.3
Non-Residential Total	**39,961,483**	**1.51**	**398,202,272**	**7.00**	**-358,240,789**	**0.25**
Portfolio Total	**322,281,498**	**2.23**	**878,919,704**	**4.94**	**-556,638,206**	**0.30**

Demand Response Programs

The TRC Scenario analysis resulted in four cost-effective demand response measures for the largest commercial and industrial segment, which includes customers over 500 kW. The four DR measures are presented as individual potential program options in the following tables. Each's program's cost and impact estimates were developed independent of the other programs; therefore, because the measures apply to the same target population of large commercial and industrial customers, the savings and participation are not additive.

Table 23. TRC Scenario – Commercial Demand Response - Automated DR Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.4	20.2	27.2	32.6	36.8	40.1	42.6	44.6	46.2	47.4
Winter MW (Cumulative)	8.9	15.8	21.2	25.5	28.8	31.3	33.3	34.9	36.1	37.1
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$3,671	$1,885	$2,049	$2,176	$2,276	$2,353	$2,414	$2,461	$2,498	$2,527

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,483,023	1.38
RIM	$8,483,023	1.38

Table 24. TRC Scenario – Commercial Demand Response – Critical Peak Pricing (CPP) Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	9.4	16.8	22.5	27.0	30.4	33.2	35.3	36.9	38.2	39.2
Winter MW (Cumulative)	7.4	15.8	21.2	25.5	28.8	31.3	33.3	34.9	36.1	37.1
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$3,671	$1,740	$1,875	$1,981	$2,063	$2,127	$2,177	$2,217	$2,247	$2,271

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$4,935,709	1.24
RIM	$4,935,709	1.24

Table 25. TRC Scenario – Commercial Demand Response – Firm Service Level Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	9.4	16.8	22.5	27.0	30.4	33.2	35.3	36.9	38.2	39.2
Winter MW (Cumulative)	7.4	13.1	17.6	21.1	23.8	25.9	27.6	28.9	29.9	30.7
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$1,721	$1,674	$1,759	$1,825	$1,876	$1,916	$1,947	$1,972	$1,991	$2,006

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,454,026	1.50
RIM	$8,454,026	1.50

Table 26. TRC Scenario – Commercial Demand Response – Guaranteed Load Drop Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	9.4	16.8	22.5	27.0	30.4	33.2	35.3	36.9	38.2	39.2
Winter MW (Cumulative)	7.4	13.1	17.6	21.1	23.8	25.9	27.6	28.9	29.9	30.7
Participation (Cumulative)	8	13	18	22	24	27	28	30	31	32
Program Costs ($ in Thousands)	$1,721	$1,674	$1,759	$1,825	$1,876	$1,916	$1,947	$1,972	$1,991	$2,006

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,454,026	1.50
RIM	$8,454,026	1.50

Demand-Side Renewable Energy Programs

JEA did not have any DSRE measures or programs that passed the cost-effectiveness screening for the TRC Scenario.

Exhibit JH-16
OUC Program Development Summary

Overview

RI worked collaboratively with OUC on the DSM program development process to develop impacts under three scenarios: 1) potential DSM programs that contribute to proposed DSM goals (Proposed Goals scenario), 2) potential DSM programs that pass the Participant and Rate Impact Measure Tests (RIM Scenario), and 3) potential DSM programs that pass the Participant and Total Resource Cost Tests (TRC Scenario).

Methodology

The development of DSM programs for each scenario included incorporating the measures and measure impacts developed for the Technical Potential (TP) study, reviewing OUC's current program offerings, collaboration with OUC on program concepts that are beneficial for their customers, and analysis of economic impacts and market adoption to create potential DSM programs. This process included the following steps:

Program Review and Measure Bundling

The analysis began with the measures from the TP study. This measure list was initially refined for program development for each scenario as follows:

1. Proposed Goals scenario – measures that passed, or were close to passing, either the TRC or RIM tests were prioritized in the initial measure bundling analysis. Measures included in current OUC programs were also identified and included in the initial measure bundling.
2. RIM Scenario – measures that passed the RIM Scenario criteria (RIM test, PCT, and payback period of at least 2 years) were included in the initial measure bundling analysis
3. TRC Scenario – measures that passed the TRC Scenario criteria (TRC test, PCT, and payback period of at least 2 years) were included in the initial measure bundling analysis

Resource Innovations then reviewed current OUC programs and eligible measures, and mapped individual measures to the appropriate programs for each scenario. Resource Innovations worked collaboratively with OUC to collect program information (e.g. program manuals, participation records, energy and demand savings, budgets) and review the existing programs to determine which measures should be included in the initial program portfolios. In addition, a gap analysis was conducted to identify measures included in each scenario that are not currently offered by OUC. These measures were either included in existing programs where there was a logical fit, or included as a new program concept.

Program Refinement and Modeling

After identifying the preliminary measure bundles and programs, Resource Innovations worked collaboratively with OUC to develop incentive amounts and non-incentive costs. Non-incentive costs, which include costs to manage, administer, and market the program, were developed based on current OUC program costs as well as secondary data on similar programs offered by other utilities, and refined as needed based on the proposed program delivery structure. Incentive costs were developed for each scenario as follows:

1. Proposed Goals scenario – preliminary incentive rates were informed by current incentives offered by OUC as well as typical incentive levels offered by similar programs regionally and nationally.
2. RIM Scenario – incentive rates were developed based on the available net benefits for each measure, based on total RIM benefits minus RIM costs. Next, the incentive amount that would result in a simple payback of two years for each measure was calculated. The final incentive applied for the measure was based on the lower of these two values.
3. TRC Scenario – the incentive amount required to result in a simple payback period of two years for each measure was used as the final incentive for the measure.

Measures included in the initial program concepts for each scenario were analyzed in RI's TEA-POT model to update the economic analysis based on the OUC-specific non-incentive and incentive costs, and to estimate market adoption for each measure. The economic analysis included calculating updated RIM, TRC, and PCT costs and benefits for each measure and re-screening measures for each scenario.

RI's market adoption estimates use a payback acceptance criterion to estimate long-run market shares for measures as a function of measure incremental costs and expected bill savings over the measures' effective useful life (inclusive of utility incentives). Incremental adoption estimates are based on the Bass Diffusion Model, which is a mathematical description of how the rate of new product diffusion changes over time. For this study, adoption curve input parameters were developed for each measure based on specific criteria, including measure maturity in the market, overall measure cost, and whether the measure was currently offered through a utility program. RI's TEA-POT model then calculated demand and energy savings by applying these estimated adoption rates to each cost-effective measure.

The TEA-POT modeling results were exported into RI's Program Planner workbook that aggregated the individual measure results into program and portfolio impacts for each scenario. For the TRC Scenario and RIM Scenario no further refinements to the programs were made. For the Proposed Goals scenario, RI continued to work collaboratively with OUC to identify the measures and program concepts that comprise the proposed DSM goals. These impacts for each scenario are provided below.

Results

Proposed Goals Scenario

The Proposed Goals Scenario is described in more detail in Witness Noonan's testimony. The following tables include the program-level details for this scenario.

Table 1. Proposed DSM Goals – Annual MWh Targets

Annual MWh	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Existing Home	849	895	940	985	1,032	1,076	1,125	1,183	1,248	1,322
Res Efficiency Delivered	74	77	81	85	88	92	96	101	106	112
Res New Home	113	119	126	133	139	146	153	161	171	181
Residential Total	1,035	1,092	1,147	1,203	1,259	1,313	1,374	1,445	1,525	1,616
Com Prescriptive	637	672	698	720	739	753	763	769	772	772
Com Lighting	1,569	1,697	1,796	1,881	1,951	2,004	2,044	2,070	2,086	2,091
Com Custom	1,001	1,139	1,275	1,417	1,558	1,689	1,799	1,876	1,912	1,904
Non-Residential Total	3,207	3,508	3,769	4,019	4,247	4,446	4,605	4,715	4,770	4,767
Portfolio Total	4,242	4,600	4,916	5,221	5,507	5,760	5,979	6,160	6,295	6,382

Table 2. Proposed DSM Goals – Annual summer MW Targets

Annual Summer MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Existing Home	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.11	0.11
Res Efficiency Delivered	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Res New Home	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residential Total	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.13
Com Prescriptive	0.08	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10
Com Lighting	0.19	0.21	0.22	0.23	0.24	0.25	0.25	0.25	0.25	0.25
Com Custom	0.21	0.24	0.26	0.30	0.33	0.35	0.38	0.39	0.40	0.40
Non-Residential Total	0.49	0.53	0.58	0.62	0.66	0.70	0.73	0.75	0.76	0.75
Portfolio Total	0.59	0.64	0.69	0.73	0.77	0.81	0.85	0.87	0.88	0.89

Table 3. Proposed DSM Goals – Annual winter MW Targets

Annual Winter MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Existing Home	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23
Res Efficiency Delivered	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Res New Home	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Residential Total	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.27	0.28
Com Prescriptive	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Com Lighting	0.20	0.22	0.23	0.24	0.25	0.25	0.26	0.26	0.26	0.26
Com Custom	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.16	0.17	0.16
Non-Residential Total	0.38	0.41	0.44	0.46	0.49	0.50	0.52	0.53	0.53	0.53
Portfolio Total	0.56	0.60	0.63	0.67	0.70	0.73	0.76	0.78	0.80	0.81

Table 4. Proposed DSM Goals – Annual Participation Targets

Annual Participation (# measures)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Existing Home	517	511	509	505	506	506	511	520	533	548
Res Efficiency Delivered	40	42	42	44	43	42	46	47	48	51
Res New Home	45	46	47	47	48	52	52	55	57	60
Residential Total	602	599	598	596	597	600	609	622	638	659
Com Prescriptive	1,521	1,612	1,675	1,726	1,763	1,790	1,803	1,813	1,814	1,807
Com Lighting	4,329	4,627	4,836	5,005	5,134	5,223	5,277	5,312	5,321	5,306
Com Custom	1,827	1,977	2,099	2,207	2,299	2,374	2,437	2,486	2,519	2,538
Non-Residential Total	7,677	8,216	8,610	8,938	9,196	9,387	9,517	9,611	9,654	9,651
Portfolio Total	8,279	8,815	9,208	9,534	9,793	9,987	10,126	10,233	10,292	10,310

Table 5. Proposed DSM Goals – Annual Program Budget Estimates

Budgets ($ in thousands)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Existing Home	$2,100	$2,306	$2,499	$2,686	$2,868	$3,037	$3,216	$3,415	$3,633	$3,875
Res Efficiency Delivered	$91	$98	$104	$110	$116	$122	$128	$134	$142	$151
Res New Home	$137	$149	$160	$171	$182	$192	$202	$214	$228	$242
Residential Total	$2,328	$2,552	$2,763	$2,967	$3,166	$3,350	$3,547	$3,763	$4,003	$4,268
Com Prescriptive	$99	$102	$104	$106	$107	$107	$108	$107	$107	$107
Com Lighting	$201	$215	$225	$233	$239	$243	$246	$248	$248	$248
Com Custom	$131	$147	$163	$180	$196	$211	$224	$233	$237	$237
Non-Residential Total	$431	$465	$493	$519	$542	$562	$578	$588	$593	$592
Portfolio Total	$2,759	$3,017	$3,256	$3,486	$3,708	$3,912	$4,124	$4,352	$4,596	$4,859

Table 6. Proposed DSM Goals – Cost-Effectiveness Results

	TRC		PCT		RIM	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio
Res Existing Home	-1,439,576	0.9	12,998,056	3.4	-14,437,631	0.3
Res Efficiency Delivered	-341,217	0.6	935,030	3.0	-1,276,247	0.3
Res New Home	-144,686	0.9	1,787,071	3.7	-1,931,757	0.3
Residential Total	**-1,925,478**	**0.84**	**15,720,157**	**3.40**	**-17,645,636**	**0.29**
Com Prescriptive	185,353	1.1	5,594,996	3.2	-5,409,642	0.4
Com Lighting	173,098	1.0	14,591,930	3.1	-14,418,832	0.4
Com Custom	1,078,887	1.2	12,025,921	3.4	-10,947,034	0.4
Non-Residential Total	**1,437,337**	**1.09**	**32,212,846**	**3.20**	**-30,775,509**	**0.36**
Portfolio Total	**-488,141**	**0.98**	**47,933,004**	**3.26**	**-48,421,145**	**0.34**

RIM Scenario

The RIM Scenario is comprised of measures and programs that achieved a cost-effectivess ratio of 1.0 or higher for the PCT and RIM test, and measures that had a simple payback of two years or more (without consideration of incentives).

Energy Efficiency Programs

OUC did not have any EE measures or programs that passed the cost-effectiveness screening for the RIM Scenario.

Demand Response Programs

The RIM Scenario analysis resulted in four cost-effective demand response measures for the largest commercial and industrial segment, which includes customers over 500 kW. The four DR measures are presented as individual potential program options in the following tables. Each's program's cost and impact estimates were developed independent of the other programs; therefore, because the measures apply to the same target population of large commercial and industrial customers, the savings and participation are not additive.

Table 7. RIM Scenario – Commercial Demand Response - Automated DR Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	13.5	24.0	32.2	38.5	43.5	47.4	50.5	52.8	54.7	56.1
Winter MW (Cumulative)	9.9	17.7	23.7	28.4	32.1	35.0	37.2	38.9	40.3	41.4
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$4,032	$2,099	$2,642	$3,066	$3,397	$3,655	$3,856	$4,013	$4,135	$4,230

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$9,599,458	1.33
RIM	$9,599,458	1.33

Table 8. RIM Scenario – Commercial Demand Response – Critical Peak Pricing (CPP) Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.1	19.8	26.6	31.9	36.0	39.3	41.8	43.7	45.2	46.4
Winter MW (Cumulative)	8.2	14.6	19.6	23.5	26.6	28.9	30.8	32.2	33.4	34.2
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$3,970	$1,916	$2,366	$2,717	$2,991	$3,204	$3,371	$3,501	$3,602	$3,681

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$6,016,084	1.23
RIM	$6,016,084	1.23

Table 9. RIM Scenario – Commercial Demand Response – Firm Service Level Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.1	19.8	26.6	31.9	36.0	39.3	41.8	43.7	45.2	46.4
Winter MW (Cumulative)	8.2	14.6	19.6	23.5	26.6	28.9	30.8	32.2	33.4	34.2
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$1,942	$1,851	$2,310	$2,668	$2,947	$3,165	$3,334	$3,467	$3,570	$3,651

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,360,168	1.36
RIM	$8,360,168	1.36

Table 10. RIM Scenario – Commercial Demand Response – Guaranteed Load Drop Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.1	19.8	26.6	31.9	36.0	39.3	41.8	43.7	45.2	46.4
Winter MW (Cumulative)	8.2	14.6	19.6	23.5	26.6	28.9	30.8	32.2	33.4	34.2
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$1,942	$1,851	$2,310	$2,668	$2,947	$3,165	$3,334	$3,467	$3,570	$3,651

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,360,168	1.36
RIM	$8,360,168	1.36

Demand-Side Renewable Energy Programs

OUC did not have any DSRE measures or programs that passed the cost-effectiveness screening for the RIM Scenario.

TRC Scenario

The TRC Scenario is comprised of measures and programs that achieved a cost-effectivess ratio of 1.0 or higher for the PCT and TRC test, and measures that had a simple payback of two years or more (without consideration of incentives). Incentive rates were based on the maximum incentive amount that would result in a simple payback period of two years for each measure. The following tables include the program-level details for this scenario.

Energy Efficiency Programs

Table 11. TRC Scenario – Energy Efficiency – Annual MWh Targets

Annual MWh	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Energy Survey	0	0	0	0	0	0	0	0	0	0
Res Existing Home	1,165	1,277	1,385	1,493	1,598	1,695	1,797	1,907	2,025	2,154
Res Efficiency Delivered	2	2	2	2	2	2	2	2	2	2
Res New Home	428	457	472	484	501	518	541	567	598	632
Res Marketplace	18	15	12	10	9	7	6	5	5	4
Res Products	0	0	0	0	0	0	0	0	0	0
Residential Total	1,614	1,751	1,872	1,990	2,109	2,223	2,346	2,481	2,630	2,792
Com Prescriptive	1,946	2,155	2,359	2,565	2,767	2,955	3,119	3,261	3,376	3,463
Com Lighting	453	502	547	590	630	663	687	698	696	683
Com Custom	285	351	424	507	592	674	742	783	790	763
Com Green Building	1	1	1	1	1	1	1	1	1	1
Com Chiller Maintenance	0	0	0	0	0	0	0	0	0	0
Non-Residential Total	2,684	3,009	3,330	3,663	3,990	4,293	4,549	4,742	4,864	4,911
Portfolio Total	4,298	4,760	5,202	5,653	6,100	6,516	6,896	7,224	7,494	7,703

Table 12. TRC Scenario – Energy Efficiency – Annual summer MW Targets

Annual Summer MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Energy Survey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Existing Home	0.14	0.16	0.18	0.20	0.22	0.24	0.25	0.27	0.29	0.31
Res Efficiency Delivered	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res New Home	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.15	0.15	0.16
Res Marketplace	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Total	0.26	0.28	0.31	0.33	0.35	0.37	0.40	0.42	0.45	0.47
Com Prescriptive	0.59	0.66	0.72	0.79	0.85	0.91	0.97	1.01	1.05	1.07
Com Lighting	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05
Com Custom	0.05	0.06	0.07	0.09	0.10	0.12	0.13	0.14	0.14	0.13
Com Green Building	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Chiller Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Residential Total	0.66	0.75	0.83	0.92	1.00	1.08	1.15	1.20	1.23	1.25
Portfolio Total	0.92	1.03	1.14	1.25	1.35	1.45	1.54	1.62	1.68	1.72

Table 13. TRC Scenario – Energy Efficiency – Annual winter MW Targets

Annual Winter MW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Energy Survey	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Existing Home	0.19	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.33
Res Efficiency Delivered	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res New Home	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05
Res Marketplace	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Res Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Total	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.36	0.38
Com Prescriptive	0.11	0.12	0.13	0.14	0.15	0.16	0.16	0.17	0.17	0.17
Com Lighting	0.04	0.04	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.06
Com Custom	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.09	0.09	0.09
Com Green Building	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Com Chiller Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Residential Total	0.18	0.20	0.22	0.25	0.28	0.30	0.32	0.33	0.33	0.33
Portfolio Total	0.41	0.45	0.49	0.53	0.57	0.61	0.64	0.67	0.70	0.71

Table 14. TRC Scenario – Energy Efficiency – Annual Participation Targets

Annual Participation	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Energy Survey	0	0	0	0	0	0	0	0	0	0
Res Existing Home	1,025	1,144	1,256	1,368	1,475	1,576	1,678	1,783	1,895	2,015
Res Efficiency Delivered	6	6	5	5	5	5	5	5	5	5
Res New Home	65	69	71	73	76	78	82	85	90	95
Res Marketplace	44	37	31	26	22	18	16	14	12	11
Res Products	0	0	0	0	0	0	0	0	0	0
Residential Total	1,140	1,256	1,363	1,472	1,578	1,677	1,781	1,887	2,002	2,126
Com Prescriptive	3,536	3,917	4,259	4,577	4,873	5,141	5,381	5,611	5,826	6,026
Com Lighting	855	952	1,040	1,128	1,208	1,275	1,323	1,346	1,344	1,321
Com Custom	115	142	172	206	241	274	299	308	301	278
Com Green Building	1	1	1	1	1	1	1	1	1	1
Com Chiller Maintenance	0	0	0	0	0	0	0	0	0	0
Non-Residential Total	4,507	5,012	5,472	5,912	6,323	6,691	7,004	7,266	7,472	7,626
Portfolio Total	5,647	6,268	6,835	7,384	7,901	8,368	8,785	9,153	9,474	9,752

Table 15. TRC Scenario – Energy Efficiency – Annual Program Budget Estimates

Budgets $ in thousands	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Res Home Energy Survey	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Res Existing Home	$2,628	$2,914	$3,181	$3,436	$3,682	$3,908	$4,145	$4,401	$4,681	$4,986
Res Efficiency Delivered	$4	$4	$3	$3	$3	$3	$3	$3	$3	$3
Res New Home	$164	$175	$181	$185	$192	$198	$207	$217	$229	$242
Res Marketplace	$3	$2	$2	$2	$1	$1	$1	$1	$1	$1
Res Products	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Residential Total	$2,799	$3,095	$3,367	$3,627	$3,878	$4,111	$4,356	$4,622	$4,913	$5,231
Com Prescriptive	$211	$233	$255	$277	$300	$321	$340	$356	$368	$375
Com Lighting	$88	$96	$103	$110	$115	$120	$123	$125	$126	$125
Com Custom	$42	$51	$61	$71	$82	$92	$101	$106	$106	$103
Com Green Building	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Com Chiller Maintenance	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non-Residential Total	$341	$381	$419	$459	$498	$534	$564	$586	$600	$603
Portfolio Total	$3,140	$3,475	$3,786	$4,085	$4,376	$4,644	$4,920	$5,208	$5,513	$5,834

Table 16. TRC Scenario – Energy Efficiency – Cost-Effectiveness Results

	TRC		PCT		RIM	
Program Cost-Effectiveness	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio	Net Benefits ($)	Benefit/Cost Ratio
Res Home Energy Survey	0	0.0	0	0.0	0	0.0
Res Existing Home	74,117,690	2.8	124,910,898	4.6	-50,793,209	0.2
Res Efficiency Delivered	2,867	1.1	50,929	2.6	-48,062	0.3
Res New Home	86,901	1.0	6,609,346	4.9	-6,522,445	0.3
Res Marketplace	16,122	1.4	73,404	3.5	-57,282	0.5
Res Products	0	0.0	0	0.0	0	0.0
Residential Total	**74,223,580**	**2.65**	**131,644,578**	**4.66**	**-57,420,997**	**0.18**
Com Prescriptive	3,454,640	1.4	18,370,613	3.4	-14,915,973	0.4
Com Lighting	349,477	1.1	5,157,917	3.4	-4,808,440	0.4
Com Custom	814,419	1.4	5,316,015	4.0	-4,501,595	0.4
Com Green Building	1,745	1.4	13,147	4.8	-11,402	0.3
Com Chiller Maintenance	0	0.0	0	0.0	0	0.0
Non-Residential Total	**4,620,280**	**1.36**	**28,857,691**	**3.51**	**-24,237,411**	**0.42**
Portfolio Total	**78,843,861**	**2.36**	**160,502,269**	**4.38**	**-81,658,408**	**0.27**

Demand Response Programs

The TRC Scenario analysis resulted in four cost-effective demand response measures for the largest commercial and industrial segment, which includes customers over 500 kW. The four DR measures are presented as individual potential program options in the following tables. Each's program's cost and impact estimates were developed independent of the other programs; therefore, because the measures apply to the same target population of large commercial and industrial customers, the savings and participation are not additive.

Table 17. TRC Scenario – Commercial Demand Response - Automated DR Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	13.5	24.0	32.2	38.5	43.5	47.4	50.5	52.8	54.7	56.1
Winter MW (Cumulative)	9.9	17.7	23.7	28.4	32.1	35.0	37.2	38.9	40.3	41.4
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$4,032	$2,099	$2,642	$3,066	$3,397	$3,655	$3,856	$4,013	$4,135	$4,230

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$9,599,458	1.33
RIM	$9,599,458	1.33

Table 18. TRC Scenario – Commercial Demand Response – Critical Peak Pricing (CPP) Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.1	19.8	26.6	31.9	36.0	39.3	41.8	43.7	45.2	46.4
Winter MW (Cumulative)	8.2	14.6	19.6	23.5	26.6	28.9	30.8	32.2	33.4	34.2
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$3,970	$1,916	$2,366	$2,717	$2,991	$3,204	$3,371	$3,501	$3,602	$3,681

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$6,016,084	1.23
RIM	$6,016,084	1.23

Table 19. TRC Scenario – Commercial Demand Response – Firm Service Level Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.1	19.8	26.6	31.9	36.0	39.3	41.8	43.7	45.2	46.4
Winter MW (Cumulative)	8.2	14.6	19.6	23.5	26.6	28.9	30.8	32.2	33.4	34.2
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$1,942	$1,851	$2,310	$2,668	$2,947	$3,165	$3,334	$3,467	$3,570	$3,651

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,360,168	1.36
RIM	$8,360,168	1.36

Table 20. TRC Scenario – Commercial Demand Response – Guaranteed Load Drop Program

Annual Impacts	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual MWh	0	0	0	0	0	0	0	0	0	0
Summer MW (Cumulative)	11.1	19.8	26.6	31.9	36.0	39.3	41.8	43.7	45.2	46.4
Winter MW (Cumulative)	8.2	14.6	19.6	23.5	26.6	28.9	30.8	32.2	33.4	34.2
Participation (Cumulative)	19	34	46	55	62	67	72	75	78	80
Program Costs ($ in Thousands)	$1,942	$1,851	$2,310	$2,668	$2,947	$3,165	$3,334	$3,467	$3,570	$3,651

COST EFFECTIVENESS	Net Benefits	Benefit/Cost Ratio
TRC	$8,360,168	1.36
RIM	$8,360,168	1.36

Demand-Side Renewable Energy Programs

OUC did not have any DSRE measures or programs that passed the cost-effectiveness screening for the TRC Scenario.