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DATE: December 16, 2008

TO: Ann Cole, Commission Clerk - PSC, Office of Commission Clerk

FROM: Kathryn D. Lewis, Regulatory Analyst IV, Office of Strategic Analysis and Governmental Affairs

RE: Presentations from Workshop held Dec. 15, 2008

In order to facilitate access by the public, please place the attached two presentations in docket files 080407-EG through 080413-EG. The presentations were made at the Commission Review of Numeric Conservation Goals workshop held December 15, 2008, in Tallahassee, Florida.

The presentations are:

- *Assessment of Technical Potential in the Service Territories of the Florida Electric Utilities* by Itron/KEMA
- *Economic and Achievable* by FEECA Utilities

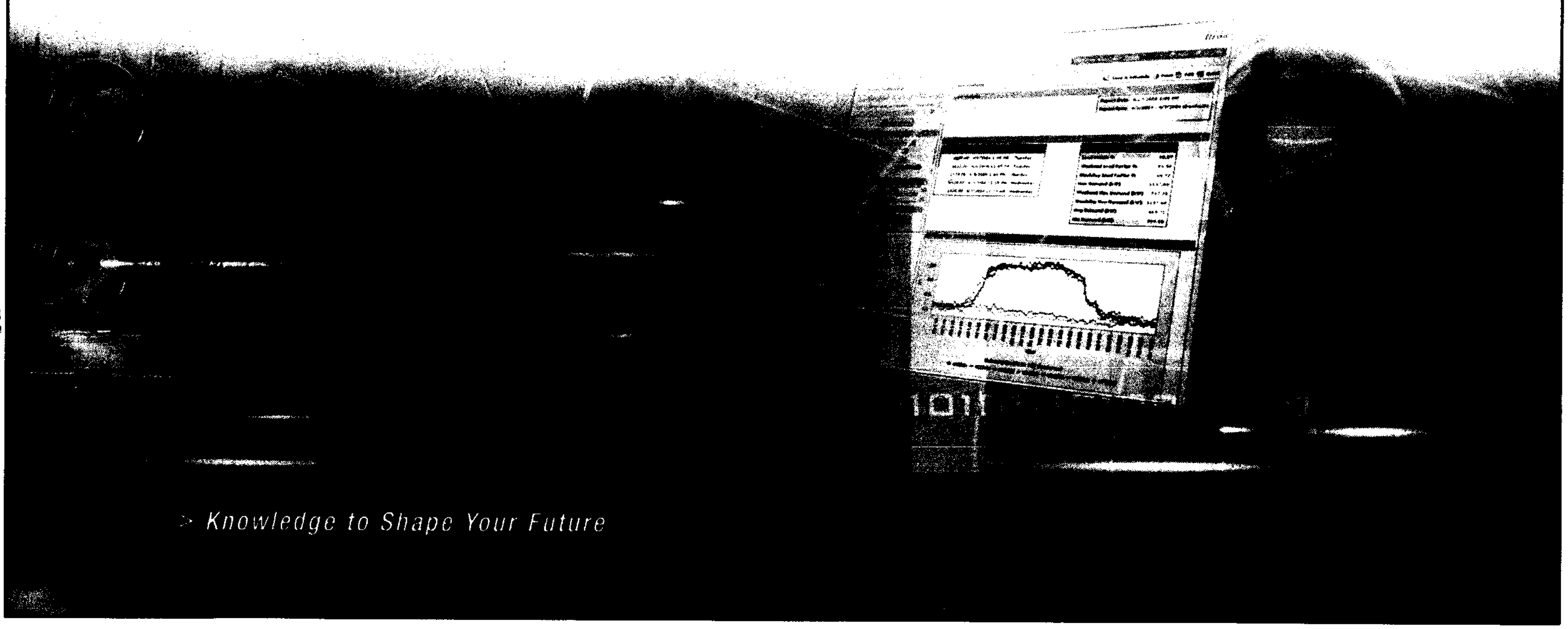
Thank you for your assistance.

Attachments
/kdl

Assessment of Technical Potential in the Service Territories of the Florida Electric Utilities

Florida Public Services Commission Workshop
December 15, 2008

Mike Ting
Mike Rufo



Presentation Overview

- Study objectives
- Overview of concepts, terminology, and methodology used in energy efficiency potential analysis
- Input data development and assumptions
  - baseline end-use data
  - energy efficiency measure data
- Baseline results
  - by end use
  - by building type
- Technical potential results for energy efficiency

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Presentation Overview (continued)

- Overview of concepts, terminology, and methodology used in demand response potential analysis
  - key differences between energy efficiency and demand response
  - key drivers of demand response potential
- Input data development and assumptions
- Technical potential results for demand response

Study Background

Study Objective

- The primary objective of the study is to assess the technical potential for reducing (avoiding) electricity use and peak demand by implementing a wide range of end-use energy efficiency (EE) and demand response (DR) measures, as well as rooftop solar PV installations, in Florida
  - Why do a technical potential study?
  - Results form the foundation for estimating economic and achievable potential
- Effort funded through a collaboration among Florida's seven FEECA utilities
  - Florida Power & Light (FPL)
  - Progress Energy Florida (PEF)
  - Gulf Power Company (Gulf)
  - Tampa Electric Company (TECO)
  - JEA
  - Orlando Utilities Commission (OUC)
  - Florida Public Utilities Company (FPU)
- Southern Alliance for Clean Energy (SACE) and Natural Resources Defense Council (NRDC) also part of Collaborative

Study Scope

- Electricity consumption and peak demand in the service territories of the seven FEECA utilities
- EE potential analysis includes some end-use specific renewable energy measures – e.g. solar water heating and PV-powered pool pumps
- Potential energy and peak demand savings from Direct Load Control (DLC), Advanced Metering Infrastructure (AMI), and rooftop solar PV being analyzed in scenario-based framework outside of EE potential analysis
- Sectors included in EE potential analysis
  - Residential
  - Commercial
  - Industrial
- Sectors *excluded* from EE potential analysis
  - Agriculture; Transportation, communications, and utilities (TCU)
    - Lack of primary research on end-use baselines and efficiency opportunities
  - Construction
    - Temporary load
  - Outdoor/street lighting
    - Already saturated with efficient equipment (e.g. LED traffic signals, pulse-start metal halide lamps)

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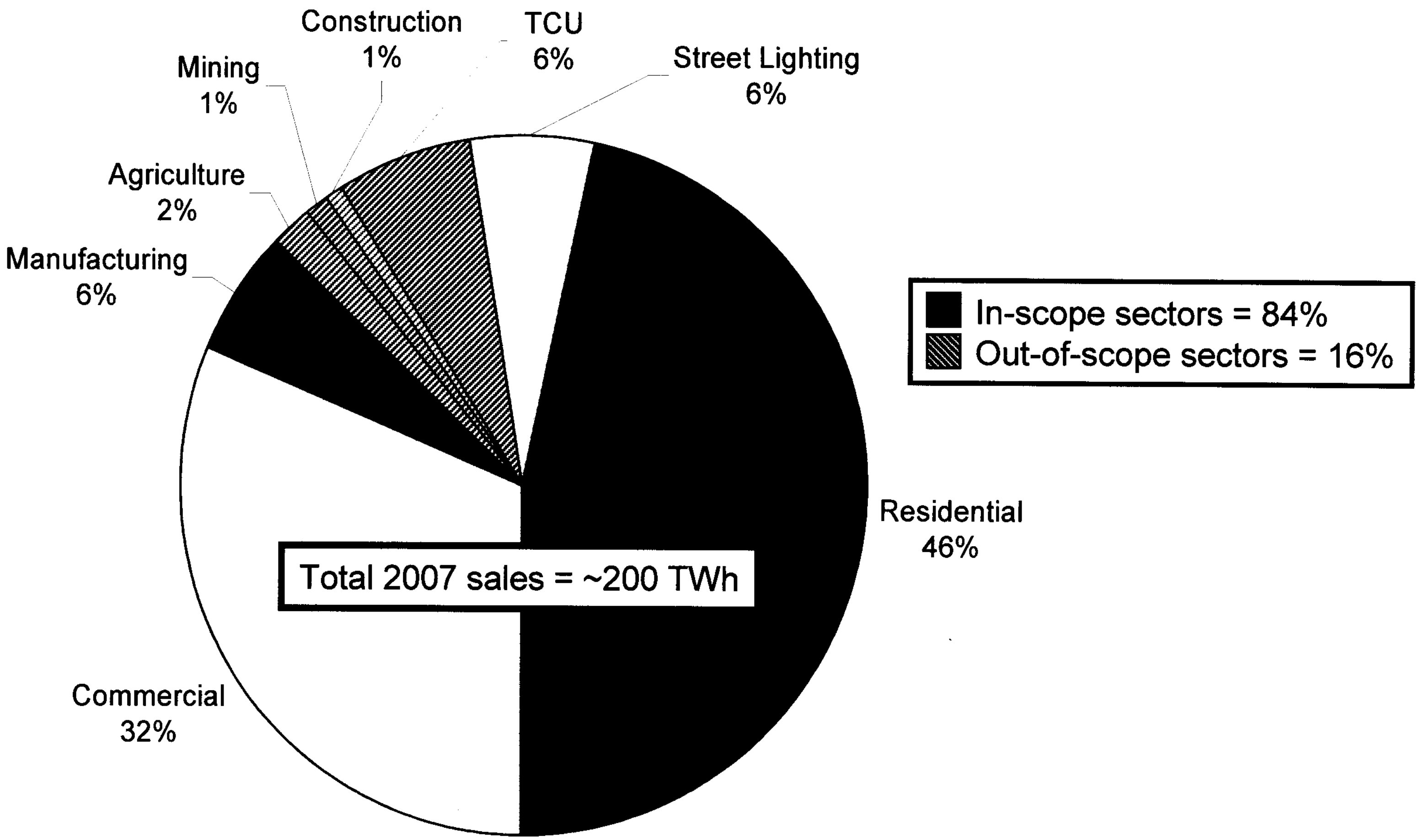
Total 2007 Electricity Sales of 7 FEECA Utilities



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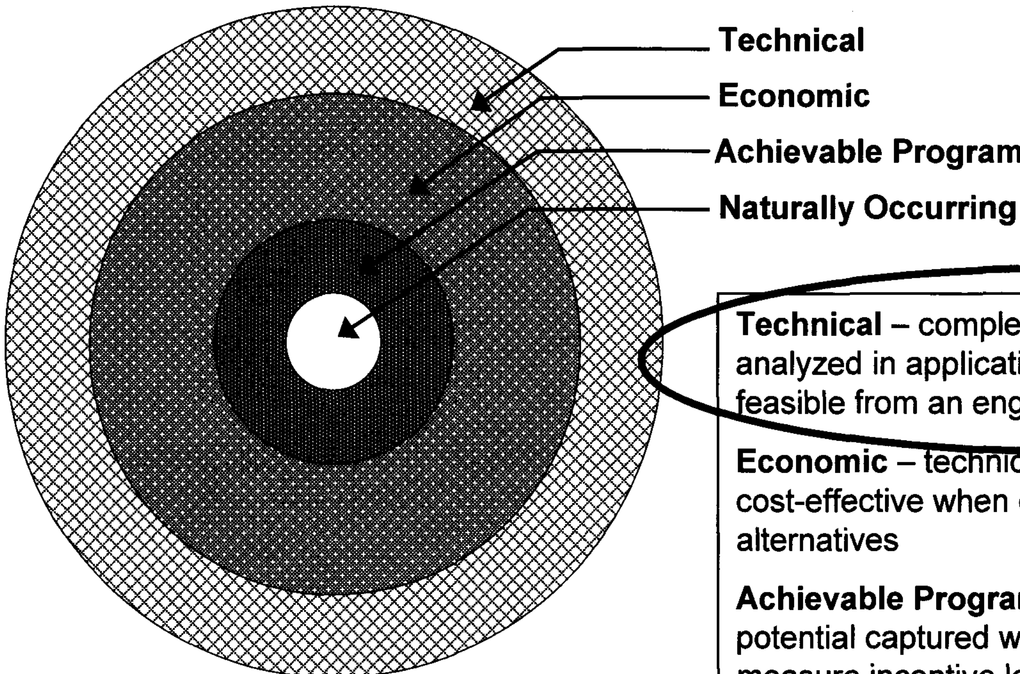
Overview of EE Potential Methods and Concepts

Overview of Study Approach

- Our method for estimating energy efficiency potential is a bottom-up approach, utilizing DSM ASSYST, KEMA's MS-Excel-based DSM potential model for energy efficiency
  - bottom-up analysis captures important differences in energy efficiency opportunities, impacts, costs, and benefits across end uses, building types, and market segments
  - In this approach, costs and savings are assessed at the measure level in each market segment to form a true bottom-up estimate of potential that can be analyzed along a wide range of dimensions, including:
    - annual impacts
      - e.g. GWh and MW savings per year for each year of the forecast
    - cumulative impacts
      - e.g. GWh and MW savings over the entire 10-year forecast
    - utility service territory
    - business/building type
    - building vintage
    - end use
    - measure

Types of Energy Efficiency Potential



Technical – complete penetration of measures analyzed in applications where deemed technically feasible from an engineering perspective.

Economic – technical potential of measures that are cost-effective when compared to supply-side alternatives

Achievable Program – subset of economic potential captured with specific program funding and measure incentive levels (Incorporates real-world customer behavior)

Naturally Occurring – the amount of reduction estimated to occur as a result of normal market forces, that is, in the absence of any utility programs

Technical Potential is the Theoretical Upper Bound

- Technical potential
  - Upper bound of energy efficiency potential in a technical feasibility sense, regardless of cost or acceptability to customers
    - Feasibility limits measure installation to situations where installation is physically practical (e.g., available space, noise considerations, and lighting level requirements are considered, among other things)
  - Total amount of energy and peak demand savings that would be possible if all technically applicable and feasible opportunities to improve energy efficiency were taken, including retrofit measures, replace-on-burnout measures, and new construction measures
- Technical potential does not account for real-world constraints on product availability, contractor/vendor capacity, or customer preferences
- Technical potential **does not** reflect the amount of energy efficiency potential that is achievable through voluntary utility programs

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Example Calculation of Basic Technical Potential

$$\text{Technical Potential (GWh)} = \overbrace{\left(\text{Units of Consumption } (10e6\ ft^2)\right)\left(\text{End-use Tech Saturation } (\%)\right)\left(\text{Base Tech EUI } (kWh/ft^2)\right)}^{\textit{Baseline Data}} \overbrace{\left(1 - \text{Measure Saturation } (\%)\right)\left(\text{Measure Feasibility } (\%)\right)\left(\text{Measure Impacts } (\%)\right)}^{\textit{Measure Data}}$$

- Interacting baseline estimates of end-use consumption with data on measure impacts, measure feasibility, and current measure saturation produces estimates of technical potential
- Technical potential for peak demand reduction is calculated analogously by adding peak-to-energy ratios to the identity above
    - these peak-to-energy ratios derived from end-use load shape data and translate annual energy consumption (kWh) to demand (kW) at the time of system coincident peak load

Supply Curve Approach

- By treating measures independently, their relative cost-effectiveness is analyzed without making assumptions about the order or combinations in which they might be implemented in customer premises
- However, total technical potential across measures cannot be accurately estimated by simply summing the individual measure potentials directly, since some savings would be double counted
- For example, the savings from a measure that reduces heat gain into a building, such as window film, are partially dependent on other measures that affect the efficiency of the system being used to cool the building
  - high-efficiency chiller example: the more efficient the chiller, the less energy saved from the application of the window film

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Supply Curve Approach

- In the second step of the modeling framework, cumulative technical potential is estimated using a supply curve approach
- This method minimizes the double-counting problem
- The supply curve consists of two axes – one that captures the levelized cost per unit of savings (e.g., $/kWh saved) and the other that shows the amount of savings that could be achieved at each level of cost
- The curve is built up by sorting individual measures on a least-cost basis
  - Total savings are calculated incrementally with respect to measures that precede them
  - Participant cost test used as least-cost sorting metric
- Supply curves typically, but not always, end up reflecting diminishing returns, i.e., as costs increase rapidly and savings decrease significantly at the end of the curve.

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Example Supply Curve Calculation: Commercial Lighting

Measure	Total End Use Consumption of Population (GWh)	Applicable, Not Complete and Feasible (1000s of ft^2)	Average kWh/ft^2 of population	Energy Savings (%)	Energy Savings (GWh)	Participant B-C Ratio
Base Case: T12 lamps w/Magnetic Ballast	425	100,000	4.3	N/A	N/A	N/A
1. T8 w. Elec. Ballast	425	100,000	4.3	21%	89	3.2
2. Occupancy Sensors	336	40,000	3.4	10%	13	1.4
3. Perimeter Dimming	322	10,000	3.2	45%	14	0.5
With all measures	309		3.1	27%	116	

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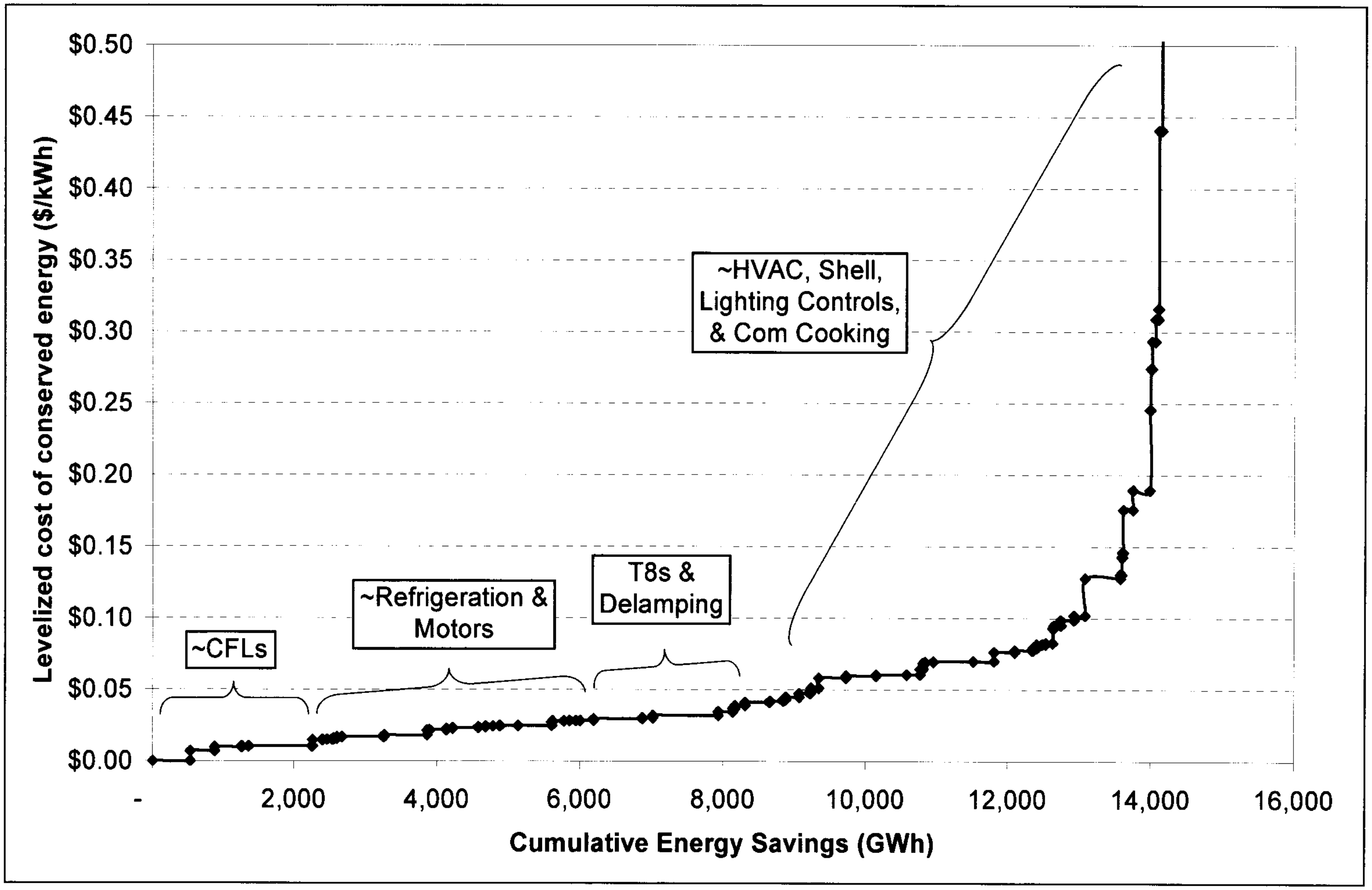
Energy Efficiency Supply Curve – Commercial Example



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Input Data & Assumptions

Data Inputs Required for Technical Potential

- Baseline data that support development of calibrated, bottom-up, end-use technology baselines
  - Housing/customer counts
  - Commercial floor area
  - End-use energy intensities
  - End-use saturations
  - End-use load shapes
  - Actual utility sales and peak demand (top-down control totals)
- Measure data that capture the average cost-savings relationships in a given market segment
  - Measure costs
  - Measure savings
  - Measure feasibility
  - Current measure saturation

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Analysis Segmentation

Segment Name	Segment Definition		
Sector	• Residential	• Commercial	• Industrial
Building type	• Single-family dwelling • Multi-family dwelling • Mobile Home	• College • Food Store • Hospital • Other Health Care • Office • Lodging • Restaurant • Retail • School • Warehouse • Miscellaneous	• Food Processing • Textiles • Lumber • Paper-Pulp • Printing • Chemicals • Petroleum • Rubber-Plastics • Stone-Clay-Glass • Primary Metals • Fab Metals • Ind Machinery • Electronics • Transp Equipment • Instruments • Miscellaneous
Building vintage	• Existing construction • New construction	• Existing construction • New construction	• Existing construction
End use	• HVAC • Lighting • Water Heating • Refrigerator • Freezer • Clothes Dryer • Clothes Washer • Dishwasher • Pool Pump • TV/VCR/DVD/STB/PC • Other Plug Loads	• Space Cooling • Ventilation • Water Heating • Commercial Cooking • Refrigeration • Exterior Lighting • Interior Lighting • Office Equipment • Miscellaneous	• Process Heating • Process Cooling • Pumps • Fans • Compressed Air • Process Drives • Lighting • HVAC • Refrigeration • Other

Summary of Key Baseline Data Requirements

Data Type	Units
Units of consumption	▪ Number of households or kWh sale (residential) ▪ Square feet of floor space or kWh sales (commercial) ▪ kWh sales (industrial)
End-use technology saturation	▪ Share of households with technology installed (residential) ▪ Share of floor space with technology installed (commercial) ▪ Share of load with technology installed (industrial)
End-use technology density	▪ Cost units per consumption unit (e.g., lamps/home, tons cooling/square foot, motor horsepower/kWh)
End-use energy intensity	▪ Annual kWh/household (residential) ▪ Annual kWh/square foot (commercial) ▪ kWh load (industrial)
End-use load shapes	▪ Distribution of end-use energy consumption across times of the day, days of the week, and season

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Residential Baseline Data Development

- Customer counts (# of households) and total annual residential sales provided from utility Customer Information System (CIS) and billing data
- End-use saturations and technology densities developed primarily from 2006 statewide Home Energy Survey (HES)
  - ~1,200 residential on-site surveys conducted in 6 of 7 FEECA utilities
  - Outside of FPL, sample sizes too small to support statistically significant estimates at the utility-specific level
  - Itron developed population weights to aggregate results and produce statewide averages
  - Gulf and JEA also provided study team with results of recent internal saturation surveys with sufficient sample sizes to support utility-specific saturation estimates for those utilities

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Residential Baseline Data Development

- HVAC and water heating UECs (kWh/household) derived from previous Itron analyses of in-situ heating, cooling, and water heating loads conducted in support of FPL program impact evaluations
  - Separate estimates by FPL climate zone, building type, and base technology
  - Itron adjusted the space heating and water heating load estimates for the other six utilities:
    - space heating loads adjusted to account for significant differences in average heating degree-days between the representative north and central climate zone weather stations in FPL's service territory and the representative weather stations for other FL utilities in the north and central climate zones
    - water heating loads adjusted to account for significant differences in average inlet water temperatures in FPL's service territory (often around 80° F) and the other FL utilities using weather station data on average ground water temperature differences

Residential Baseline Data Development

- Lighting and appliance UECs (kWh/household) derived from a variety of FL-specific sources
  - Lighting, refrigerators, freezers - FSEC monitoring study of ~200 homes conducted for Progress Energy (2000)
  - Clothes washers, clothes dryers, and dishwashers – Florida-specific results from the 2001 Residential Energy Consumption Survey (RECS) conducted by the Energy Information Administration (USDOE, 2004)
- Home electronics UECs (kWh/household) derived from most recent national and regional studies on residential plug loads
  - Field measurements of residential plug loads in 75 California homes (Porter et al, 2006)
  - Comprehensive national assessment of energy consumption from consumer electronics (Roth and McKenney, 2007)

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Commercial Baseline Data Development

- Customer-level Standard Industrial Classification (SIC) information in utility billing/CIS data used to map annual sales to 11 commercial building types (top-down control totals for calibration)
  - 4 of 7 utilities were missing SIC data for commercial customers
  - for customers with missing SIC data, Itron used data from US Census Bureau and the EIA's 2003 Commercial Building Energy Consumption Survey (CBECS) to estimate utility-specific distributions of sales across building types
    - Census data provides # of full-time equivalent (FTE) staff by business type by zip code
    - CBECS provides average kWh/FTE by business type (South Atlantic region)
    - interacting these estimates provides utility-specific estimates of distribution of commercial kWh sales by building type
- End-use EUIs (kWh/ft^2), saturations, and end-use load shapes derived primarily from previous commercial survey conducted by RER for FPL (1997)
  - 1,157 on-site surveys of FPL commercial and industrial (C&I) customers
  - DOE-2 building energy simulations generated for each site
  - Simulation results weighted and scaled to population level for each building type
- Supplemented with recent data from ongoing Itron evaluations of FPL's C&I programs and recent C&I market assessments in California

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Commercial On-Site Surveys

- Robust baseline equipment and EE measure saturation data by commercial building type are often most uncertain inputs in potential studies
- FL Utilities included base task of conducting 600-point on-site survey of commercial facilities in the service territories of FPL, Progress Energy, and Gulf Power
  - Survey development, testing, and implementation being administered by KEMA (subcontractor to Itron for this study)
  - Primary data being collected:
    - Building characteristics
    - Baseline end-use equipment saturations
    - EE measure saturations

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Commercial On-Site Surveys

- Current status: >580 on-site surveys completed
  - Quality control, data entry, and analysis scheduled to be completed by mid-January
- Survey results will be used to "true up" end-use baselines developed from 1996 FPL survey
  - more likely to affect distribution of technical potential across end uses and building types, rather than total level of technical potential
- More importantly, survey results will also be used to update estimates of current penetration of EE measures in Florida's commercial buildings
  - significant changes in these estimates will directly affect both the distribution and the total level of technical potential across measures, end uses, and building types

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Industrial Baseline Data Development

- Customer-level SIC information in utility billing/CIS data used to map annual sales to 16 industrial subsectors (top-down control totals for calibration)
- End-use shares from the EIA's 2002 Manufacturing Energy Consumption Survey (MECS) used to derive end-use consumption at the subsectoral level
  - Motor loads further disaggregated using results of USDOE's Motors Assessment Study (1998)
- Utility rate load research and customer-level interval data leveraged to develop subsector-specific load profiles

Summary of Key Measure Data Requirements

Data Type	Units
Measure costs	▪ $/cost unit (e.g. per lamp, per ton of cooling capacity, per square foot of insulation)
Measure savings	▪ Savings relative to base case technology at equivalent level of service
Measure saturation	▪ % of households with measure installed (residential) ▪ % of floor space with measure installed (commercial) ▪ % of load with measure installed (industrial)
Measure feasibility	▪ % of eligible households where measure is technically and practically feasible (residential) ▪ % of eligible floor space where measure is technically and practically feasible (commercial) ▪ % of eligible load where measure is technically and practically feasible (industrial)

Energy Efficiency Measures Considered

- Types of measures
  - Retrofit
    - Screw-based CFLs, O&M measures, controls, insulation measures
  - Replace-on-burnout
    - Residential and commercial HVAC equipment, advanced windows, water heating equipment, pumps, motors
  - New construction
    - Energy Star Homes, integrated system design
- Scope of measures considered in study
  - In general, scope limited to measures that are currently available in the market for which independently-verified cost and savings data are available
    - non-commercialized "emerging" techs not considered
    - included some measures that are likely to face significant supply constraints in near term, e.g. SEER 19 CAC, hybrid desiccant-DX cooling systems, solar water heating, heat pump water heaters

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Energy Efficiency Measures Considered

- Development of final measure list
  - Minimum list from RFP Appendix A
  - Additional measures previously analyzed by Itron in other jurisdictions
  - Additional measures from existing DSM programs in FL
  - Additional measures provided by FL Collaborative
- Itron conducted initial assessment of data availability and modeling/data development issues associated with "new" measures
  - FL Collaborative members submitted written comments
  - Multiple conference calls to reach consensus and determine further action items
    - Individual utilities provided data from internal R&D for selected measures
    - SACE/NRDC provided research briefs on selected measures
- Final scope of EE measures considered in the study
  - 276 unique measures: 70 residential, 92 commercial, 114 industrial
  - 58 "new" measures (relative to previous Itron/KEMA studies): 25 residential, 33 commercial

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Residential Energy Efficiency Measure Data

- Measure costs
  - FPL program tracking data
  - Previous FPL program evaluations conducted by Itron
  - California DEER databases
  - Energy Star calculators
  - FSEC estimates of radiant barrier costs
  - Energy Data Sourcebook for the U.S. Residential Sector (LBNL)
- Measure savings
  - Previous measure impact evaluations and R&D conducted by Itron for FPL
  - Previous measure impact studies conducted by FSEC
  - Measure impact simulations conducted by Itron using the RESFEN model (LBNL)
  - Engineering calculations based on differences in fixture wattages, energy factors, modified energy factors
  - California DEER databases
  - Energy Star product specifications
  - TIAX study of usage patterns and active/standby/off power mode draws in home electronics
- Current measure saturations
  - 2006 FPL HES
  - FPL program tracking data
  - Florida-specific results from the 2005 RECS (EIA)
  - EPA estimates of Energy Star product market penetration
  - Gulf and JEA saturation surveys

Commercial Energy Efficiency Measure Data

- Measure costs
  - FPL program tracking data
  - Previous FPL program evaluations
  - California DEER databases
  - Energy Star calculators
- Measure savings
  - Previous measure impact evaluations and R&D conducted by Itron for FPL
  - Previous measure impact studies conducted by FSEC
  - Engineering calculations based on differences in fixture wattages, energy factors, kW/ton, etc.
  - California DEER databases
  - Energy Star product specifications
  - ADL study of usage patterns and active/standby/off power mode draws for office equipment
- Current measure saturations
  - FPL program tracking data
  - ADL estimates of Energy Star product market penetration

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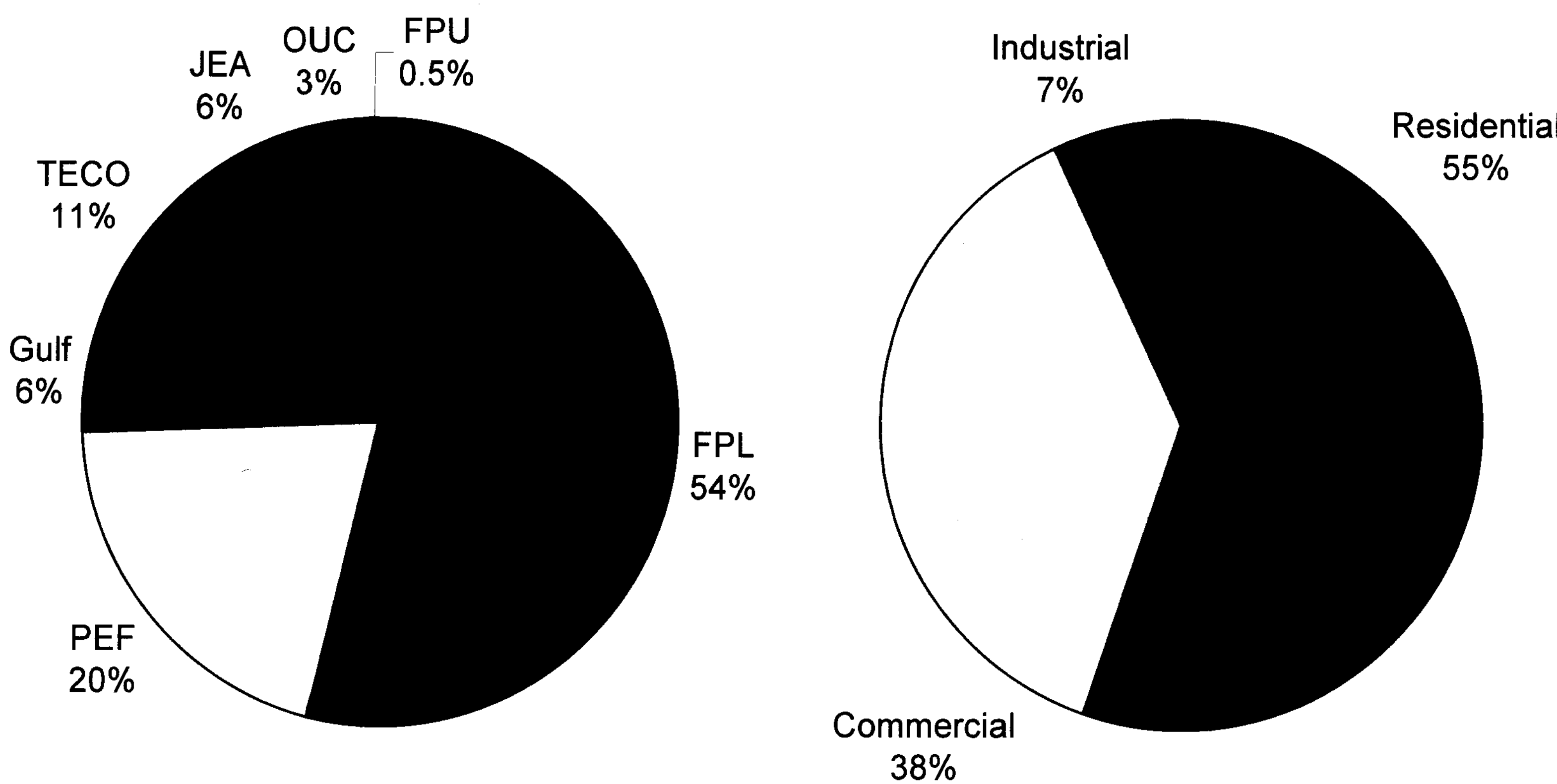
Industrial Energy Efficiency Measure Data

- Industrial measure data (costs, savings, incomplete factors) derived from two principle sources:
  - Previous industrial energy-efficiency market characterization and market assessment studies by KEMA for the California IOUs (2001, 2003)
  - Data and results of a series of national-level industrial efficiency case studies conducted by Lawrence Berkeley National Laboratory (1998-2004)
  - Other key secondary sources:
    - USDOE Motor Assessment Study (1998)
    - CADDET industrial case studies (1997-2003)
    - USDOE Compressed Air Market Assessment Study (2001)
    - USDOE Industrial Assessment Centers Database

Energy and Peak Demand Baseline Results

Baseline Results

Total In-Scope Sales (171,672 GWh)



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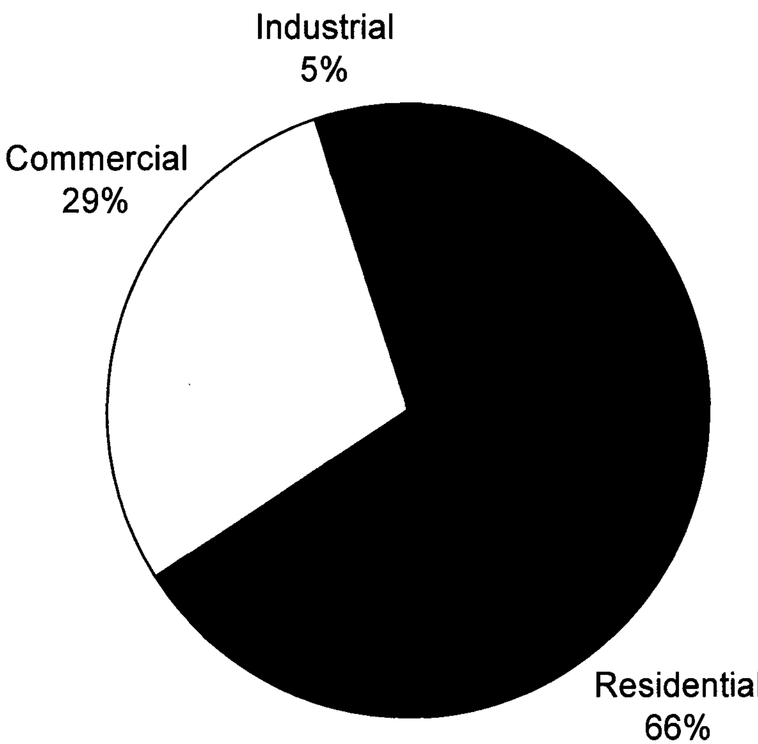
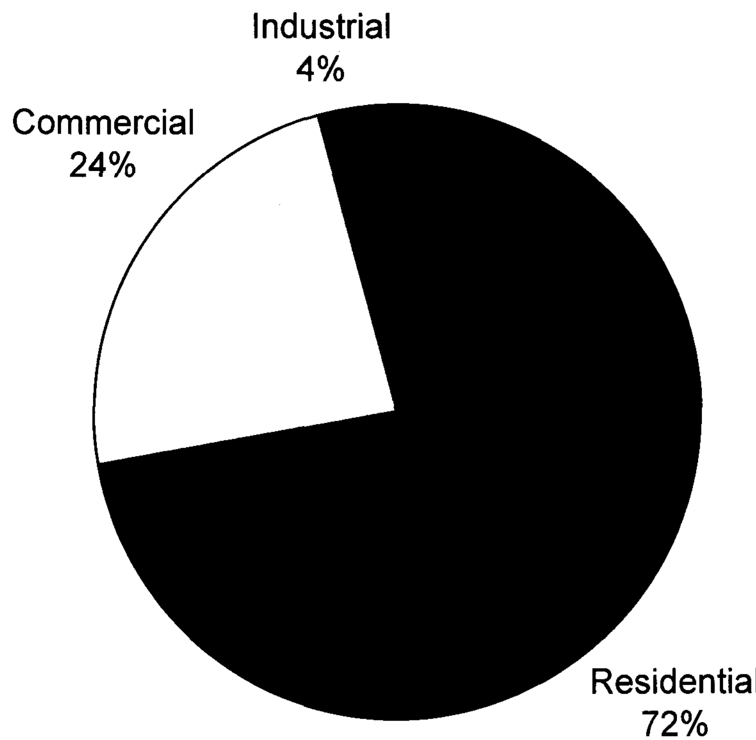
Baseline Results

Total Summer Peak (33,825 MW)



Total Winter Peak (31,506 MW)



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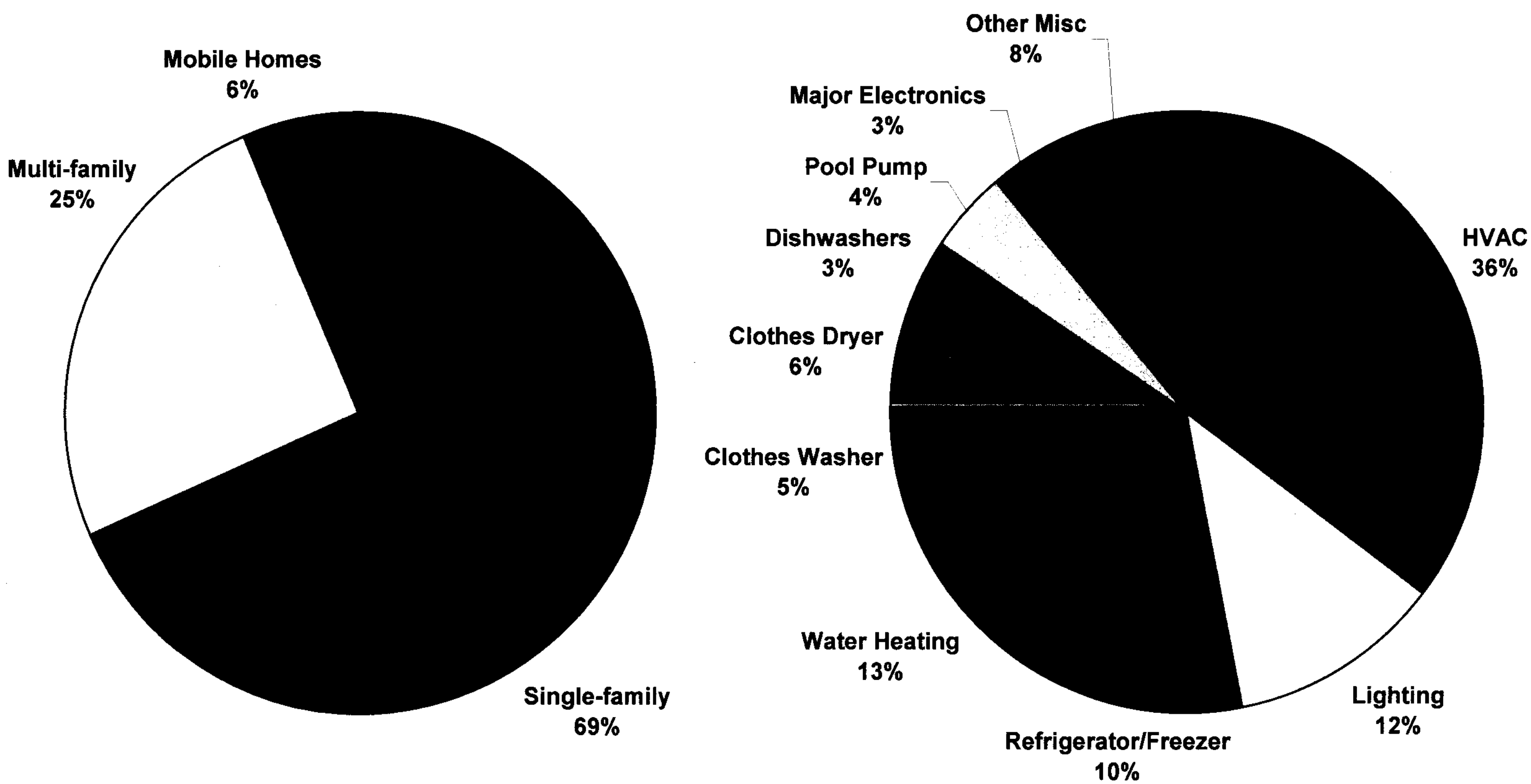
Baseline Results – Residential Sector

Total Residential Sales (94,745 GWh)



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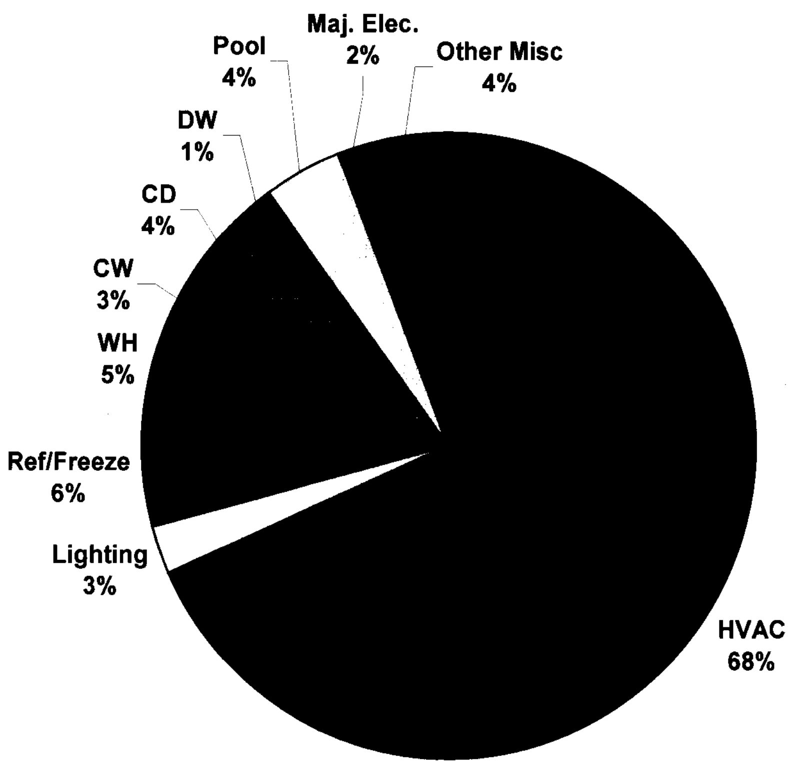
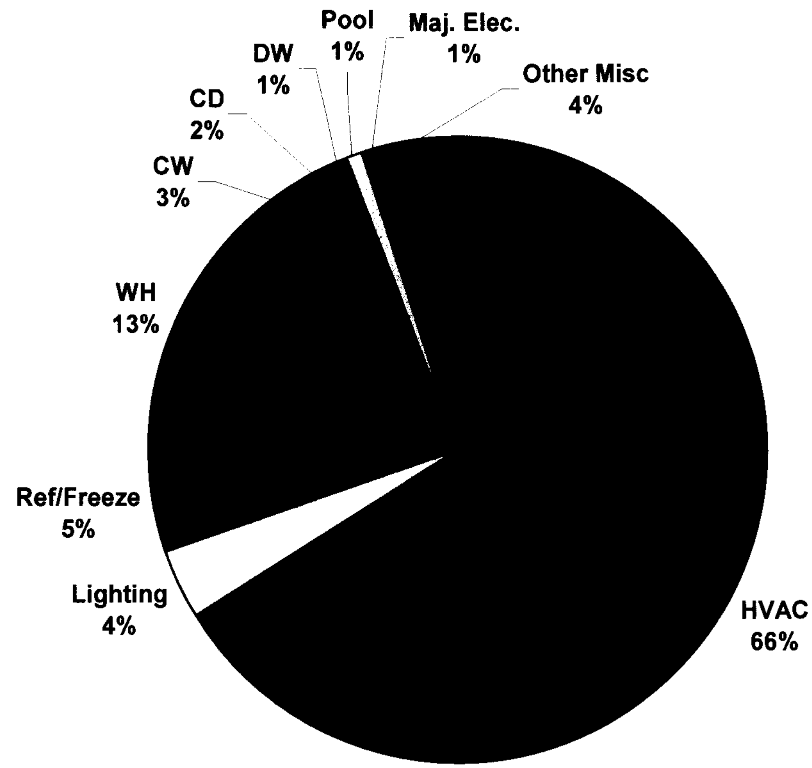
Baseline Results – Residential Sector

Summer Peak Demand (22,263 MW)



Winter Peak Demand (22,728 MW)



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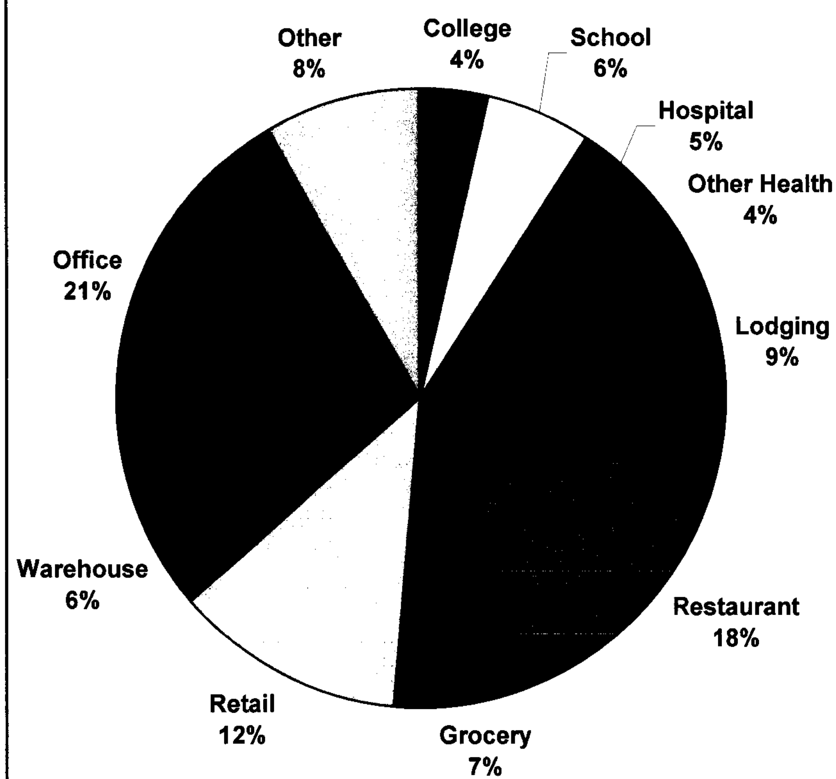
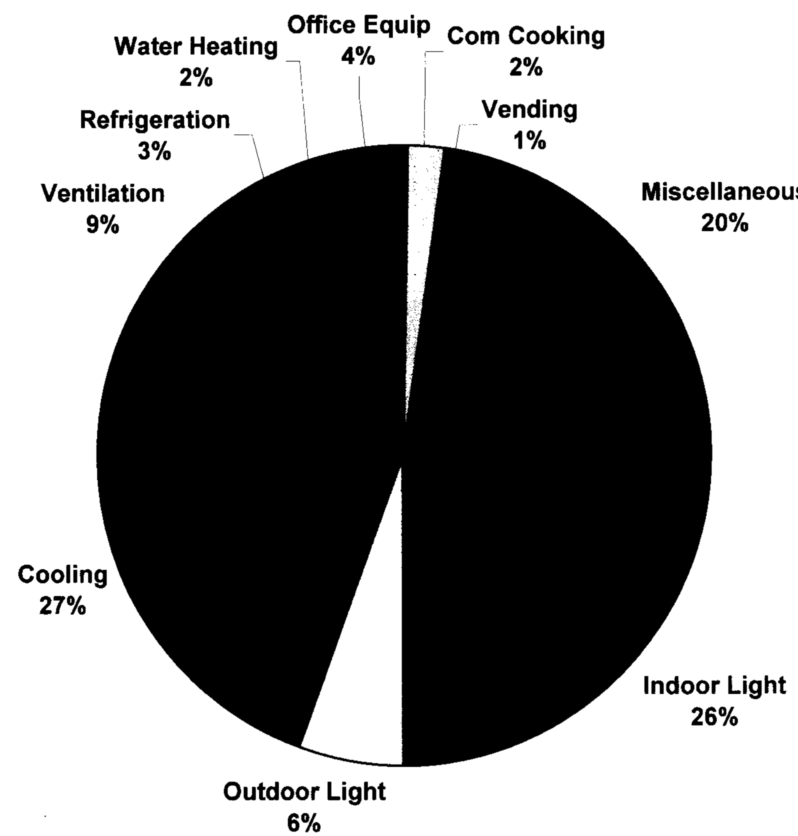
Baseline Results – Commercial Sector

Total Commercial Sales (65,051 GWh)





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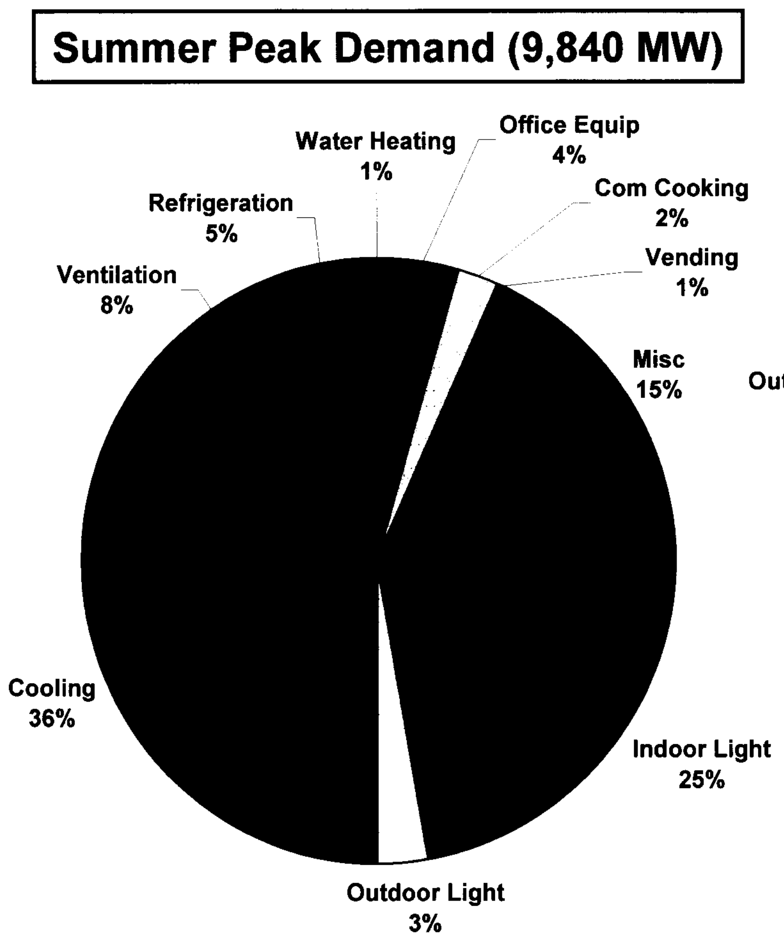
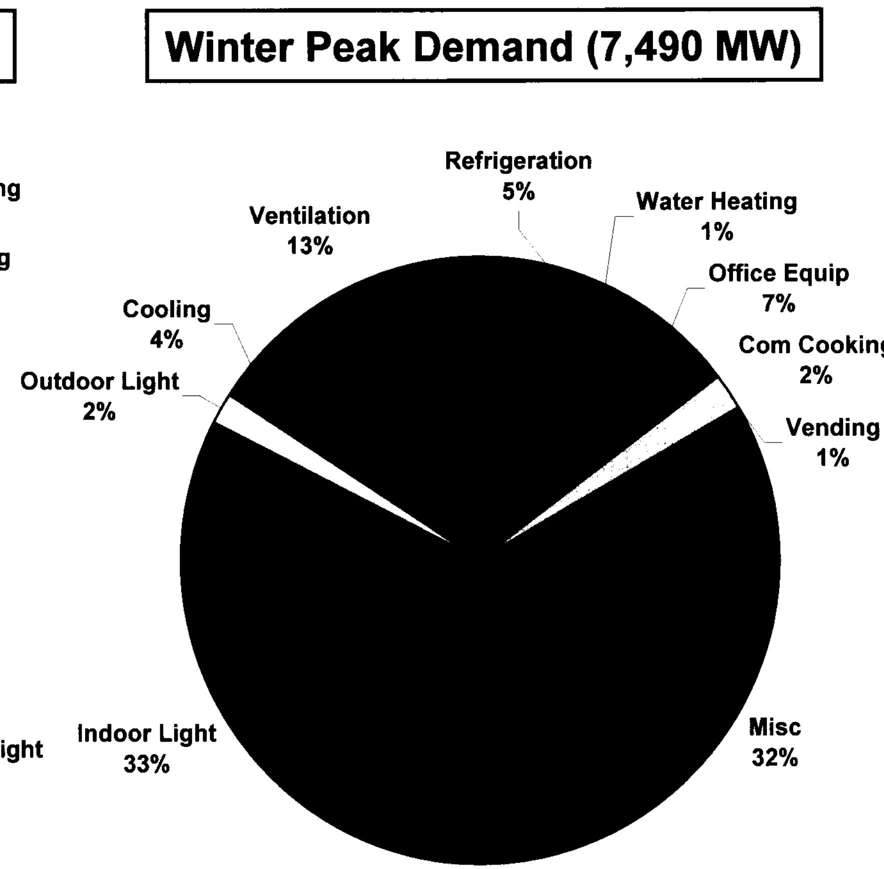
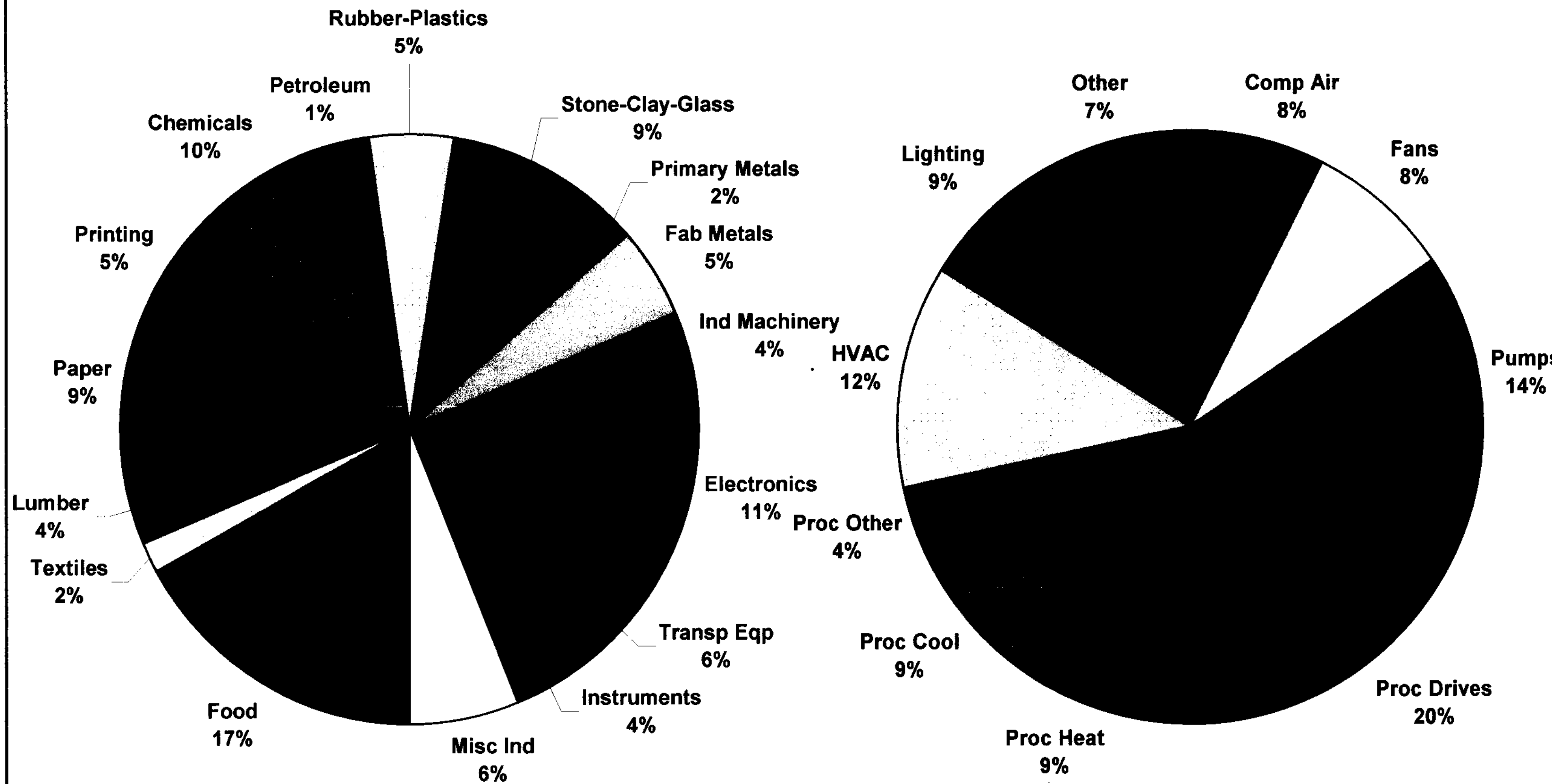
Baseline Results – Commercial Sector





Baseline Results – Industrial Sector

Total Industrial Sales (11,877 GWh)



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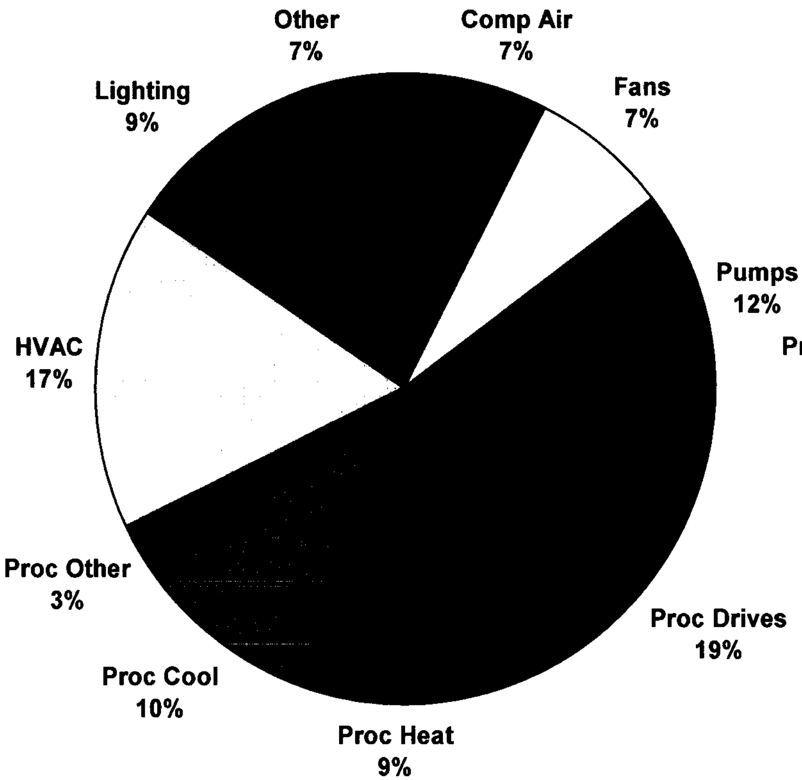
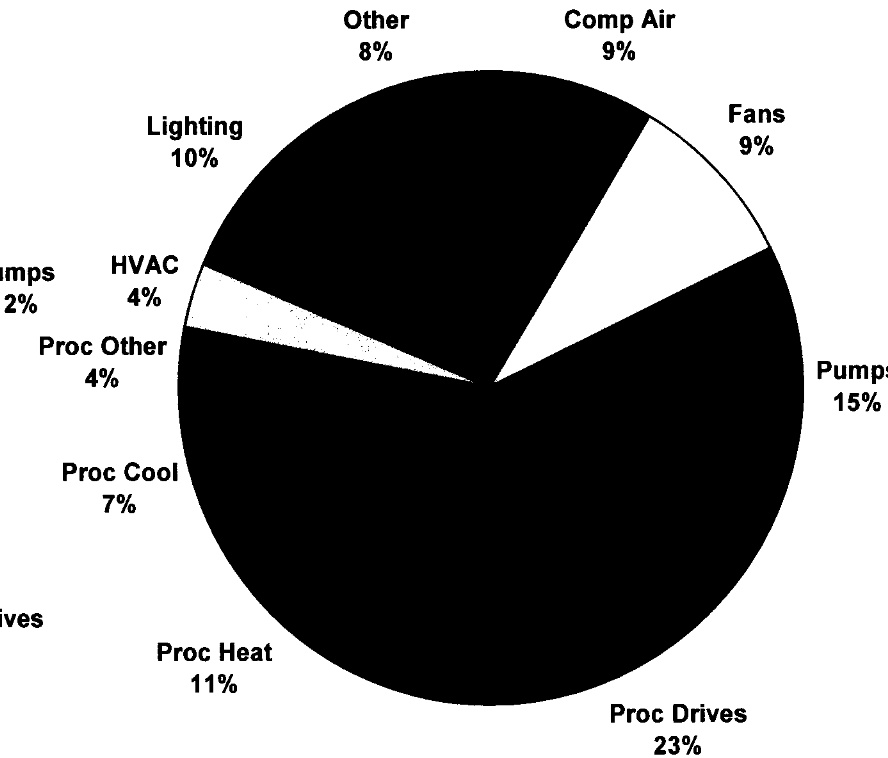
Baseline Results – Industrial Sector

Summer Peak Demand (1,721 MW)



Winter Peak Demand (1,298 MW)



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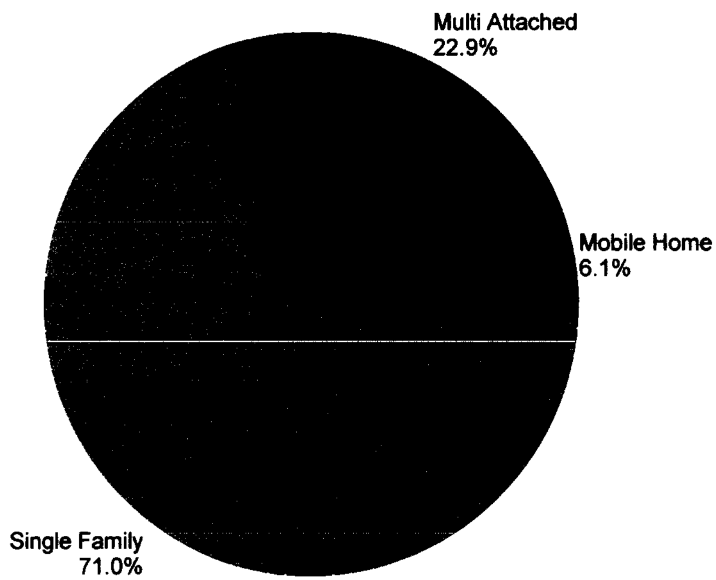
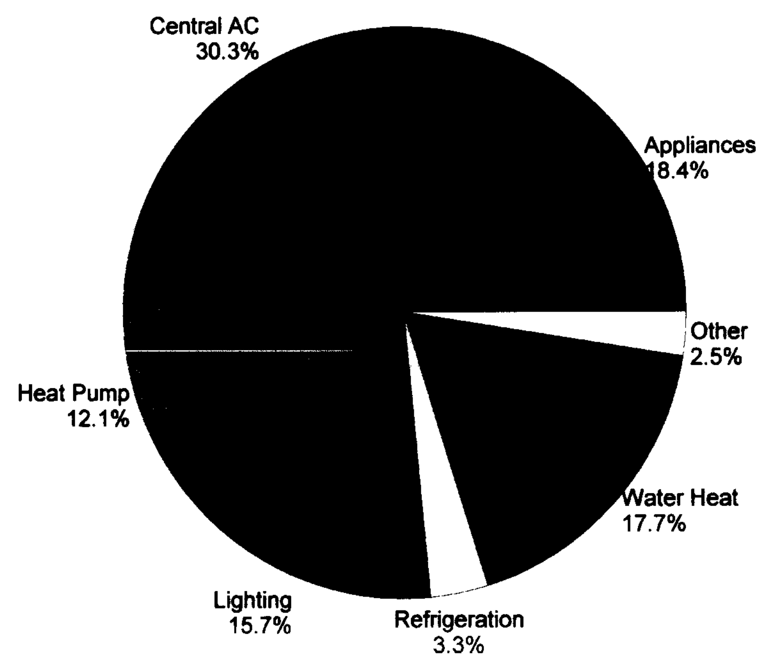
EE Technical Potential Results

Residential Technical Potential – Energy Savings

Total GWh Savings: 36,136



Total GWh Savings: 36,136



'Other' includes Plug Load(1.8%), Room AC(0.7%)

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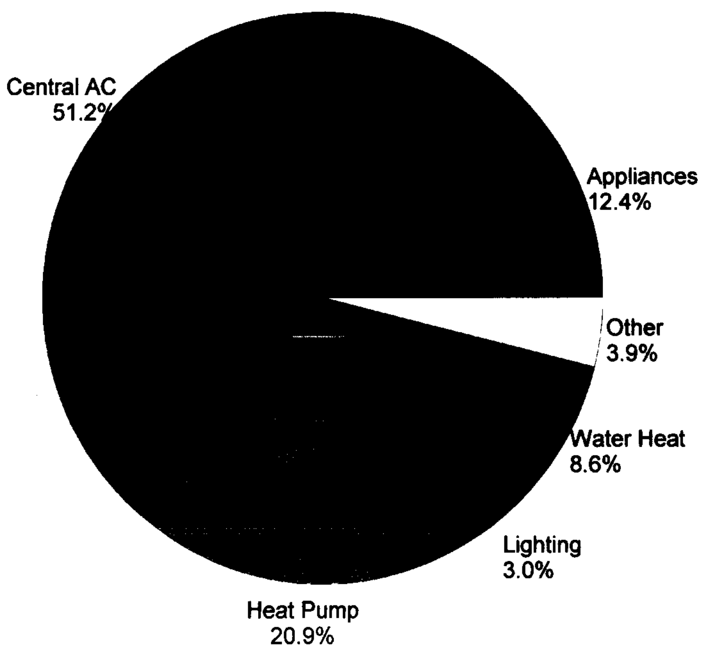
Residential Technical Potential – Demand Savings

Summer Peak

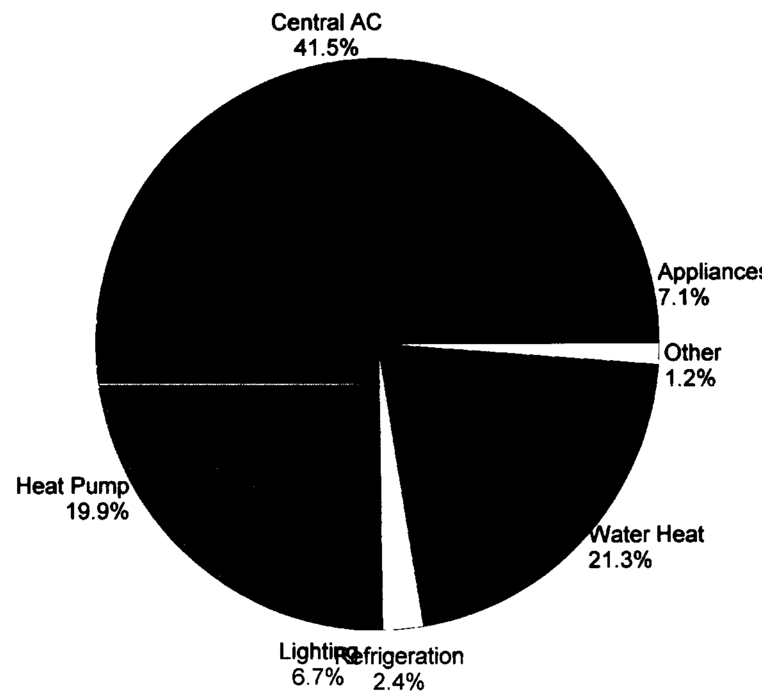
Total MW Savings: 9,764



'Other' includes Plug Load(0.8%), Refrigeration(1.6%), Room AC(1.4%)

Winter Peak

Total MW Savings: 6,288



'Other' includes Plug Load(1.1%), Room AC(0.1%)

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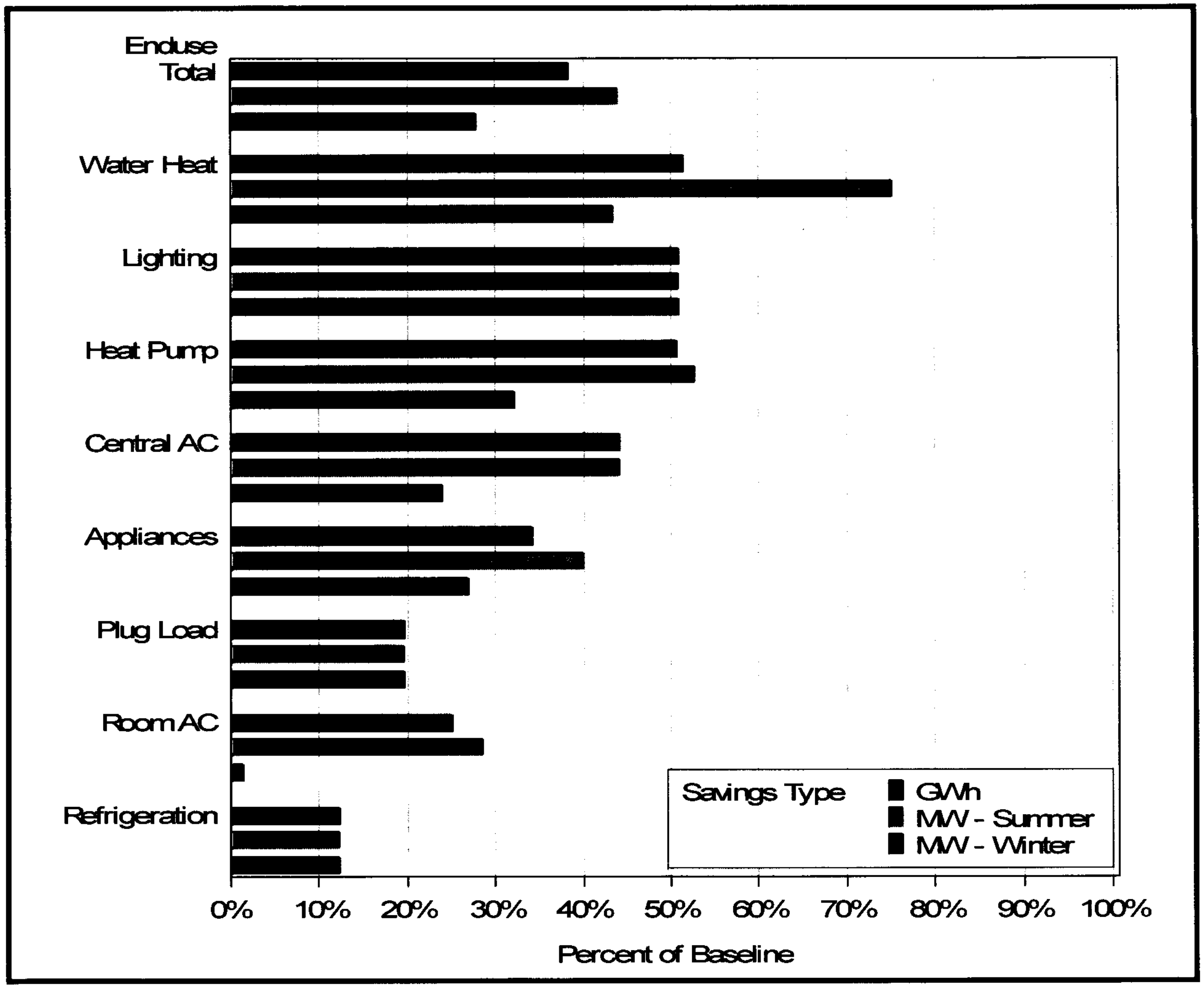
Residential Technical Potential – Relative Savings



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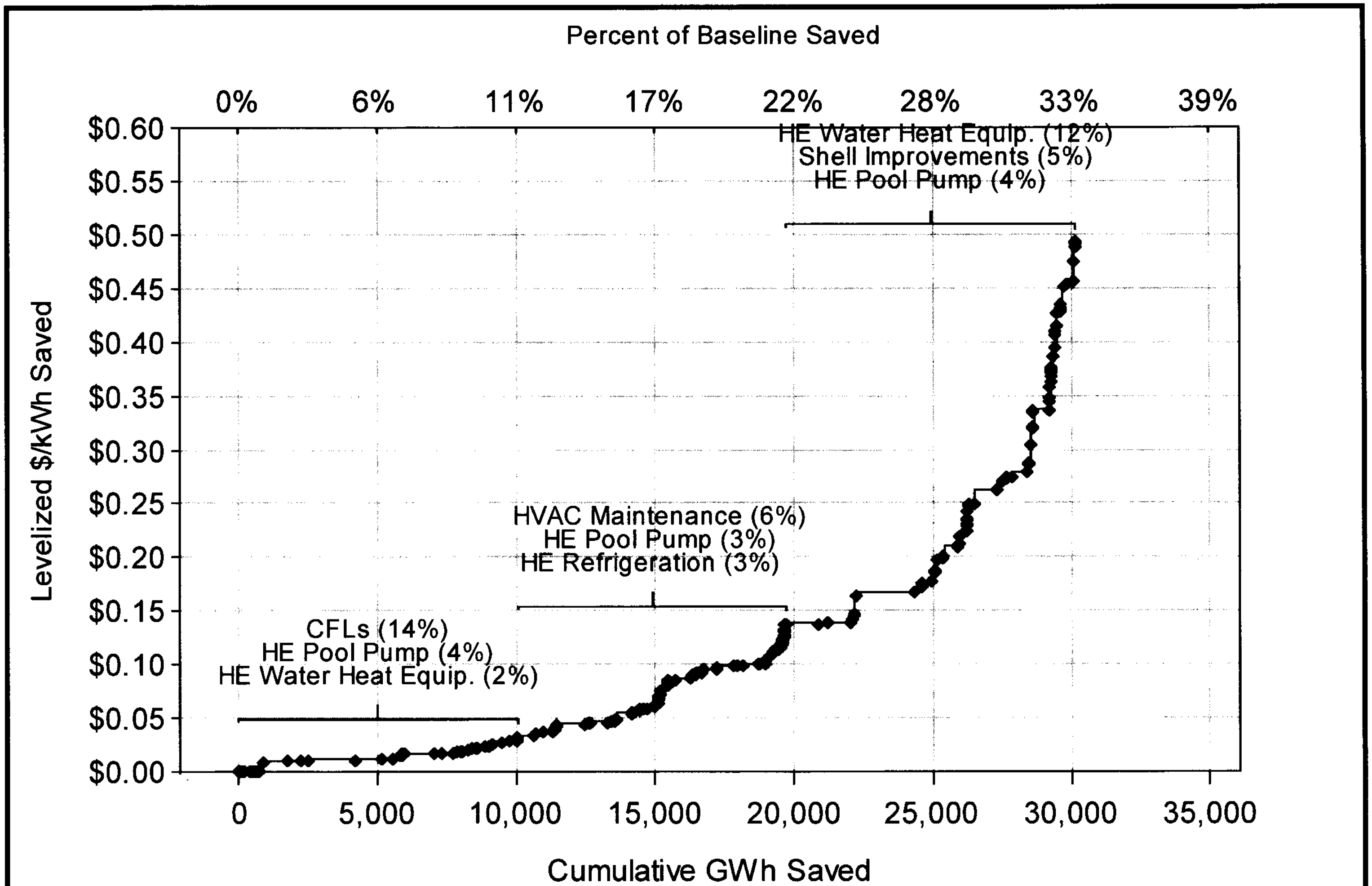
Residential Efficiency Supply Curve



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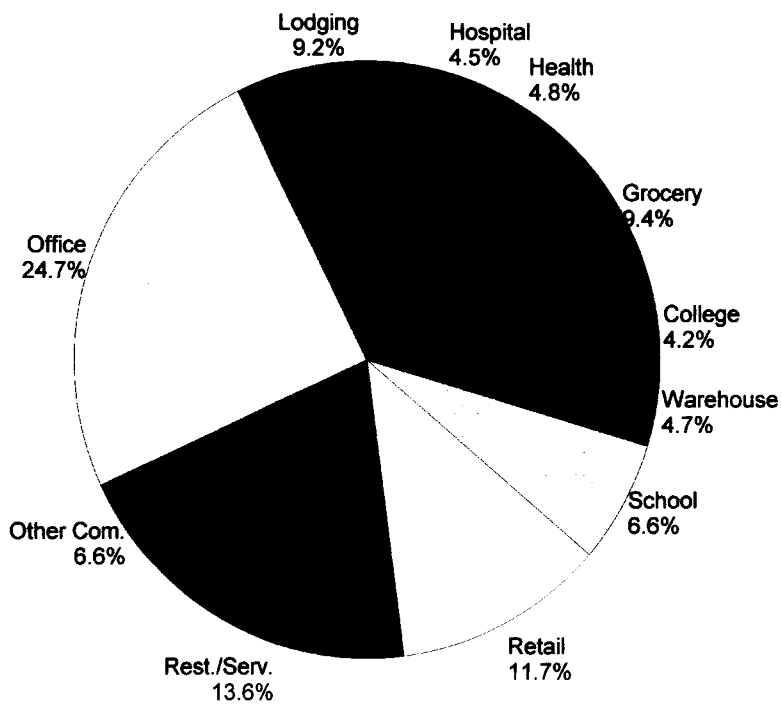
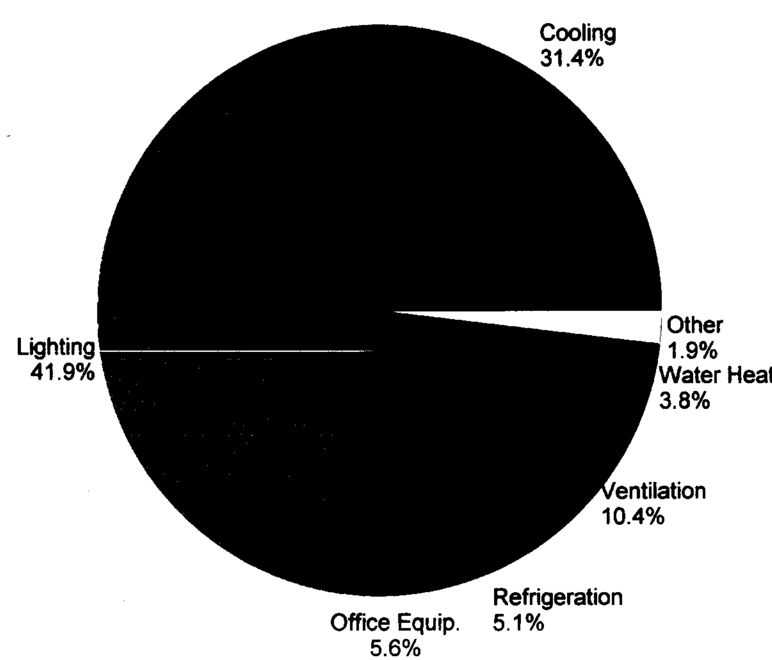
Commercial Technical Potential – Energy Savings

Total GWh Savings: 19,924



Total GWh Savings: 19,924



'Other' includes Cooking(0.8%), Vending(1.1%)

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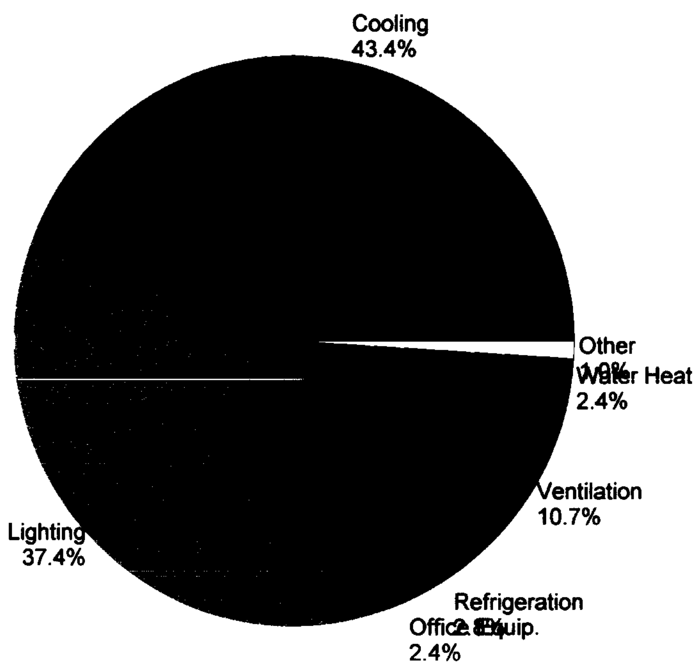
Commercial Technical Potential – Demand Savings

Summer Peak

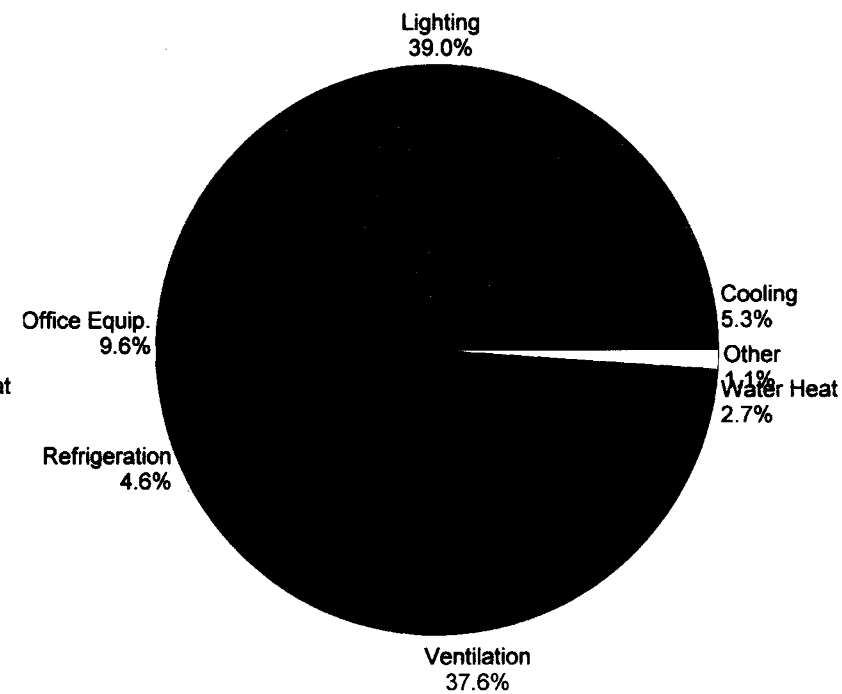
Total MW Savings: 4,079



'Other' includes Cooking(0.6%), Vending(0.4%)

Winter Peak

Total MW Savings: 2,206



'Other' includes Cooking(0.2%), Vending(0.9%)

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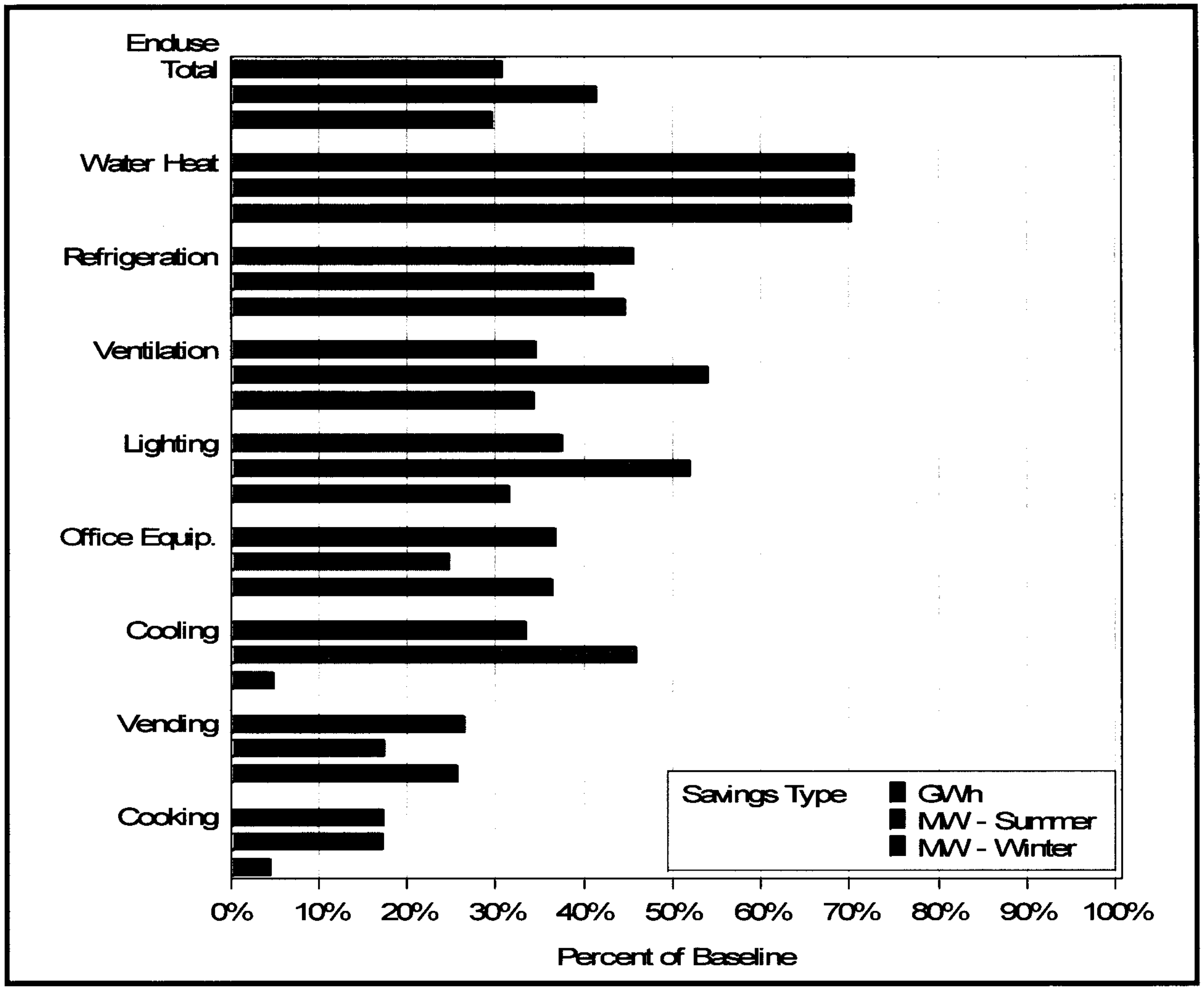
Commercial Technical Potential – Relative Savings



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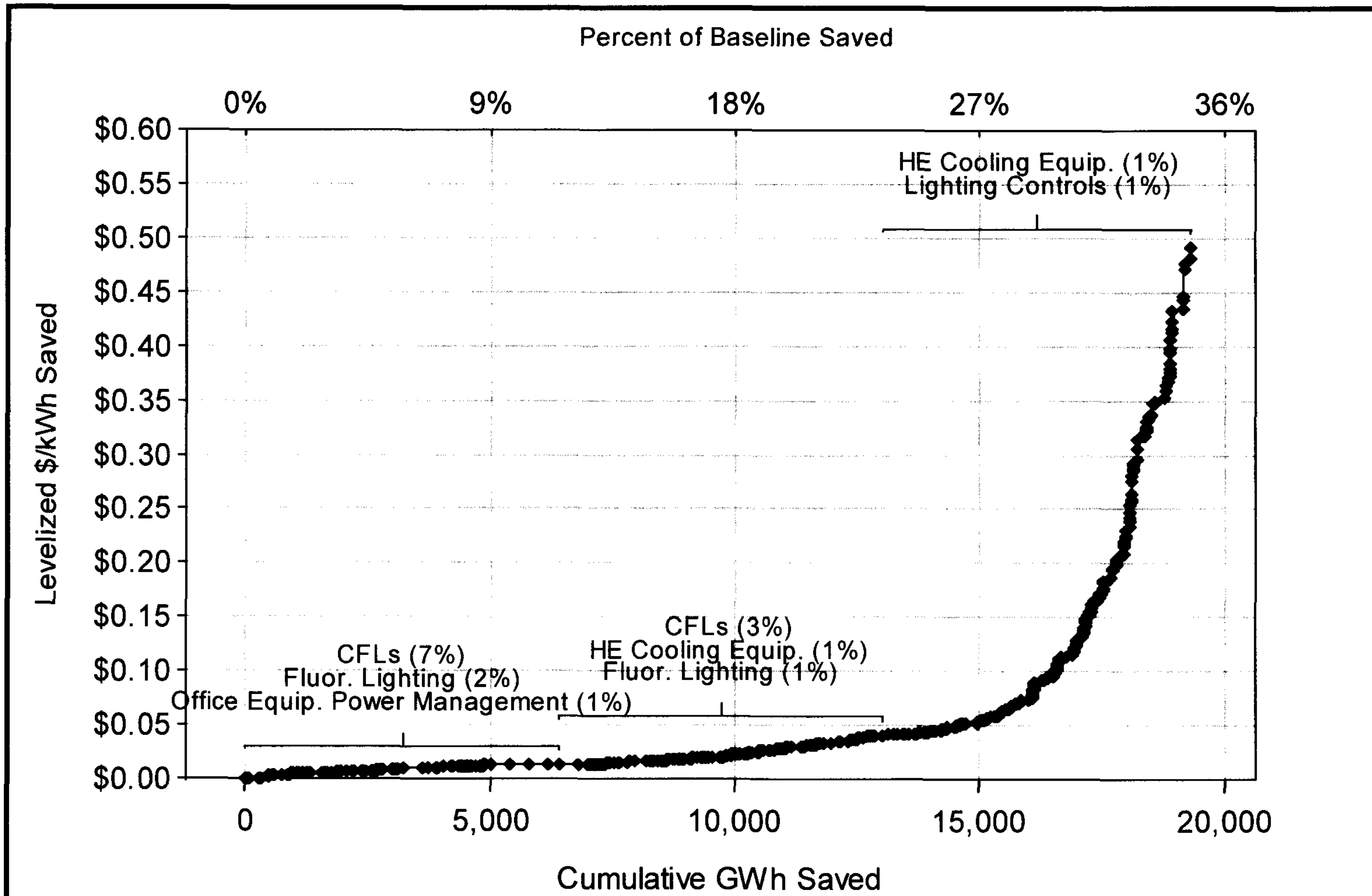
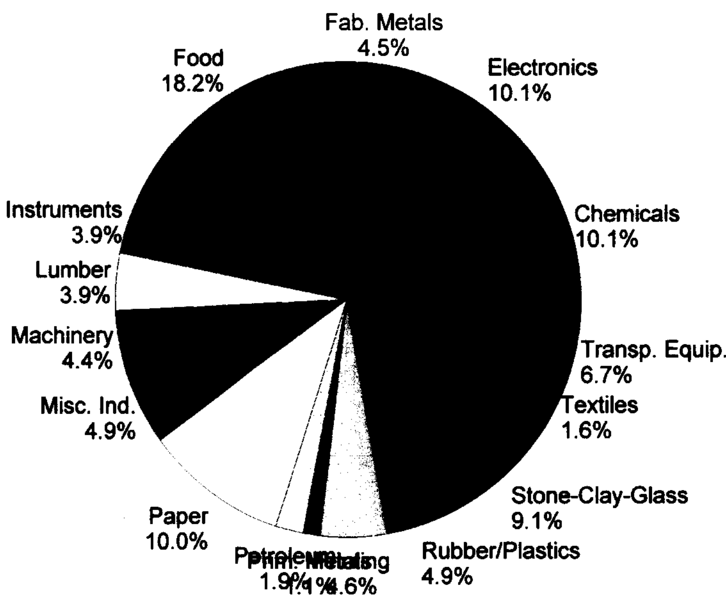
Commercial Efficiency Supply Curve

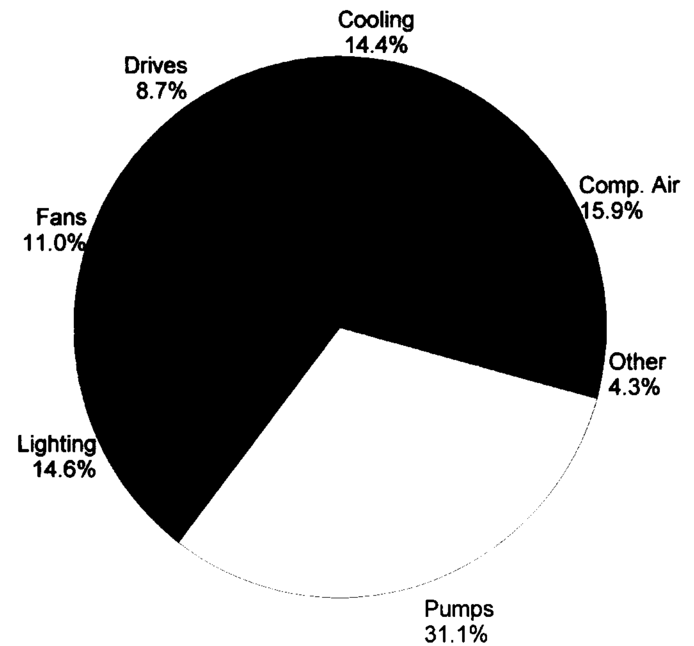


Industrial Technical Potential – Energy Savings

Total GWh Savings: 2,108



Total GWh Savings: 2,108

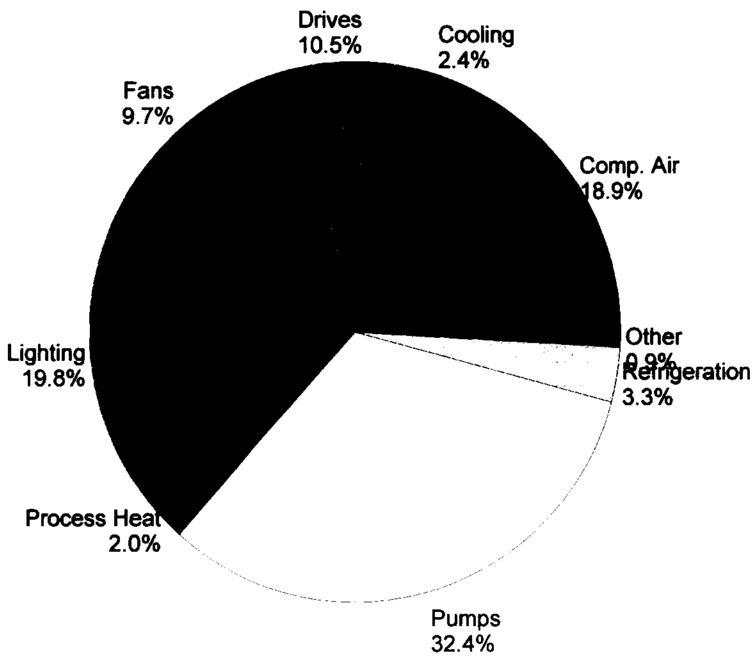


'Other' includes Other(0.0%), Other Process(0.8%), Process Heat(1.5%), Refrigeration(2.0%)

Industrial Technical Potential – Demand Savings

Summer Peak

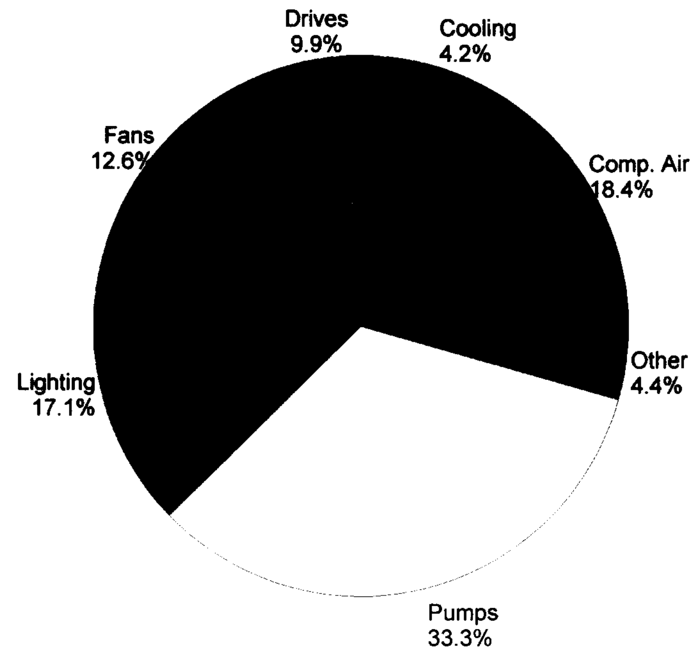
Total MW Savings: 221



'Other' includes Other(0.0%), Other Process(0.9%)

Winter Peak

Total MW Savings: 226



'Other' includes Other(0.0%), Other Process(0.8%), Process Heat(2.0%), Refrigeration(1.7%)

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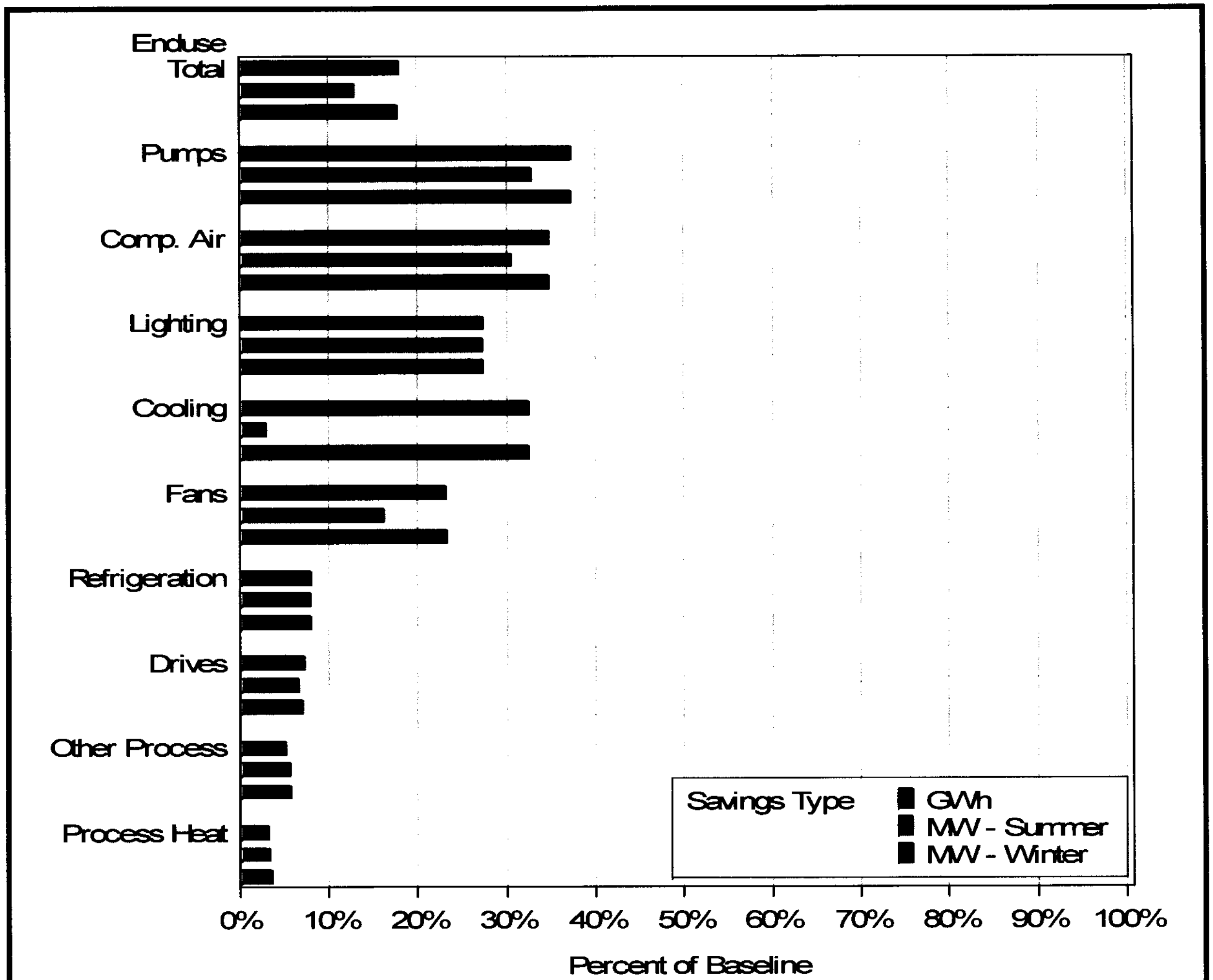
Industrial Technical Potential – Relative Savings



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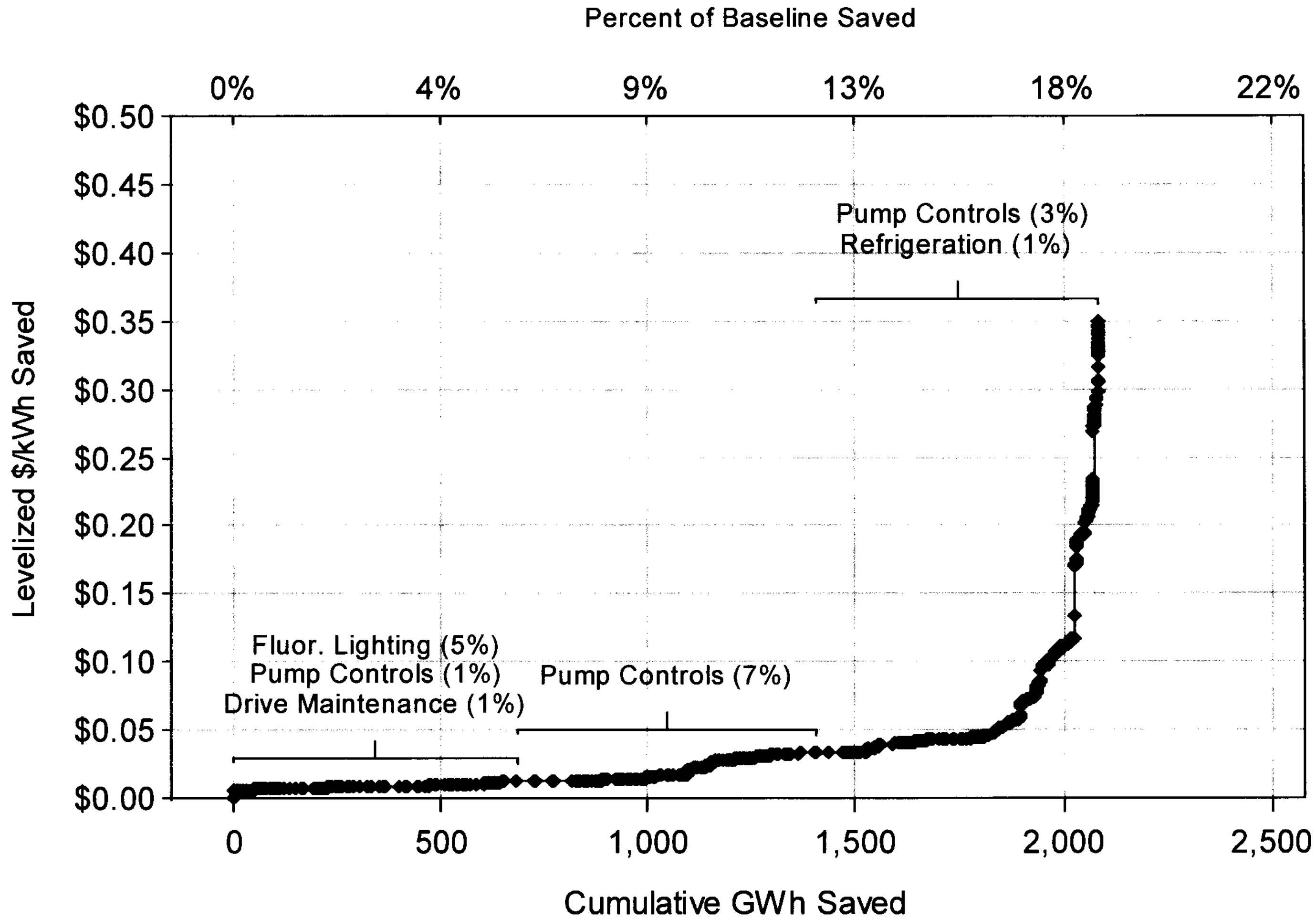
Industrial Efficiency Supply Curve



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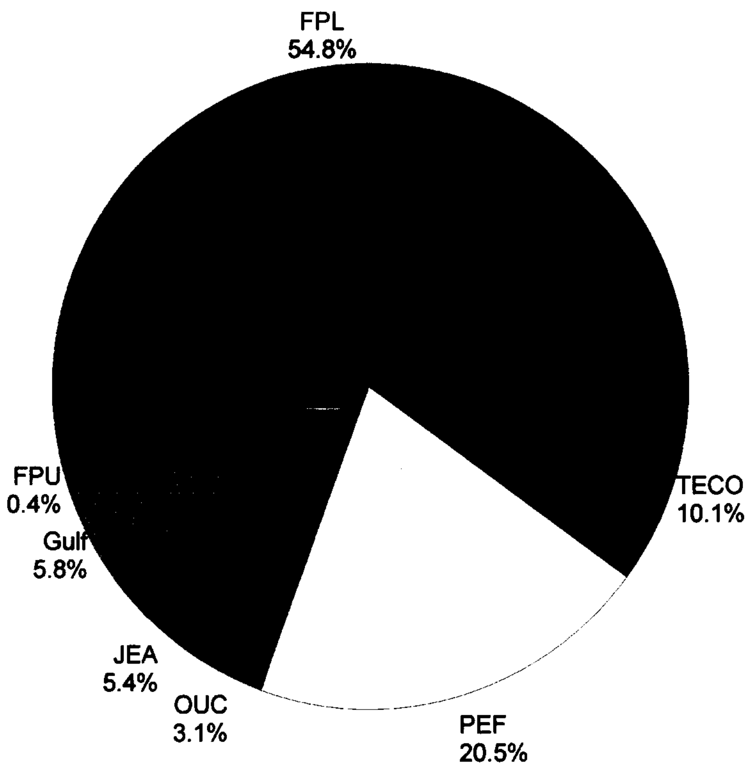
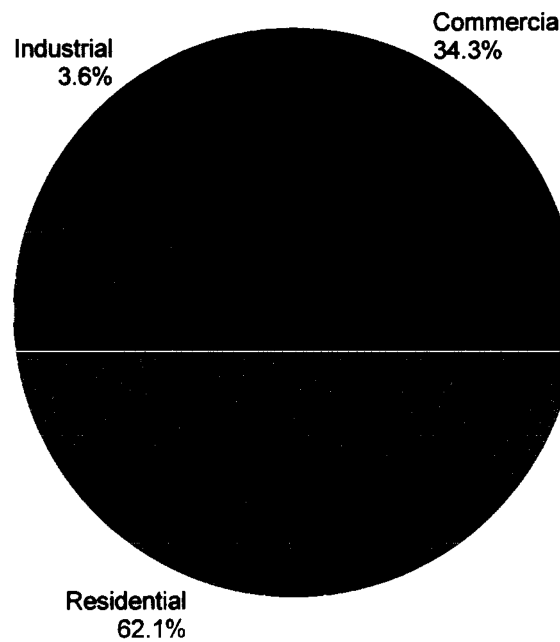
Total Technical Potential – Energy Savings

Total GWh Savings: 58,168



Total GWh Savings: 58,168



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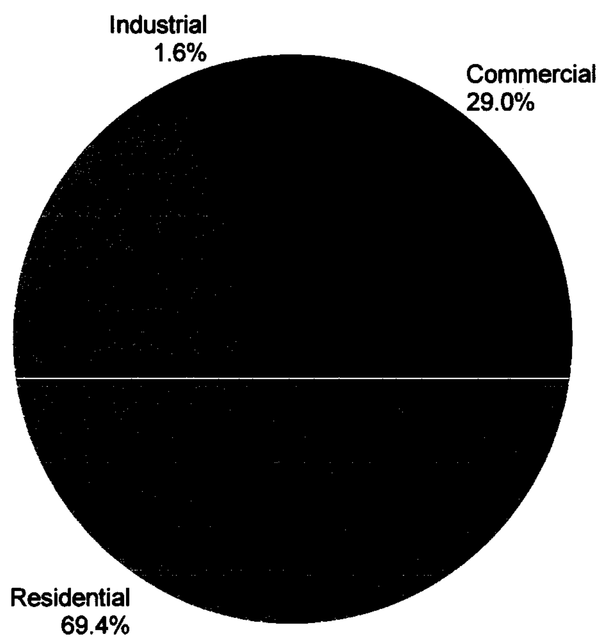
Total Technical Potential – Demand Savings

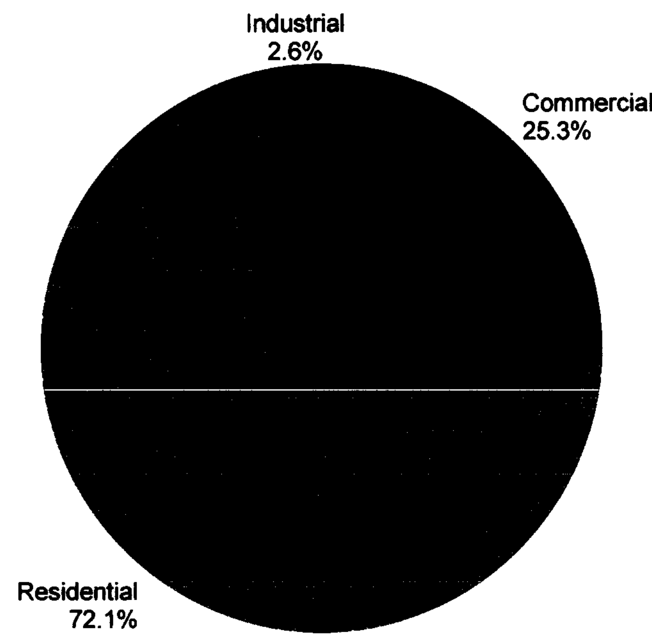
Summer Peak

Total MW Savings: 14,064



Winter Peak

Total MW Savings: 8,720



Total Technical Potential – Relative Savings

	Annual Energy			Summer System Peak			Winter System Peak		
	Baseline	Technical Potential		Baseline	Technical Potential		Baselin e	Technical Potential	
	(GWh)	(GWh)	*(%)*	(MW)	(MW)	*(%)*	(MW)	(MW)	*(%)*
Residential	94,745	36,136	*38.1%*	22,263	9,764	*43.9%*	22,728	6,288	*27.7%*
Commercial	65,051	19,924	*30.6%*	9,840	4,079	*41.5%*	7,490	2,206	*29.5%*
Industrial	11,877	2,108	*17.7%*	1,721	221	*12.8%*	1,289	226	*17.5%*
Total	**171,672**	**58,168**	***33.9%***	**33,825**	**14,064**	***41.6%***	**31,506**	**8,720**	***27.7%***

Perspectives on Technical Potential Results

- Results for 7 Florida utilities reflect:
  - HVAC and water heating nearly all-electric in FL residential sector
    - fuel share of natural gas insignificant outside of Gulf Power's service territory
  - Relative share of HVAC in total load and the relative number of HVAC measures in measure list
  - Wide scope of measure list
    - several advanced technologies included in analysis that are likely to face near-term constraints in availability and distributor/contractor capacity
    - e.g. SEER 19 Central Air Conditioners, SEER 17 Heat Pumps, Geothermal Heat Pumps, Heat Pump Water Heaters, Hybrid-Desiccant DX Systems, PV-powered Pool Pumps, etc.

EE Forecasting Uncertainties

- Type of uncertainty in EE potential studies:
  - Uncertainty in baseline data
    - End-use consumption, intensity, full load hours, etc.
    - Equipment saturation and unit density
  - Uncertainty in measure data
    - Measure saturation, measure penetration rates
    - Measure costs and measure savings
  - Uncertainty in forecasting
    - Changes and growth in total units, end-use shares
- This study leverages extensive efforts of FL utilities and research groups (e.g. FSEC & universities) to quantify and understand end-use energy consumption and peak demand and corresponding EE opportunities in Florida
  - Less uncertainty in baseline and measure data than in many recent studies

Technical Potential for Peak Savings from Demand Response

Demand Response (DR) - Definition

Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized

- Federal Energy Regulatory Commission

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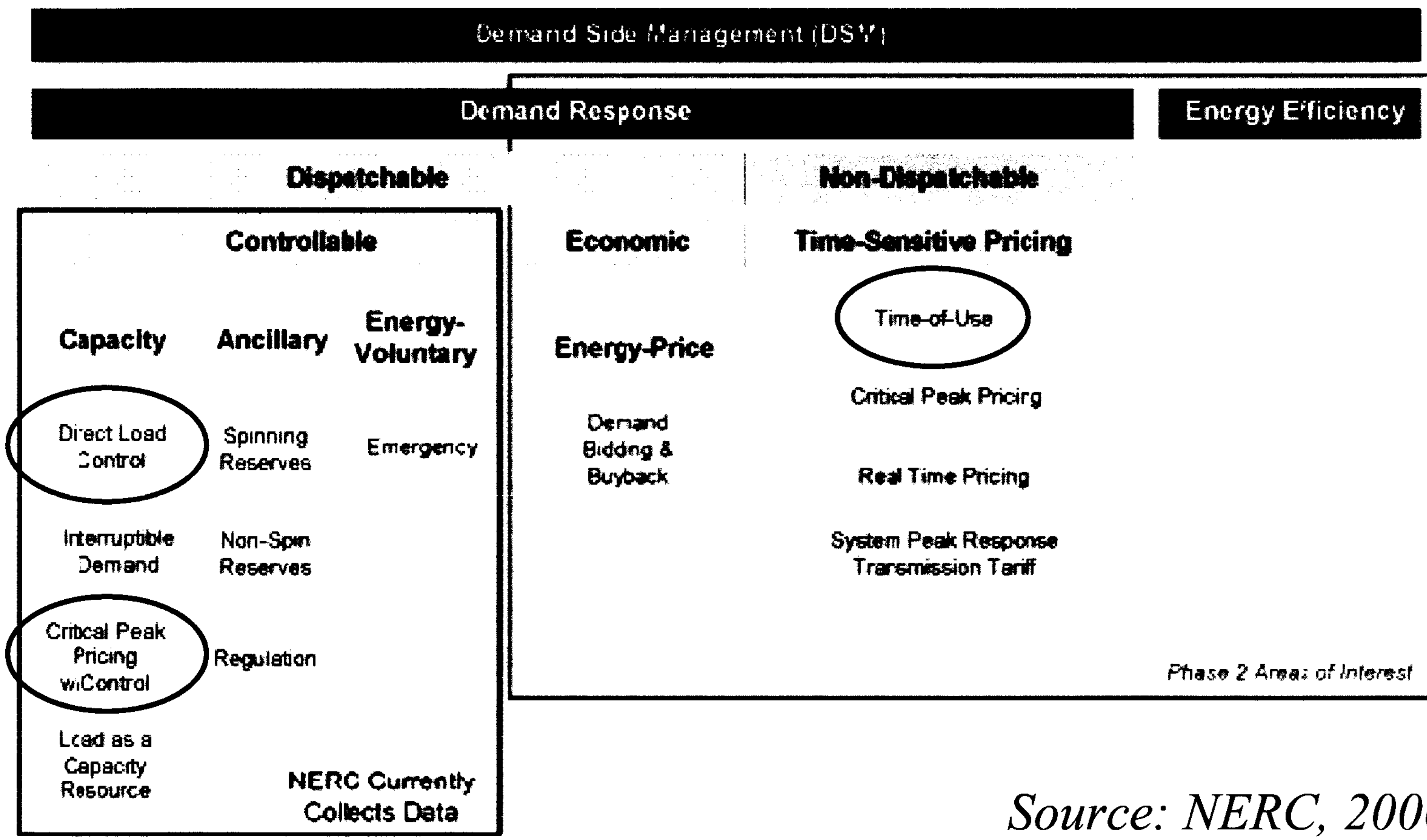
Demand Response – Program Typology



Source: NERC, 2006

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Difference Between EE and DR

- Nature of customer participation
  - DR: Two-step process
    - Enrolling in program
    - Reducing load in response to events and/or incentives
  - EE: One-step process
    - Whether to invest in more efficient technology/process
- Costs/Benefits
  - DR: Depend on customer behavior in response to events and/or incentives
  - EE: Depend on technical characteristics of equipment
- Predictability of costs/benefits
  - DR: Relatively less predictable since size of load reduction for each customer may vary from event to event
  - EE: Relatively more predictable than DR

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Key Factors Determining Technical Potential of DR

- Communication Technology
  - How event and/or price information is sent from utility/system operator to the customers?
  - Alternatives: AMI, 2-way, 1-way
- DR-enabling Technologies
  - Switches for cycling or shedding space cooling/heating
  - Smart thermostats of space cooling/heating
  - Automated control strategies for various end-uses
- Tariffs (or Pricing)
  - Flat rate, Time-of-use, Critical peak, Hourly

DR Potential Estimation Methodology

- Engineering Approach
  - Technical Potential
    - Availability of communication networks, DR technology, tariffs
    - **DOES NOT** include economic, policy, and other considerations
  - Economic Potential
    - Cost-benefit analysis
  - Achievable Potential
    - Other barriers: customer awareness, technical assistance
- Economic Approach
  - Price elasticity of demand

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DR Technical Potential – Core Equation

	Baseline Data			*DR Measure Data*			
Technical Potential= (MW)	Units of Consumption (Households)	End-use Tech Saturation (%)	Base Tech EUI (kW per Household)	Communication Network (%)	Tariff (%)	DR Technology (%)	Demand Reduction (%)

- Baseline data used same as that developed for EE analysis
- DR measure data developed through an iterative process between Itron and the FL utilities
  - Itron developed *"straw-man"* values for each key parameter based on a review of current DR literature and FL utility program data
  - Straw-man values were modified based on feedback from utilities and incorporated into Itron forecast
  - Draft results circulated for review; comments incorporated in results presented here

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DR Technical Potential – Key Assumptions

In Year 2018…

- All customers on **Advanced Metering Infrastructure** (AMI)
- The following **DR control technologies** are available to respective customer classes:
  - Residential
    - Space cooling/heating – switches (both cycling and shedding), smart thermostats, in-home displays with pre-set control strategies
    - Water heating and pool systems – on/off switching via Zigbee, in-home displays
    - All other end-uses – in-home displays
  - Commercial and Industrial
    - HVAC – automated control, direct control
    - Lighting and other non-process loads – automated control
- Subset of customers on **Critical Peak Pricing (CPP) tariffs**, rest on flat rates
  - "High" scenario – Higher penetration of dynamic pricing tariffs
  - "Low" scenario – Lower penetration of dynamic pricing tariffs

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Availability of DR Technology (in 2018)

RESIDENTIAL CUSTOMERS	Space Cooling/ Heating	Water heating	Pools	Other
Switch – Cycling	20%	NA	NA	NA
Switch – Shedding	10%	NA	NA	NA
Smart Thermostat	50%	NA	NA	NA
On-Off Via Zigbee	NA	60%	10%	NA
In-home displays, Pre-set strategies	10%	10%	10%	10%
NONE	10%	30%	80%	90%

C&I CUSTOMERS	HVAC	Lighting	Other
Automated Control Strategies	60%	60%	60%
Direct Load Control System	30%	NA	NA
NONE	10%	40%	40%

Note: These are default values. Itron incorporated utility-specific refinements where requested

Demand Reduction Potential (in 2018)

RESIDENTIAL CUSTOMERS	Space Cooling/ Heating	Water heating	Pools	Other
Switch – Cycling	31%	NA	NA	NA
Switch – Shedding	100%	NA	NA	NA
Smart Thermostat	14%	NA	NA	NA
On-Off Via Zigbee	NA	90%	90%	NA
In-home displays, Pre-set strategies	10%	10%	10%	10%

C&I CUSTOMERS	HVAC	Lighting	Other
Automated Control Strategies	20%	20%	20%
Direct Load Control System	10%	NA	NA

Note: These are default values. Itron incorporated utility-specific refinements where requested

DR Technology and Applicable Tariff (in 2018)

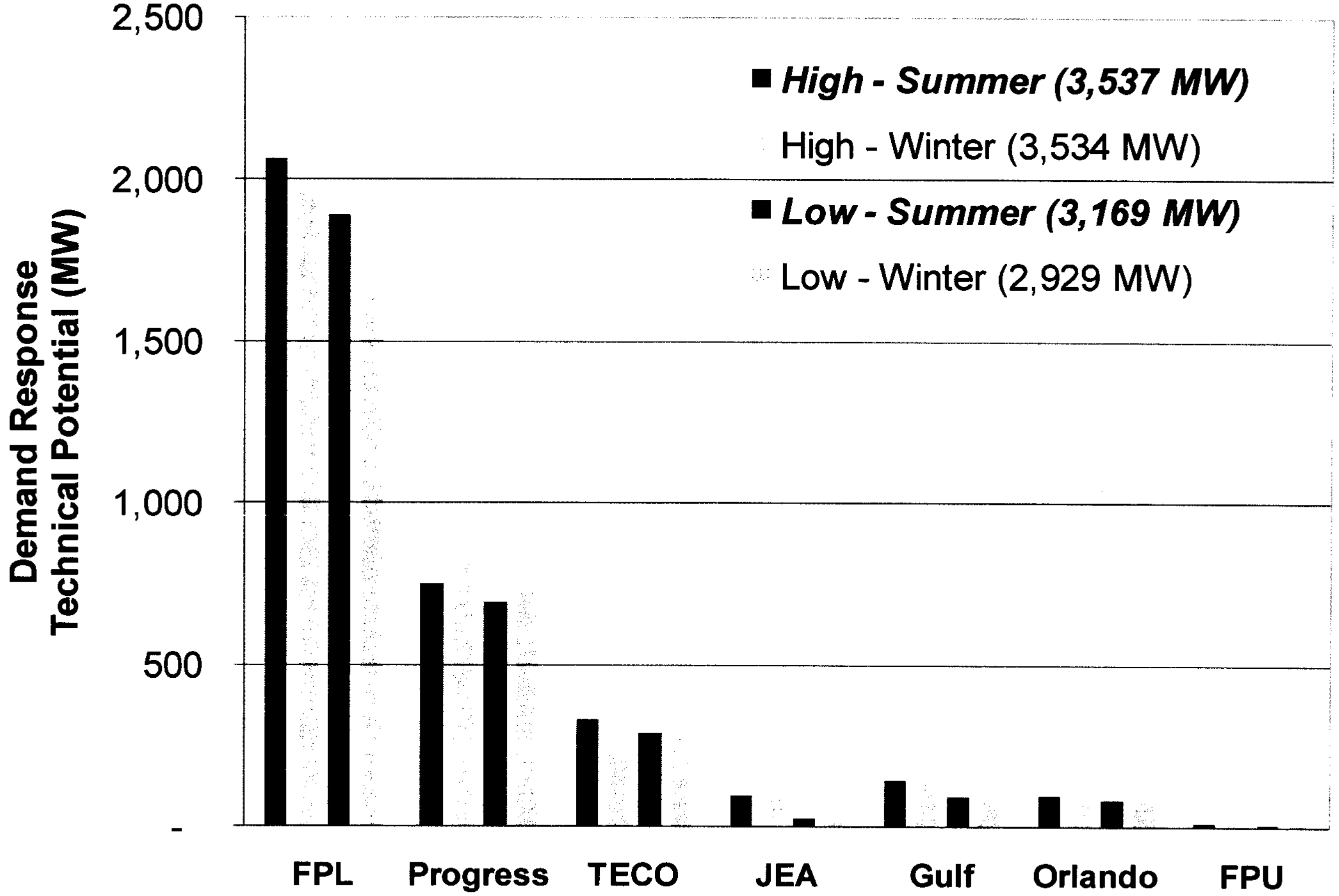
DR Control Technology	**Tariff**
Residential	
A/C Cycling	Flat rate
A/C Shedding	Flat rate
Smart Thermostats for A/C	CPP
On-Off Switching via Zigby for water heating and pool systems	CPP
In-home displays and pre-set control strategies	CPP
Commercial	
Automated control strategies	CPP
Direct load control system	Flat rate
Industrial	
Automated control strategies	CPP
Direct load control system	Flat rate

Dynamic Pricing Scenarios (in 2018)

	Flat Rate	Dynamic Pricing Tariff: Critical Peak	TOTAL
Low penetration of dynamic pricing tariffs			
Residential	90%	10%	100%
Commercial	90%	10%	100%
Industrial	90%	10%	100%
High penetration of dynamic pricing tariffs			
Residential	50%	50%	100%
Commercial	65%	35%	100%
Industrial	65%	35%	100%

Note: These are default values. Itron incorporated utility-specific refinements where requested

DR Technical Potential – All Customers



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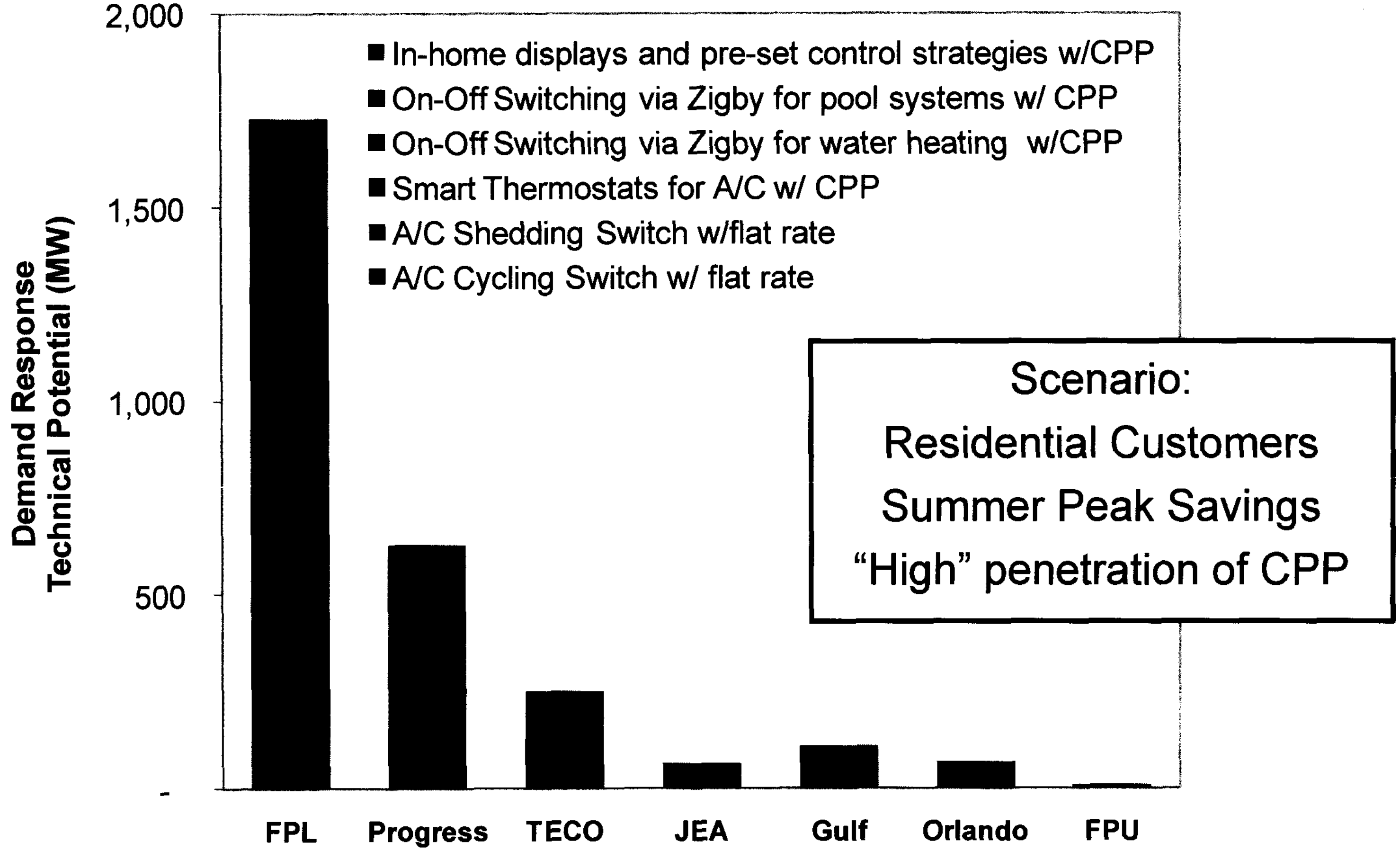
DR Technical Potential – Residential Customers



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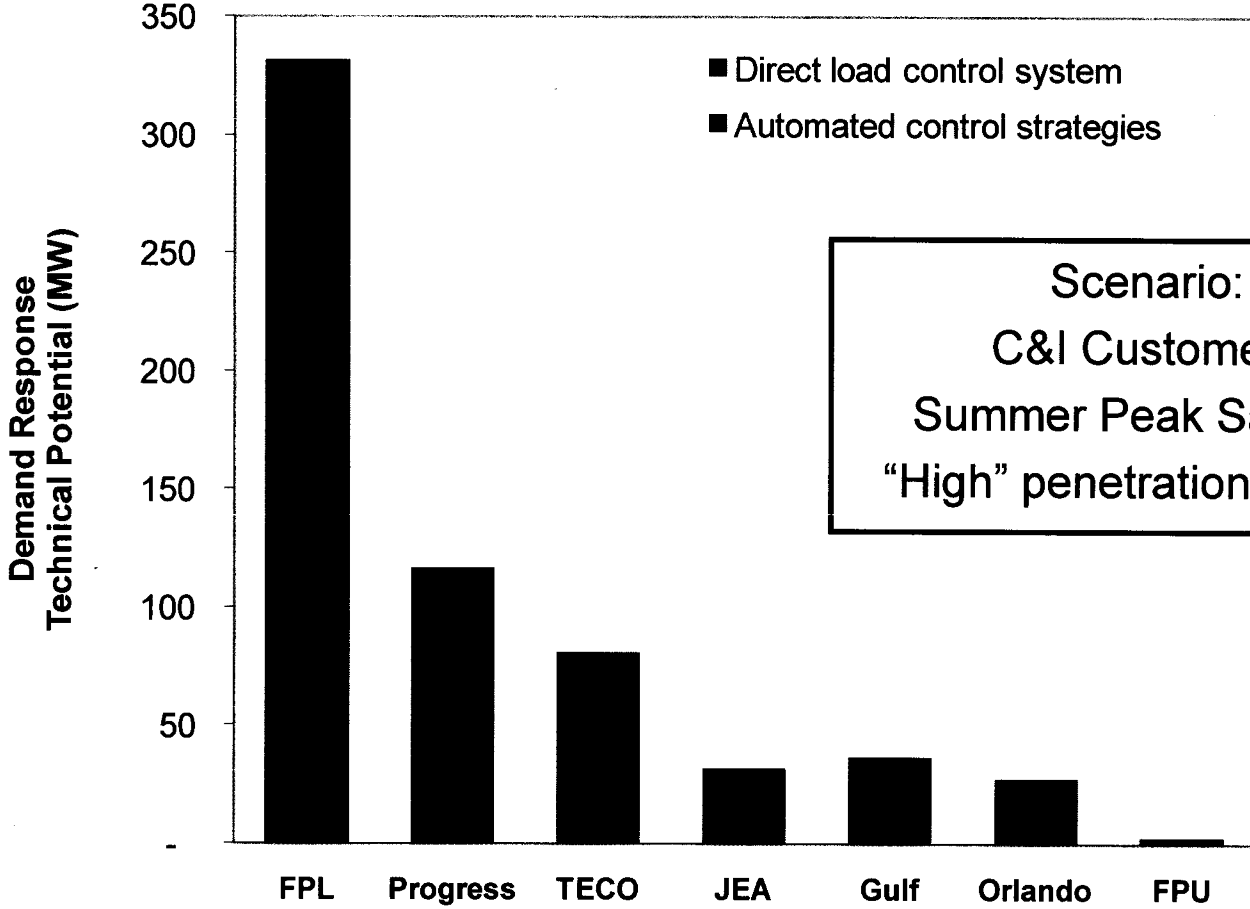
DR Technical Potential – C&I Customers



Scenario:
C&I Customers
Summer Peak Savings
"High" penetration of CPP

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Perspectives on DR Technical Potential

- DR Technical Potential ranges between ***5% to 6.5%*** of annual peak demand
  - Space cooling and heating have the largest potential peak demand savings among all end-uses

- Key caveats of current analysis:
  - Use of onsite generation as way of responding to DR events or price signals is NOT included in the analysis
  - Estimated DR potential is incremental to interruptible
  - The direct load control programs targeted to C&I customers assume an average 10% reduction in peak demand
  - Assumptions about availability of smart thermostats, Zigbee systems, and in-home displays with pre-set control strategies represent ONE scenario
  - There are large uncertainties associated with customer behavior, program design, and tariff (both structure and level) that can lead to wide range in actual load reductions from event to event

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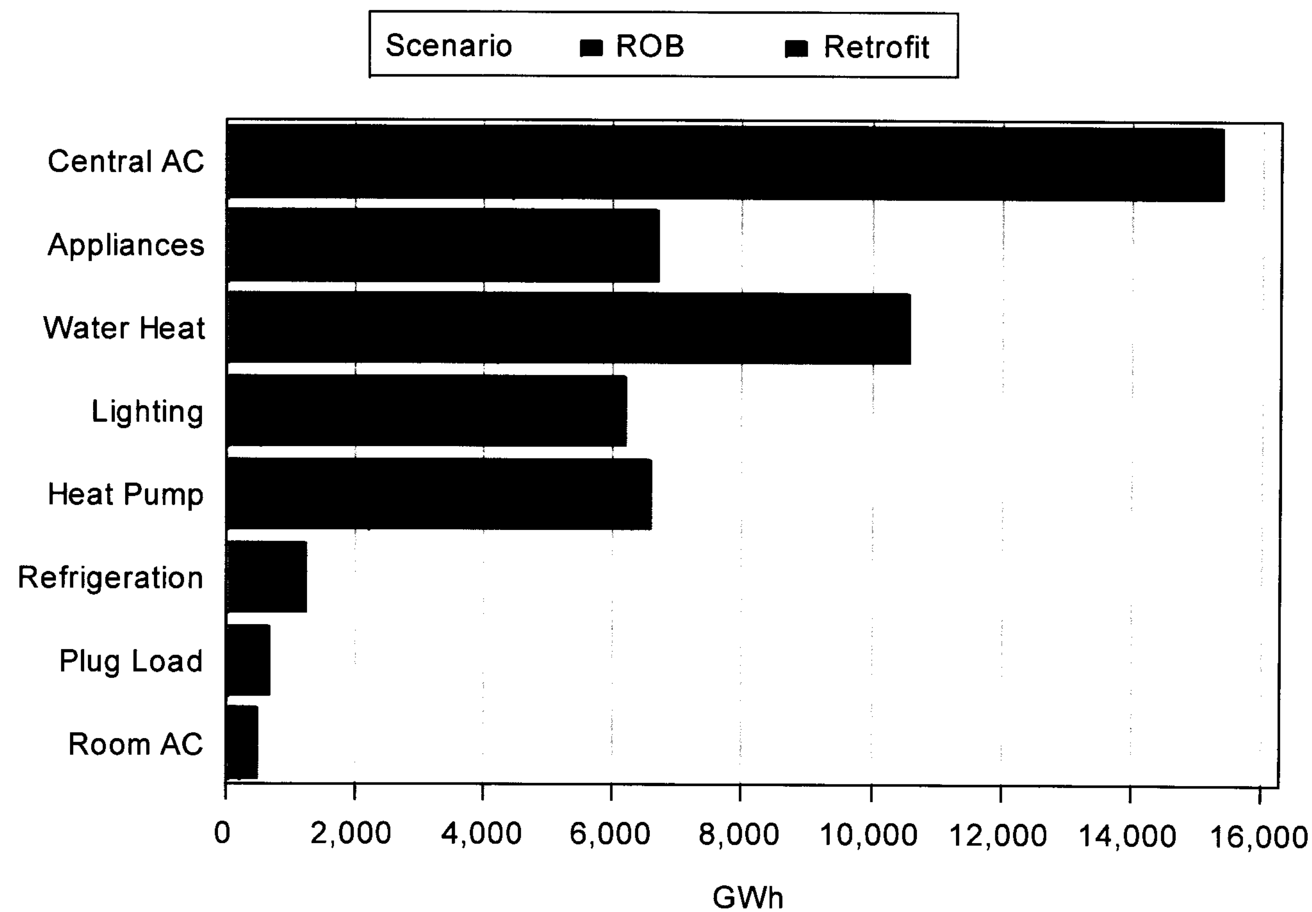
Appendix Slides

Residential Technical Potential by Measure Type



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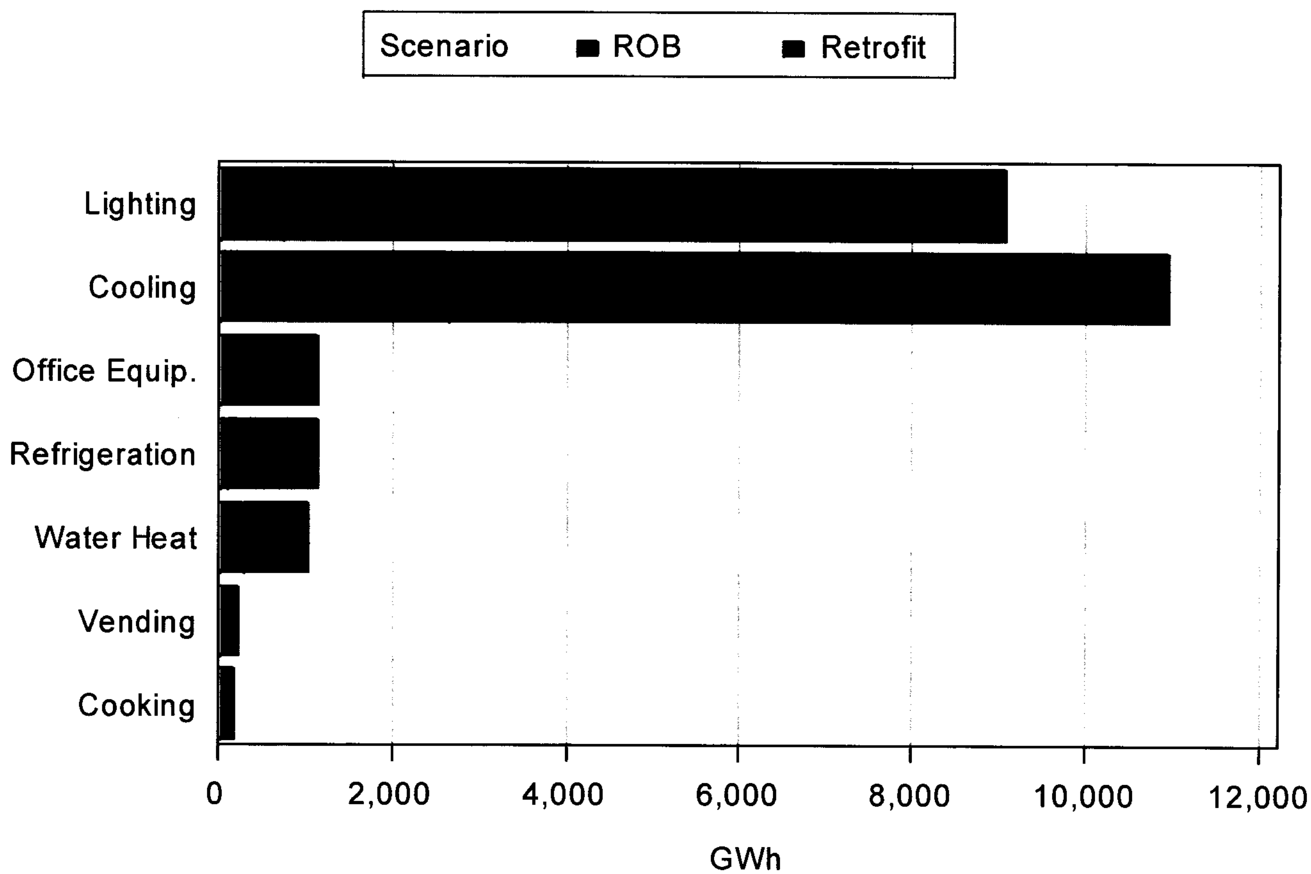
Commercial Technical Potential by End Use



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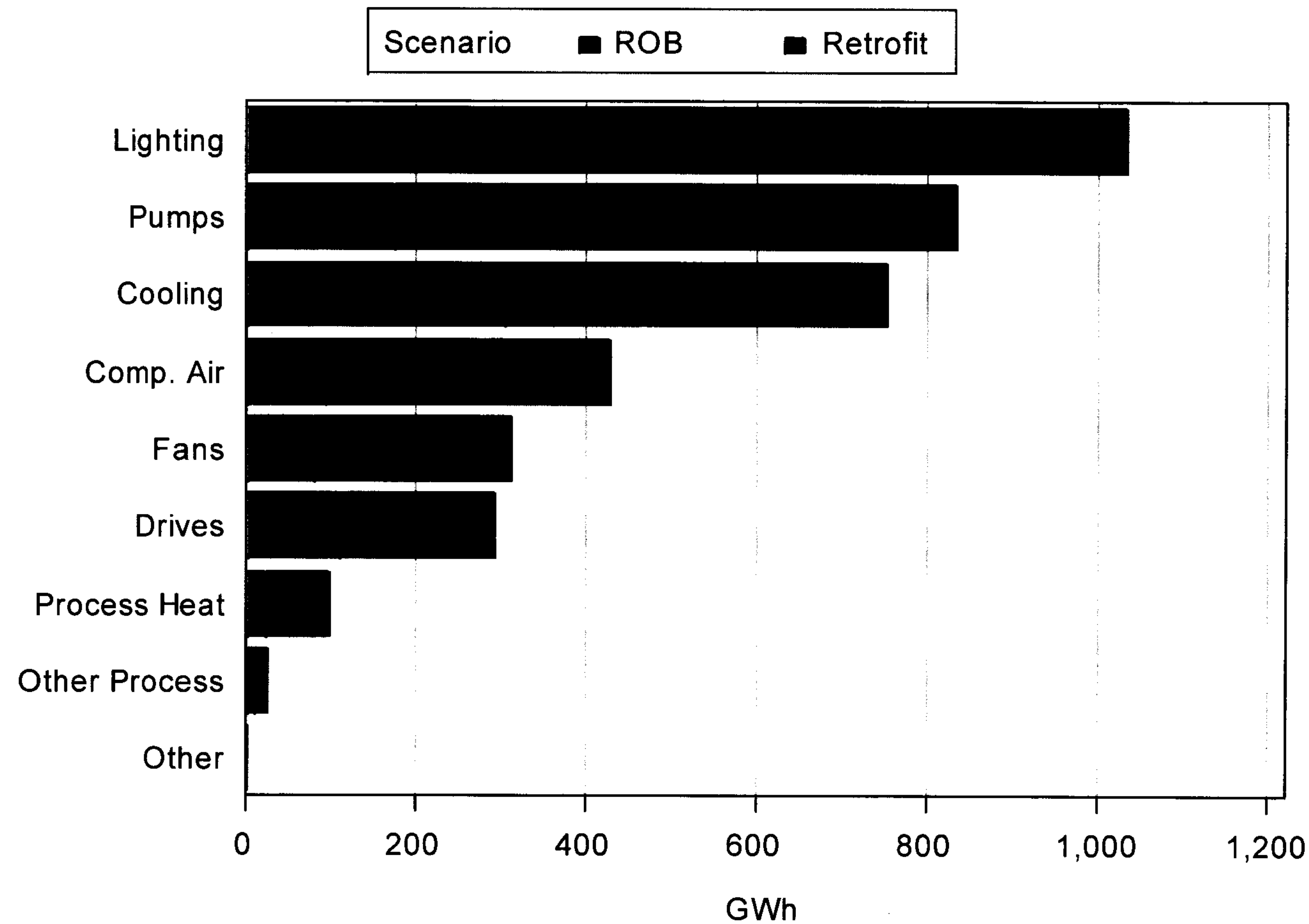
Industrial Technical Potential by End Use



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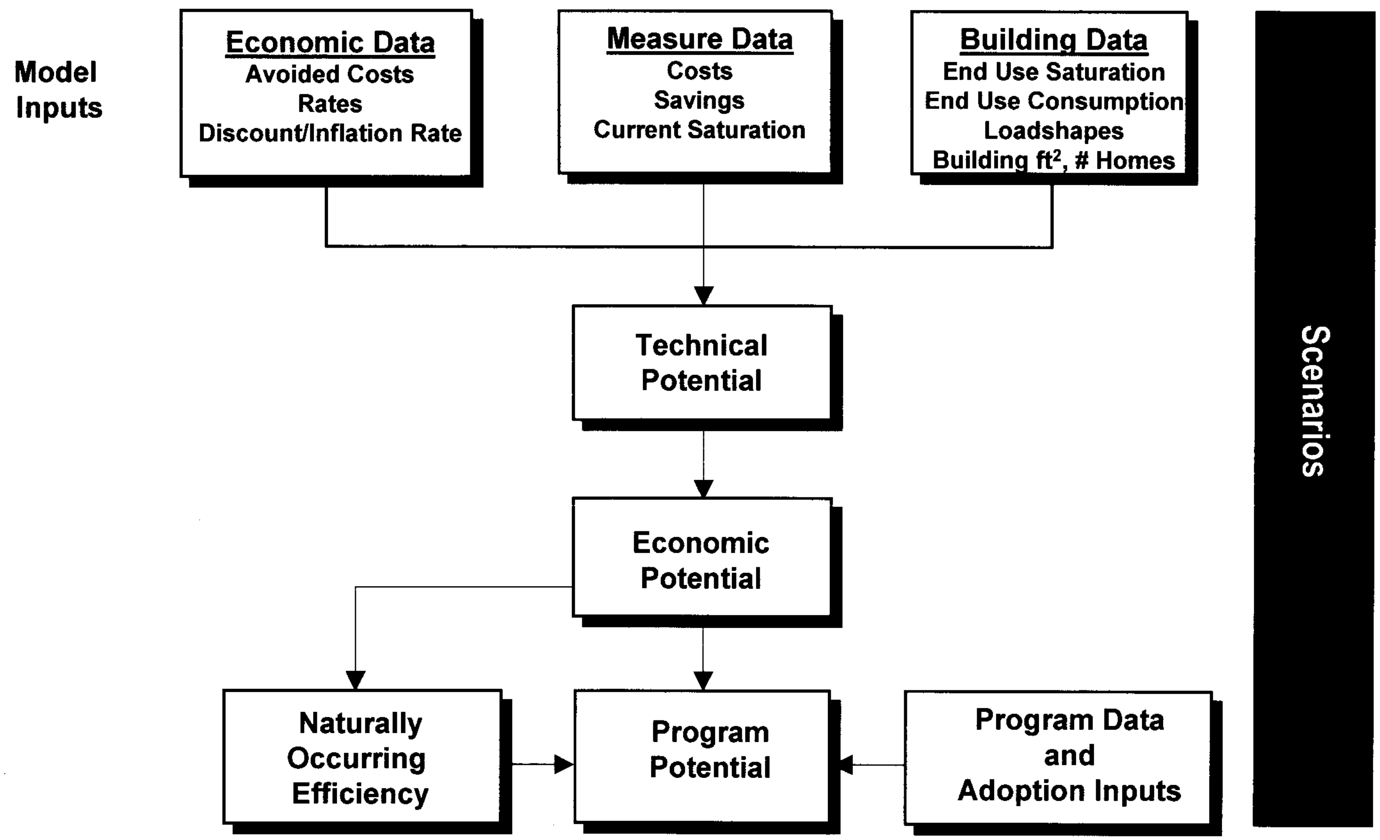
Overview of DSM ASSYST Modeling Process



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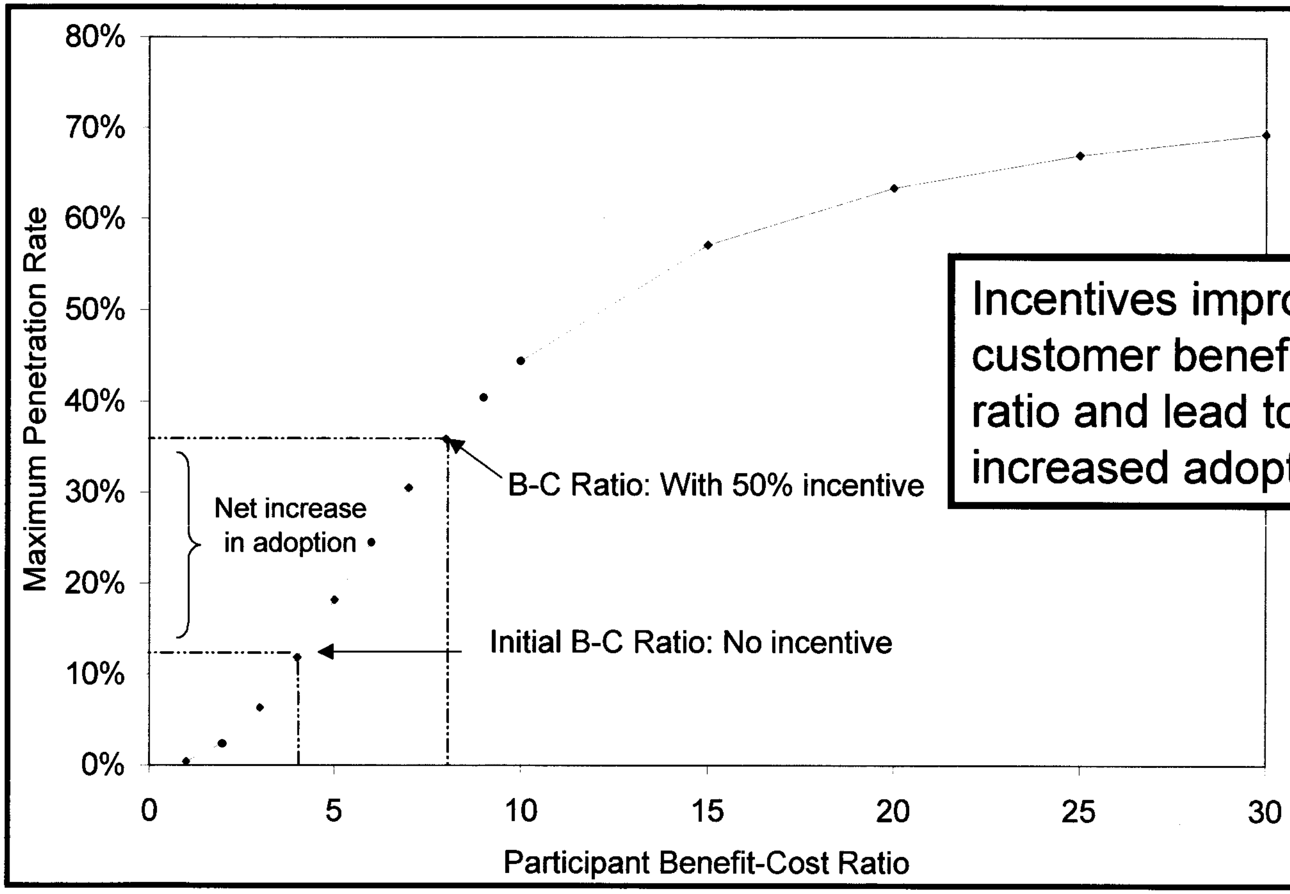
Achievable Potential Scenarios

- **Technical potential**: the complete penetration of all measures analyzed in applications where they were deemed technically feasible from an engineering perspective
- **Economic potential**: the technical potential of those energy conservation measures that are cost-effective when compared to supply-side alternatives
- **Achievable potential**: the amount of savings that would occur in response to specific program funding and measure incentive levels
- **Naturally occurring potential**: the amount of savings estimated to occur as a result of normal market forces, that is, in the absence of any utility or governmental intervention

Modeling Program Penetration

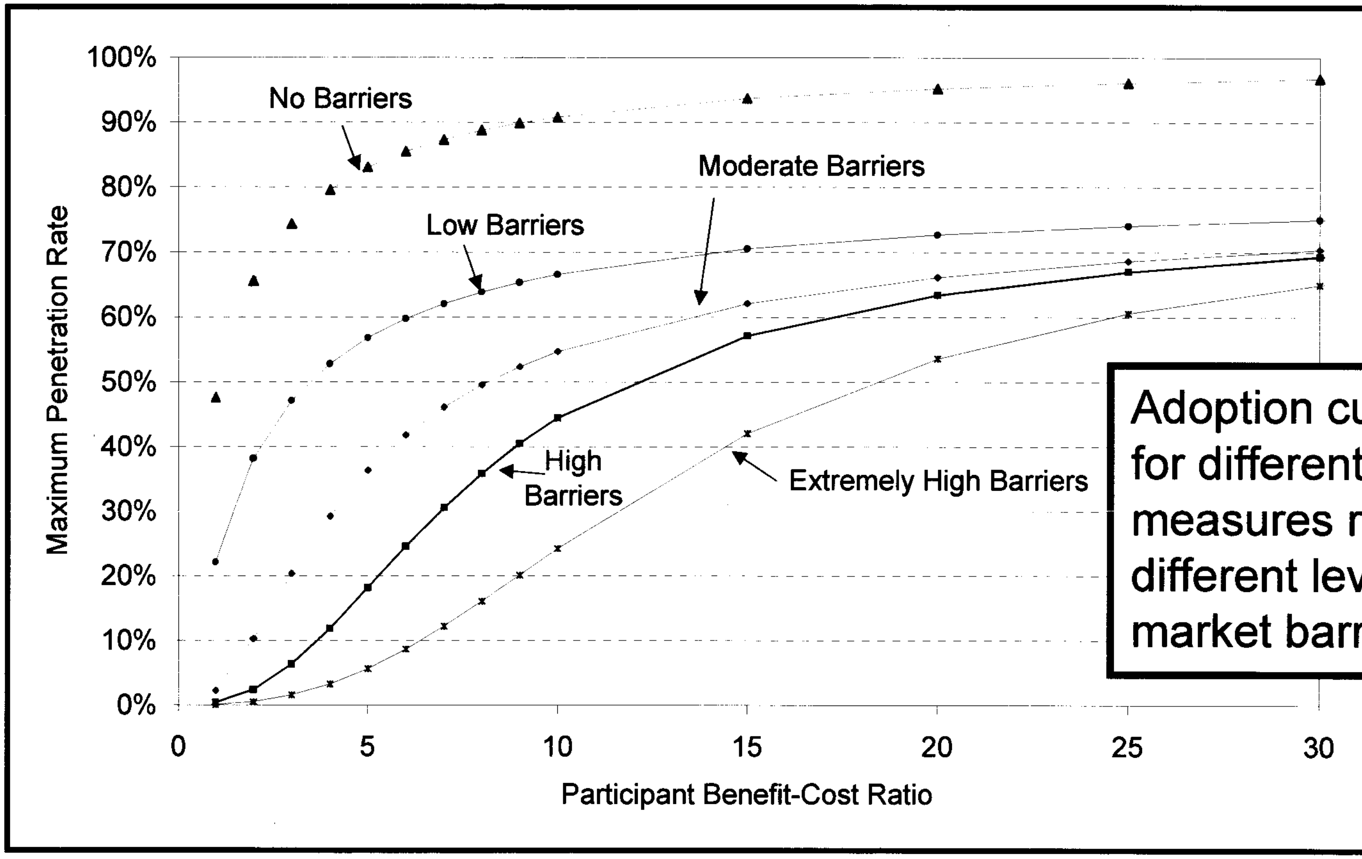
- Availability
  - Cost effectiveness
  - Equipment turnover rates
- Awareness
  - Measure economics
  - Market barriers
  - Initial awareness level and decay
  - Program marketing expenditures and effectiveness
- Adoption
  - Measure economics
  - Market barriers
  - Incentive levels and budgets

Incentive Modeling Process



Incentives improve the customer benefit-cost ratio and lead to increased adoption

Examples of EE Adoption Curves



Adoption curves for different EE measures reflect different levels of market barriers

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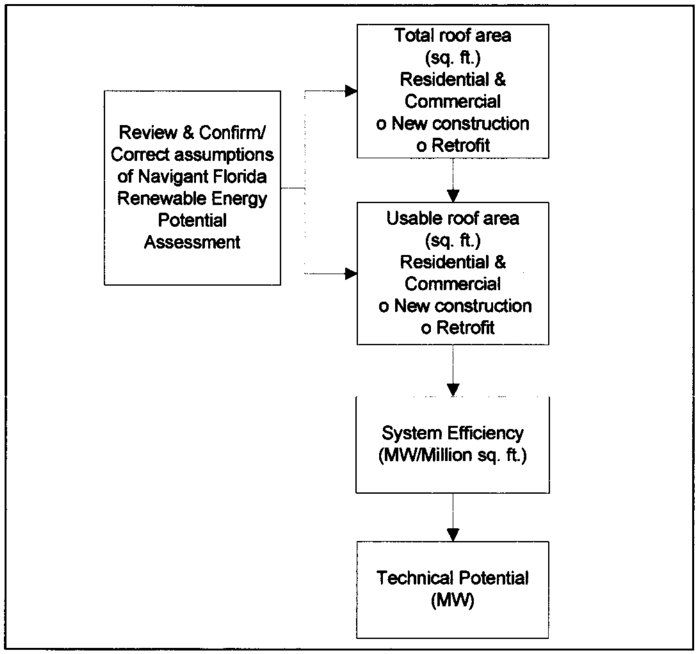
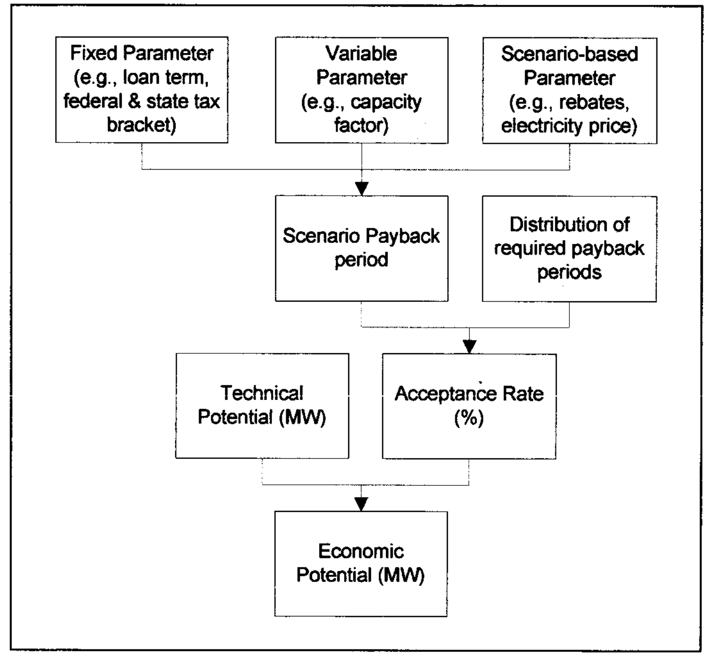
PV Potential Modeling - Methodology Overview

Technical Potential



Economic Potential



Results will be presented spatially and per Florida IOU

PV Technical Potential Methodology

- Navigant:
  - Determined the technical potential from a combination of PV access factors (determined from usable roof area for both residential and commercial buildings) & estimated future system efficiencies.
  - Included roof mounted and ground mounted systems
- Itron:
  - Use similar method to Navigant but will only include roof mounted systems
  - In addition:
    - Results presented in an ARC GIS map per IOU service territory
    - Impacts will be reported as ranges
      - Key sources of uncertainty will be addressed in a discussion

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PV Economic Potential Methodology

- Navigant:
  - Reported typical values of key economic parameters
- Itron:
  - Financial & PV system parameter assumptions will be combined to develop an estimate for each scenario payback period
  - Scenario-based parameters include capital costs, incentives, feed-in tariffs, and retail rates. Values will differ based on the scenario.
  - Economic potential is calculated by multiplying the net technical potential by the acceptance rate and represents the cost-effective portion
    - The acceptance rate is based on the distribution of the required payback period

FPSC Workshop on Commission Review of Numeric Conservation Goals

December 15, 2008

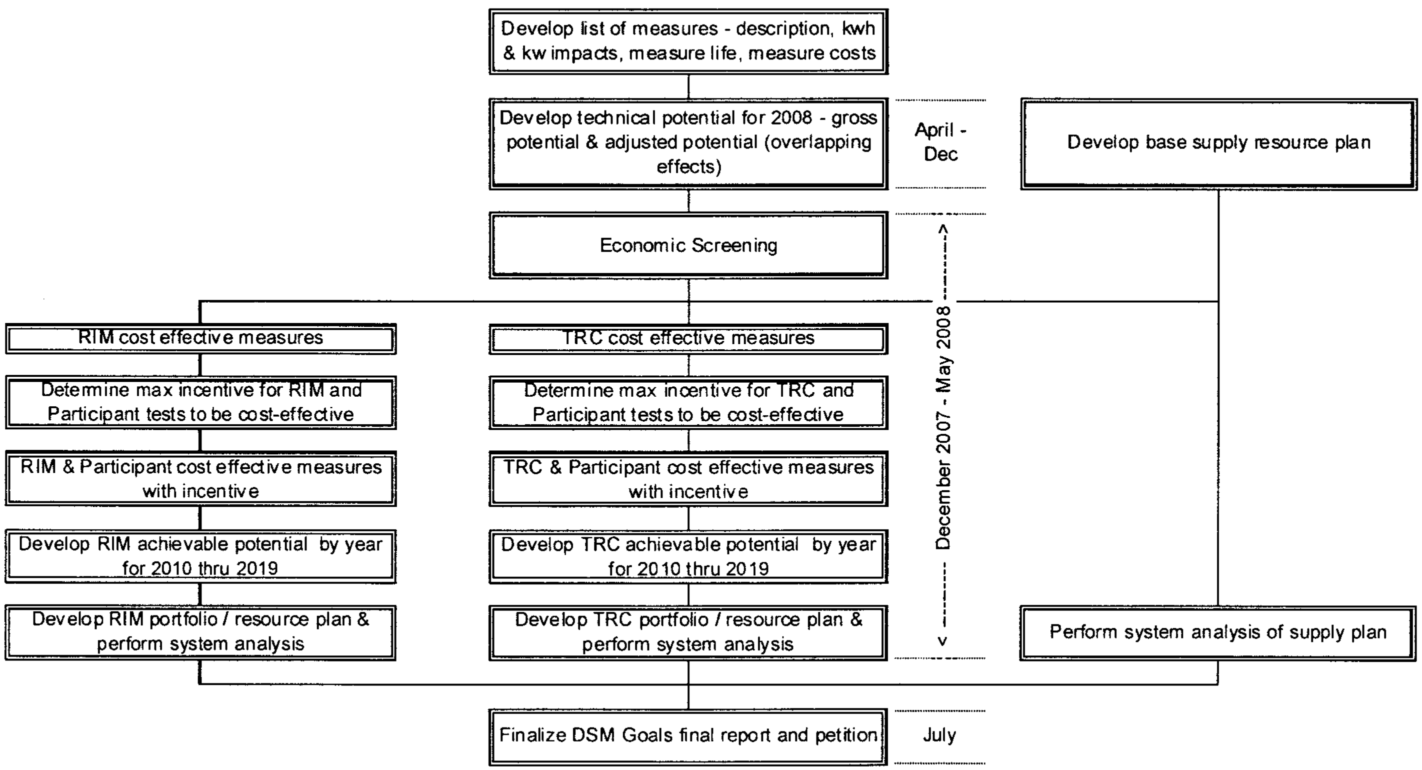
Economic and Achievable Potential

- Collaborative Status
  - Original Memo of Understanding (MOU) between Gulf Power, Tampa Electric, Progress Energy Florida, Florida Public Utilities, Orlando Utilities Commission, JEA, Florida Power & Light, Southern Alliance for Clean Energy and Natural Resources Defense Council
  - Original MOU addresses Technical Potential study
  - MOU amended to address economic and achievable potential
  - All parties have agreed to amended MOU
  - Signatures are in progress

Economic and Achievable Potential

- Economic and achievable potential analysis
  - Updated statement of work developed by Itron/KEMA
  - Statement of work currently being reviewed by collaborative members
  - Statement of work should be finalized by December 19, 2008
- Goals setting schedule
  - Economic potential is scheduled to be done in January 2009
  - Achievable potential is scheduled to be done in April 2009
  - May 2009 will be used to finalize DSM goals and to start preparation of DSM Goals filing
  - Proposed schedule is consistent with Itron/KEMA scope of work schedule

DSM Goals Schedule



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