

# Electric DSM Planning and Design: The Colorado Regulatory Experience

**Jeff Ackermann**  
**Commission Advisor, Energy Efficiency/DSM**  
**Colorado Department of**  
**Regulatory Agencies**  
Public Utilities Commission  
1560 Broadway, Suite 250  
Denver, CO 80202  
P 303.894.2856 | F 303.894.2065  
Email: [jeffrey.ackermann@dora.state.co.us](mailto:jeffrey.ackermann@dora.state.co.us)



# Presentation Objectives:

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1. Walk Through the Decisions & Steps of DSM Planning
2. Propose Questions/Issues for Consideration by the Kingdom of Jordan RE: Pursuing a DSM Strategy



# Main Messages: Jordan-Colorado Partnership (From May 2009 presentation)

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1. **Components of DSM Success:**
  - a) Financial Incentives – customer & utility
  - b) Clear (usually singular) objectives – growth; load; societal
  - c) Adequate administrative structure – utility and market
2. **Reasonable Expectations of DSM:**
  - a) 1% reduction in system growth (energy) – USA markets
  - b) Treat DSM as a resource in planning – (financial metrics)
  - c) Coordinate utility DSM with other (non-utility) EE efforts
3. **Challenges:**
  - a) Measuring & Verifying DSM Results [impacts 2(b), above]
  - b) Consumers are not as rational as we want them to be
  - c) Utility culture (business model) and utility admin of DSM

NOTE: Some additional messages about Demand Response (later)



# Why Pursue DSM? (Identifying the Objectives)

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- Resource Planning Benefits:
  - Minimize revenue requirements
  - Mitigate system growth
- Public Policy Objectives:
  - Reduce electric system carbon emissions
  - Encourage energy efficiency/conservation
  - Economic benefits: employment; investment
- Utility Business Objectives:
  - Minimize average rates (or increases)
  - Increase profitability
  - Increase customer satisfaction



# Measuring DSM: Relates to Objective(s)

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1. As part of Resource Planning:
  - a) Revenue Requirements (\$/...)
  - b) Cost-effectiveness of investment (e.g., a TRC test)
2. As a Public Policy:
  - a) Tons CO<sub>2</sub>
  - b) Usage/customer (kWh)
  - c) Jobs created
3. As a Utility Business Practice:
  - a) Net rate impact, over time
  - b) Earnings/share
  - c) Customer satisfaction ratings



# Objectives of DSM in Colorado

- State Statute:
  - Incorporate DSM within resource planning
  - Establish specific (minimum) energy and demand reduction targets
- Measurement Criteria:
  - Net Present Value of Revenue Requirements
  - Cost-Effectiveness



HOUSE BILL 07-1037

BY REPRESENTATIVE(S) Levy, Borodkin, Buescher, Carroll M., Fischer, Frangas, Green, Hodge, Jahn, Kefalas, Kerr A., Labuda, McGihon, Merrifield, Peniston, Primavera, Rice, Solano, and Todd; also SENATOR(S) Fitz-Gerald, Boyd, Gordon, Groff, Romer, Schwartz, Shaffer, Tochtrop, Tupa, Williams, and Windels.

CONCERNING MEASURES TO PROMOTE ENERGY EFFICIENCY, AND MAKING AN APPROPRIATION THEREFOR.

*Be it enacted by the General Assembly of the State of Colorado:*

**SECTION 1.** 40-1-102 (5) and (6), Colorado Revised Statutes, are amended, and the said 40-1-102 is further amended BY THE ADDITION OF THE FOLLOWING NEW SUBSECTIONS, to read:

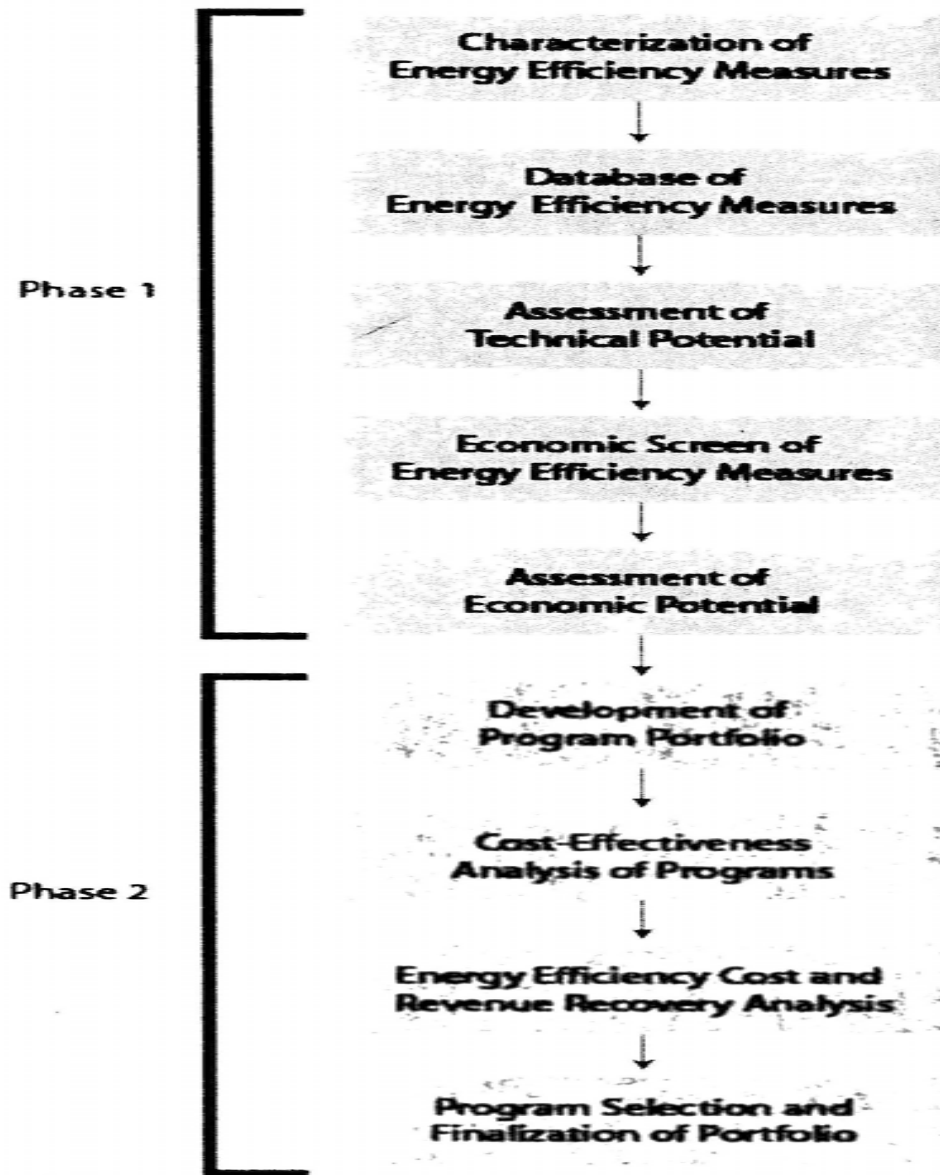
**40-1-102. Definitions.** As used in articles 1 to 7 of this title, unless the context otherwise requires:

(5) (a) ~~"Person" means any individual, firm, partnership, corporation, company, association, joint stock association, and other legal entity.~~ "COST-EFFECTIVE", WITH REFERENCE TO A NATURAL GAS OR ELECTRIC DEMAND SIDE MANAGEMENT PROGRAM OR RELATED MEASURE, MEANS HAVING A BENEFIT-COST RATIO GREATER THAN ONE.

*Capital letters indicate new material added to existing statutes; dashes through words indicate deletions from existing statutes and such material not part of act.*



**Figure 1. Program Planning Process**



# Overview of Process

Source: Black Hills Energy Gas DSM Plan for 2009-2011



# Characterizing Energy Efficiency Measures

- The List of Potential Energy Efficiency Measures
  - What measures are worthy of consideration?
  - Insights from load growth data; market segmentation
  - Examples from other jurisdictions & databases





# Residential Market Segment Baseline

**Table 3-1**  
**Residential End-use Saturation and Unit Consumption**

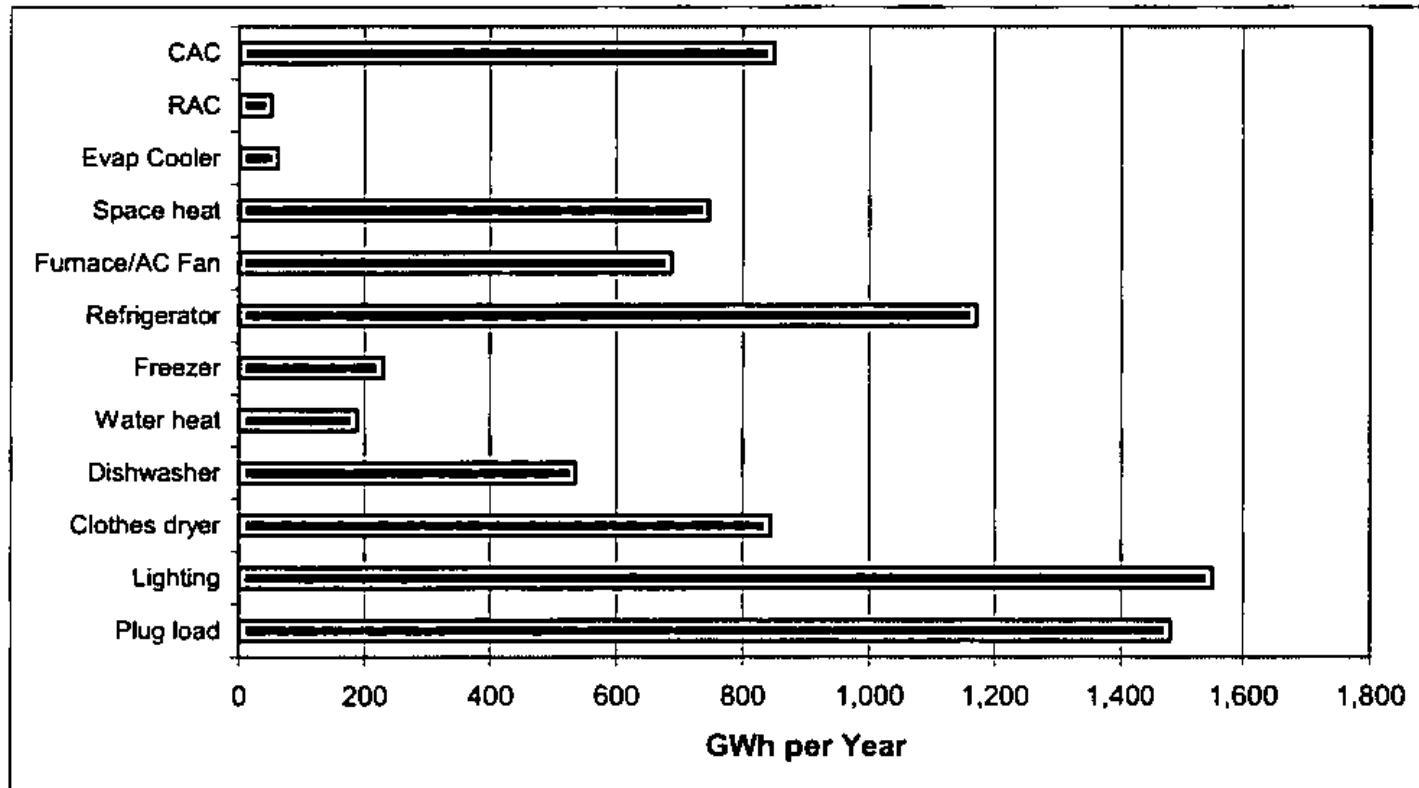
End Use	Multifamily		Single Family	
	Saturation	kWh/unit	Saturation	kWh/unit
Central Air Conditioning (CAC)	47%	1,747	41%	1,837
Room Air Conditioning (RAC)	9%	873	4%	919
Evaporative Cooler	12%	349	17%	367
Space heat	12%	5,900	7%	9,500
Furnace/AC Fan	64%	720	76%	900
Refrigerator	110%	696	129%	910
Freezer	17%	418	51%	510
Water heat	12%	1,815	6%	2,560
Dishwasher	81%	464	86%	613
Clothes dryer	61%	820	81%	1,068
Lighting	100%	1,025	100%	1,550
Plug loads	100%	708	100%	1,583

Source: Colorado DSM Market Potential Assessment;  
March 31, 2006 (this and following slides)



# Res. Baseline – Comparative End Uses

**Figure 3-2**  
**Residential Energy Usage by End**

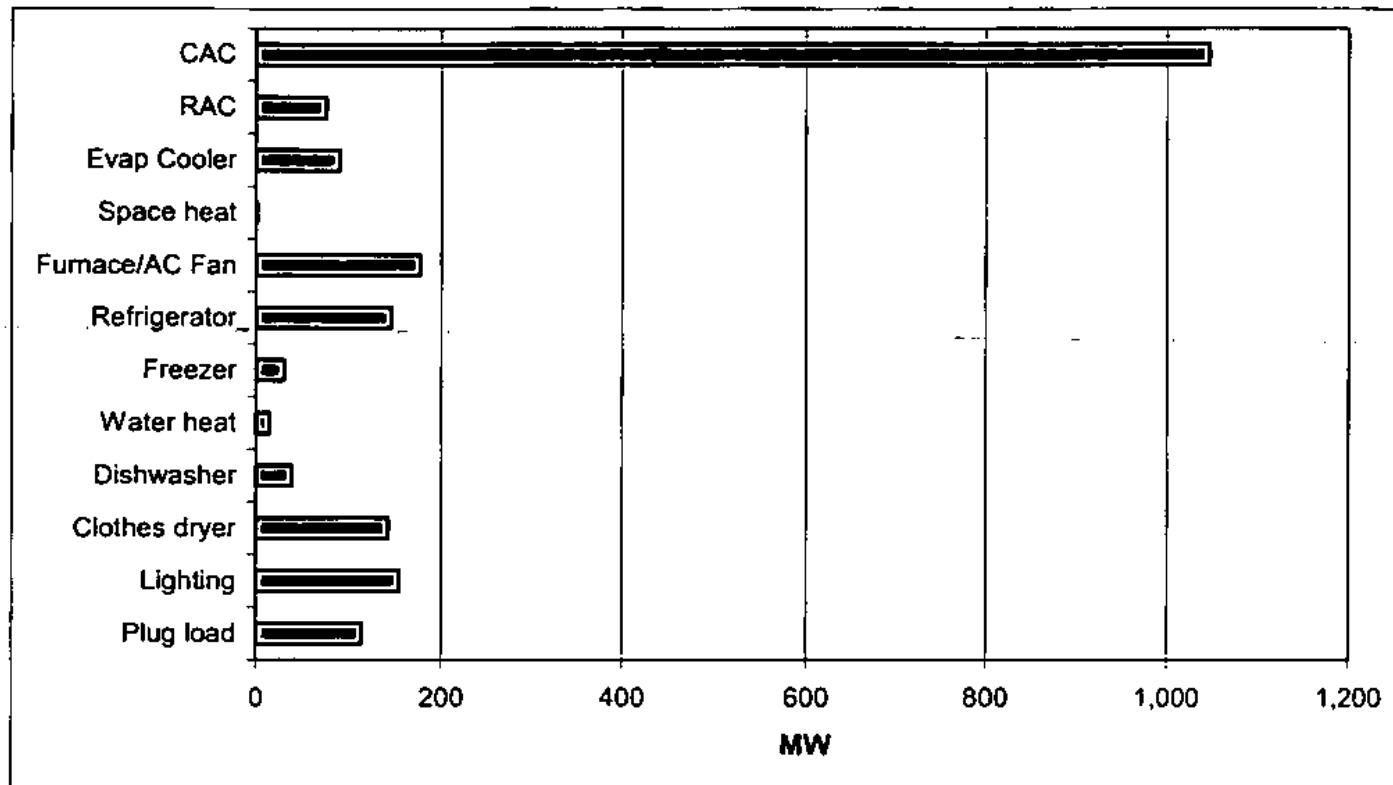


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# Res. Baseline – Peak Demand (Insights for Demand Response)

**Figure 3-3**  
**Residential Peak Demand by End Use**



# Comm. Baseline Data

**Table 3-3**  
**Commercial Baseline Consumption Summary**

Saturation	Office	Restaurant	Retail	Food Store	Warehouse	School	College	Health	Lodging	Miscellaneous
Cooking	0.01	0.41	0.02	0.32	0.00	0.14	0.14	0.35	0.06	0.07
Cooling	0.99	0.81	0.62	0.99	0.75	0.49	0.49	0.66	0.82	0.77
Heating	0.53	0.39	0.05	0.34	0.69	0.41	0.41	0.29	0.80	0.32
Indoor Lighting	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Outdoor Lighting	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00
Miscellaneous	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Office Equipment	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Refrigeration	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
Ventilation	1.00	1.00	1.00	0.98	0.76	0.67	0.67	1.00	0.86	0.94
Water Heating	0.48	0.01	0.30	0.35	0.67	0.21	0.21	0.07	0.33	0.30

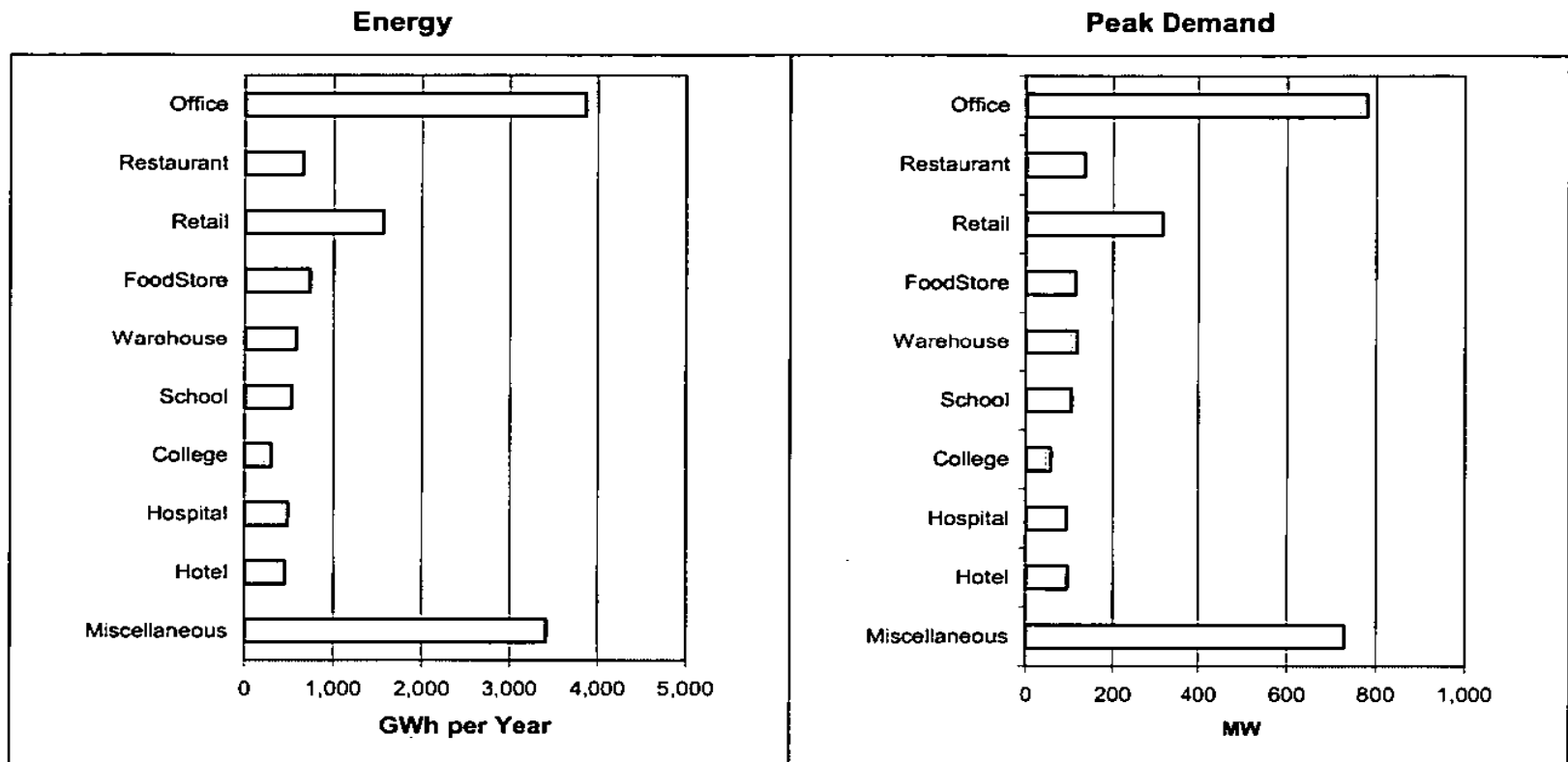
EUI = kWh per Sqft	Office	Restaurant	Retail	Food Store	Warehouse	School	College	Health	Lodging	Miscellaneous
Cooking	2.2	1.9	1.1	0.6	0.0	1.3	1.3	0.2	3.1	1.2
Cooling	2.8	4.3	1.5	1.9	0.9	2.5	2.5	2.3	3.0	2.4
Heating	1.5	3.0	1.1	1.6	0.2	1.6	1.6	1.3	1.9	1.5
Indoor Lighting	7.1	4.3	5.2	6.5	2.8	4.3	5.2	8.5	6.9	5.4
Outdoor Lighting	1.0	1.9	1.0	0.9	0.3	1.2	0.3	0.3	1.0	1.5
Miscellaneous	1.2	3.1	0.4	1.2	0.8	0.3	0.3	2.6	1.5	0.9
Office Equipment	5.1	0.4	0.7	0.3	1.8	0.6	0.6	2.8	1.6	1.2
Refrigeration	0.1	7.4	0.2	21.4	0.4	0.4	0.4	0.8	0.8	0.4
Ventilation	1.8	2.0	0.6	0.7	0.2	1.0	1.0	1.5	0.6	1.1
Water Heating	0.3	1.4	0.2	1.5	0.1	1.8	1.8	1.8	2.6	0.4
Total EUI	20.1	24.7	9.1	34.2	6.0	9.9	9.9	18.4	17.3	13.0

	Office	Restaurant	Retail	Food Store	Warehouse	School	College	Health	Lodging	Miscellaneous	Total
Square Footage Estimate (1000s)	192,013	26,893	171,738	21,592	95,404	53,950	28,977	26,556	26,711	263,168	907,000



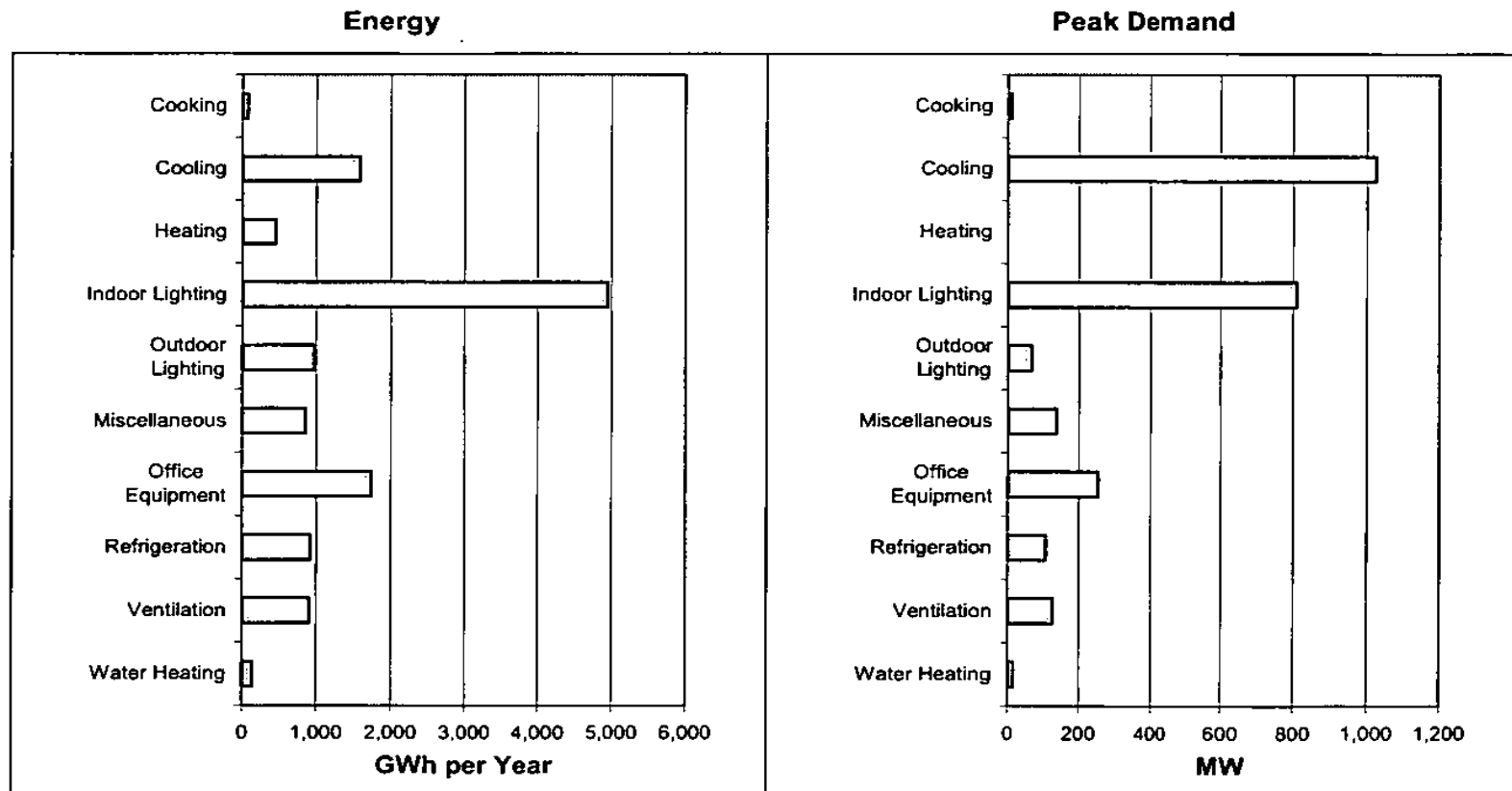
# Commercial Baseline, by Building Type

**Figure 3-11**  
**Commercial Electricity Usage by Building Type**



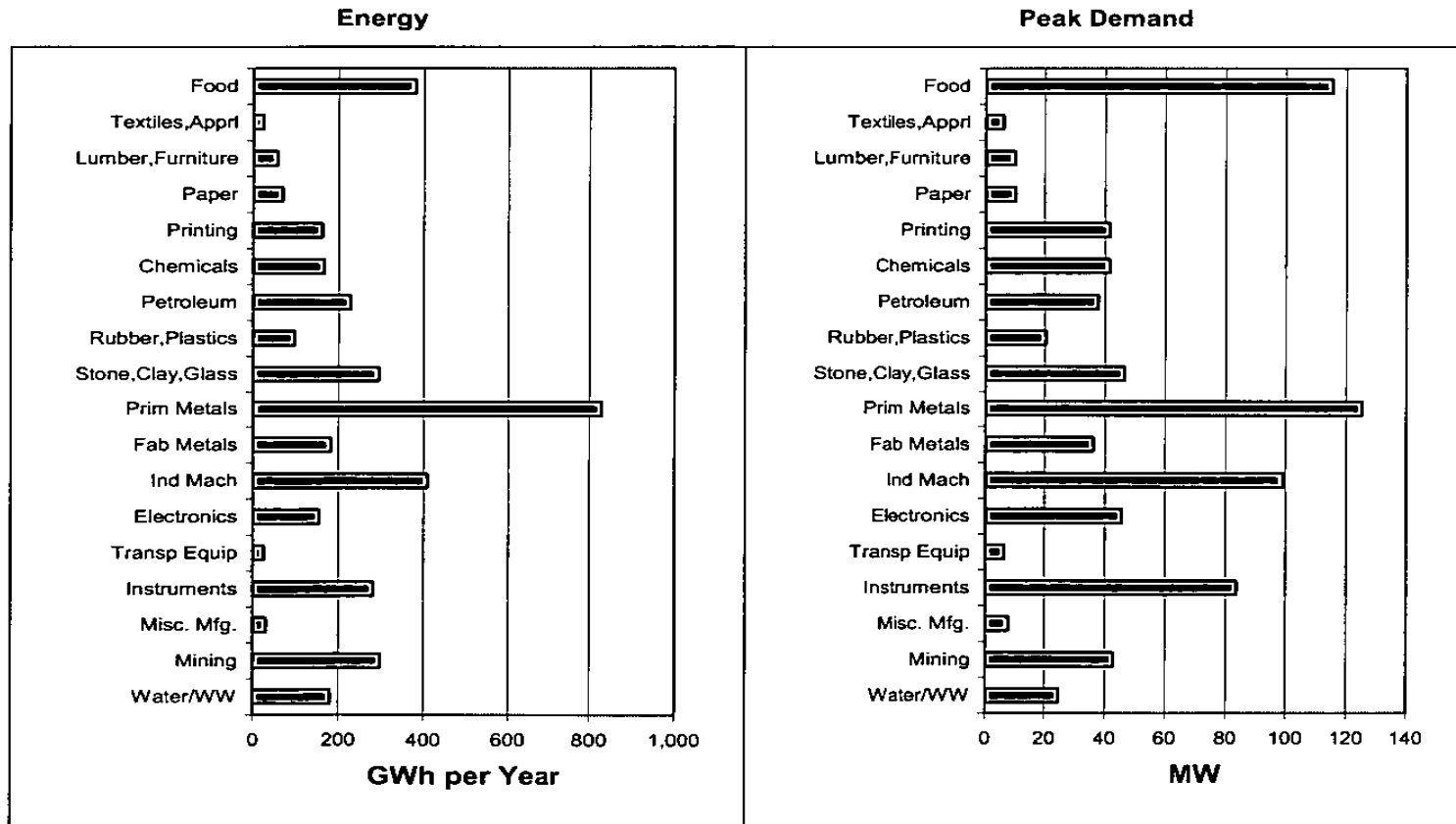
# Comm. Baseline – Comparative End Uses

**Figure 3-12**  
**Commercial Electricity Usage by End Use**



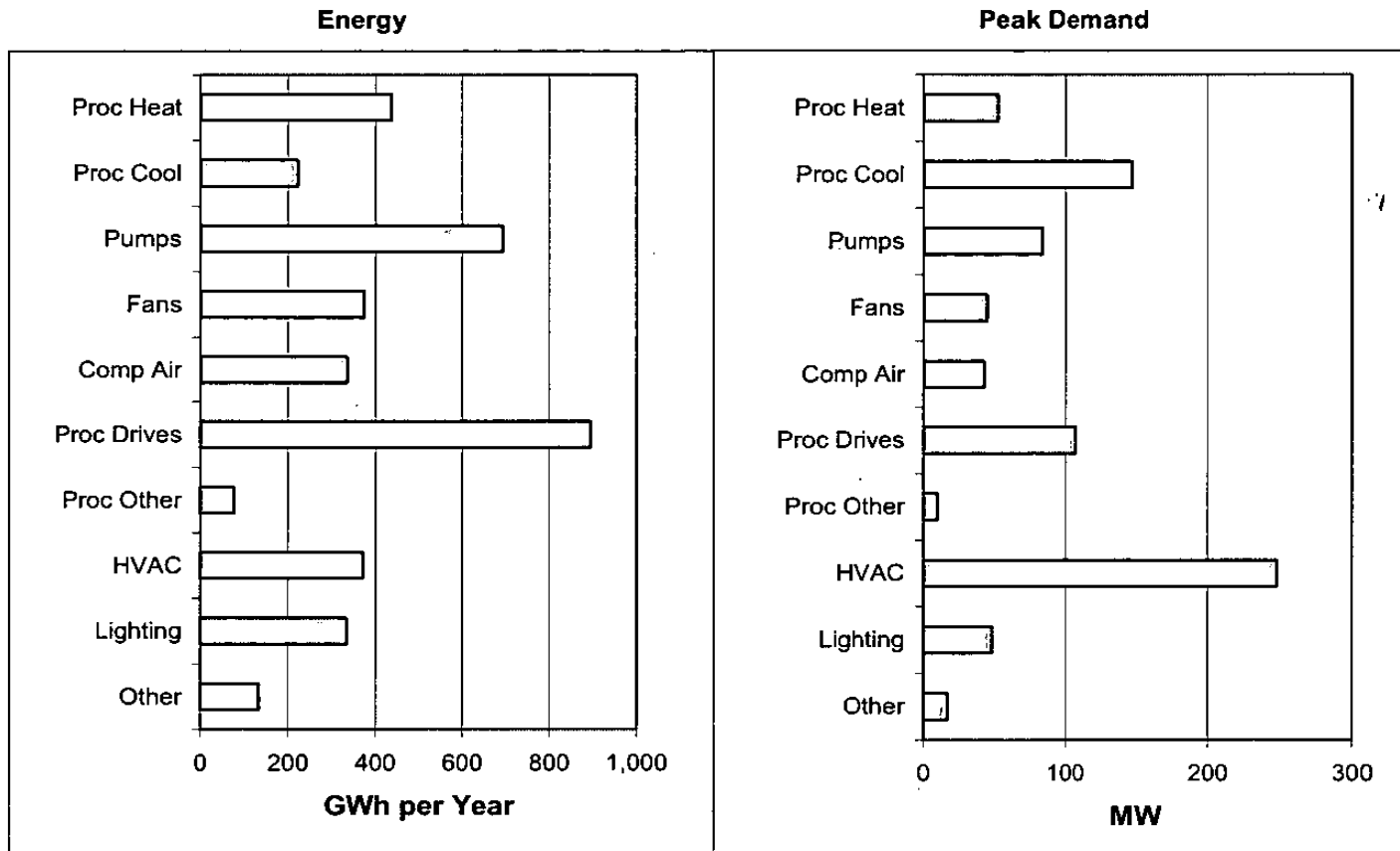
# Industrial Baseline by Sectors

**Figure 3-20**  
**Industrial Electricity Usage by Industry Type**



# Ind. Baseline - Comparative End Uses

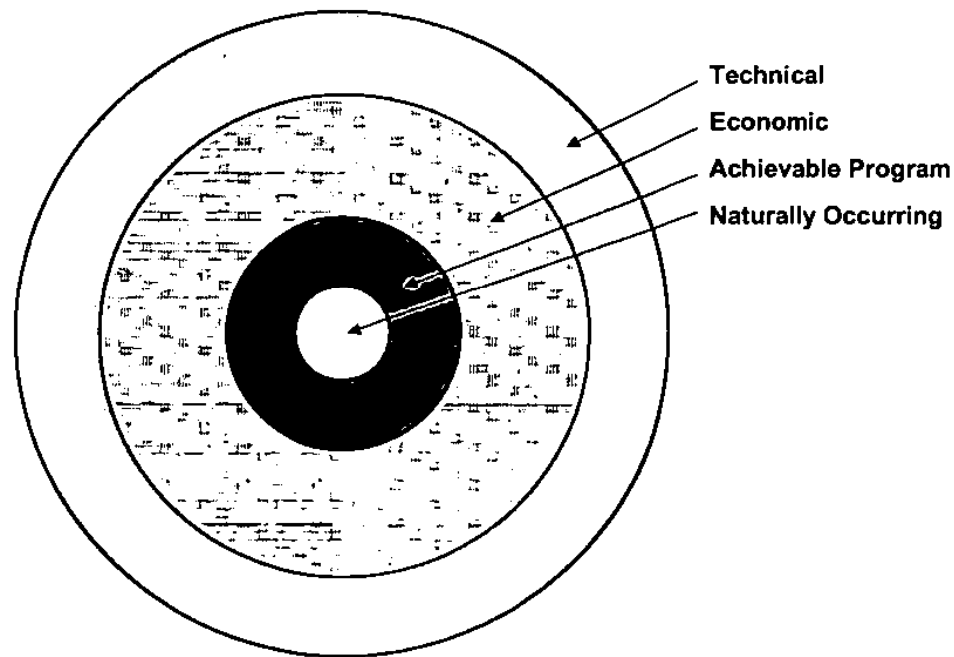
**Figure 3-21**  
**Industrial Electricity Usage by End Use**





# Assessing DSM Potential

**Figure 2-2**  
**Conceptual Relationship Among Energy-Efficiency Potential Definitions**



Source: Colorado DSM Market Potential Assessment;  
March 31, 2006



# The Levels of DSM Potential:

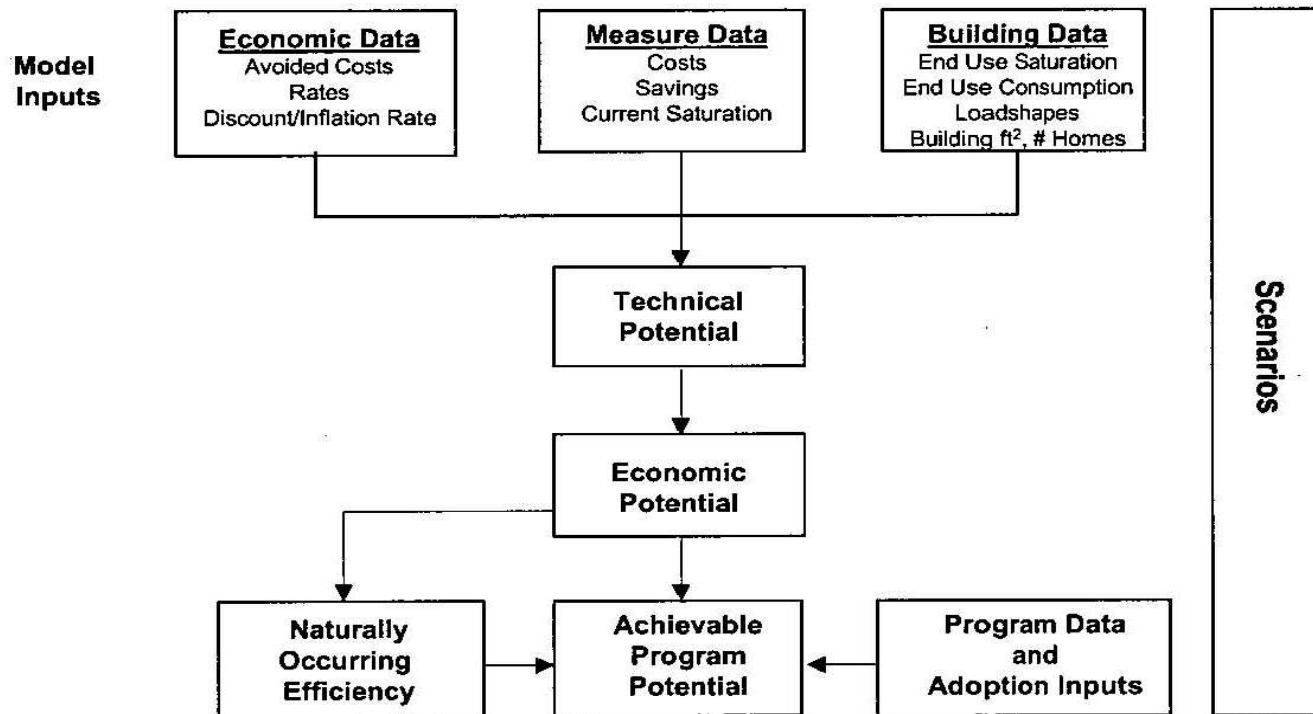
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1. Technical Potential: The maximum possible impact of available techniques/technologies
2. Economic Potential: The portion of technical potential that are cost effective
3. Achievable Potential: The portion of the economic potential that is deemed feasible, (using various incentive levels)
4. Naturally Occurring: The energy efficiency activity already underway in the market; (not requiring additional incentives)



# The Market Potential Study Process

**Figure 2-3**  
**Conceptual Overview of Study Process**



# Calculating the Potential of Measures

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- Current sales (kWh) in targeted sector/segment:
  - Current device efficiency (avg. kWh/device)
  - # Devices in use (# customers \* saturation rate)
  - Vintage of segments (new/used)
  - Longevity of devices (and expected replacement rate)
- Outputs:
  - UEC: Unit Energy Consumption (kWh/household)
  - EUI: Energy Use Intensity (kWh/sq. ft.) – Comm. & Ind.



# Calculating Technical Potential

## Core Equation

The core equation used to calculate the energy technical potential for each individual efficiency measure, by market segment, is shown below (using a commercial example):<sup>1</sup>

$$\begin{array}{ccccccccccc} \text{Technical} & & \text{Total} & & \text{Base} & & \text{Not} & & & & \\ \text{Potential of} & = & \text{Square} & \times & \text{Case} & \times & \text{Complete} & \times & \text{Feasibility} & \times & \text{Savings} \\ \text{Efficient} & & \text{Feet} & & \text{Equipment} & & \text{Factor} & & \text{Factor} & & \text{Factor} \\ \text{Measure} & & & & \text{EUI} & & & & & & \end{array}$$

EUI: Energy Use Intensity (kWh/sq. ft. in this example)

Applicability Factor: portion of total potential (sq. ft.) where old technology in use

Not Complete Factor: portion of total applicable area not yet converted

Feasibility Factor: portion of total applicable area that is technically feasible

Savings Factor: the reduction in consumption from application of efficient technology



# Example of Calculating Technical Potential: Commercial Lighting

**Table A-1**

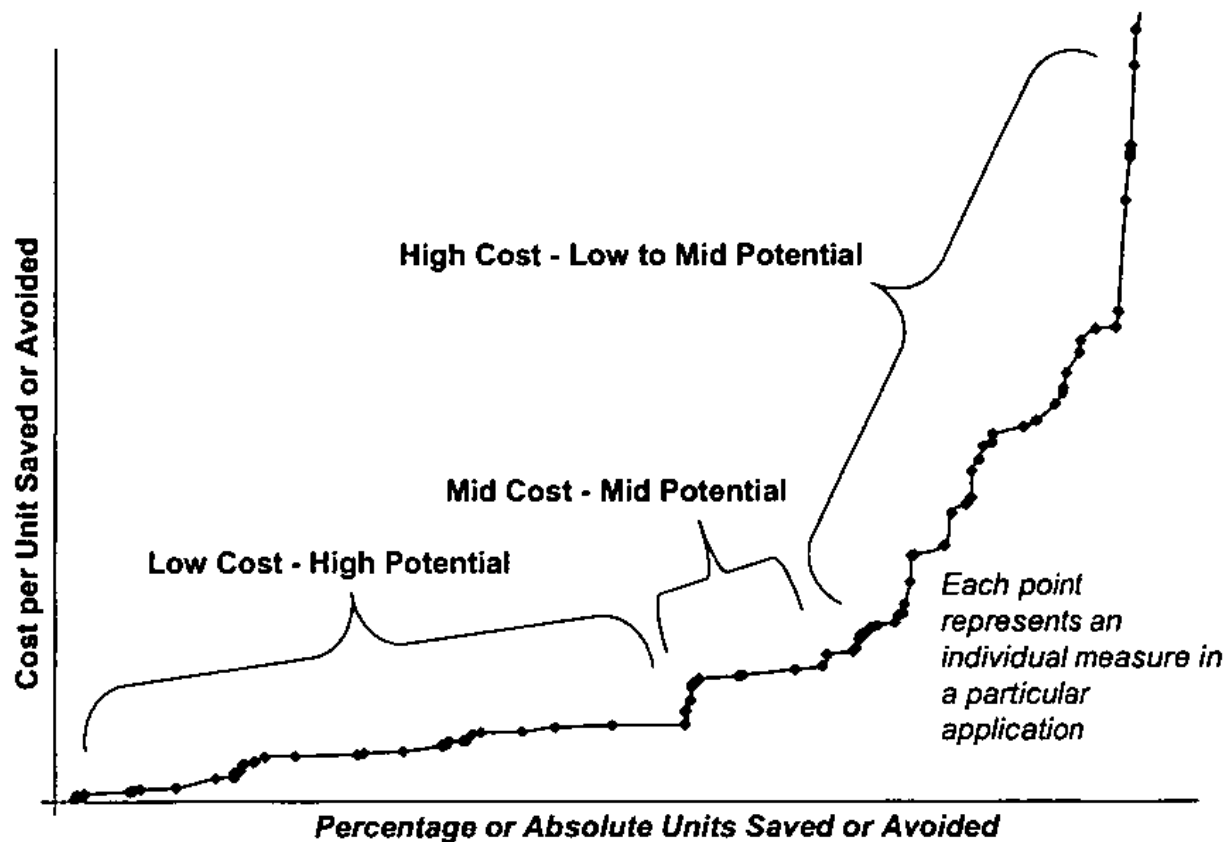
**Example of Technical Potential Calculation—Replace 4-Lamp 4-Foot Standard T-8s with 4-Lamp 4-Foot Premium T-8s in the Office Segment of a Utility Service Territory**  
*(Note: Data are illustrative only)*

Technical Potential of Efficient Measure	=	Total square feet	× Base Case Equipment UEC	× Applicability Factor	× Not Complete Factor	× Feasibility Factor	× Savings Factor
57-million kWh		195 million	5.74	0.34	0.95	1.00	0.16



# Developing a Supply Curve for a DSM Measure

**Figure A-2**  
**Generic Illustration of EE Supply Curve**



# Calculating Economic Potential

**Table A-4**

**Sample Use of Supply Curve Framework to Estimate Economic Potential**

*(Note: Data are illustrative only)*

<b>Measure</b>	<b>Total End Use Consumption of Population (GWh)</b>	<b>Applicable, Not Complete and Feasible Sq.Feet (000s)</b>	<b>Average kWh/ft<sup>2</sup> of population</b>	<b>Savings %</b>	<b>GWh Savings</b>	<b>Total Resource Cost Test</b>	<b>Savings Included in Economic Potential?</b>
Base Case: T12 lamps with Magnetic Ballast	425	100,000	4.3	N/A	N/A	N/A	N/A
1. T8 w. Elec. Ballast	425	100,000	4.3	21%	89	2.5	Yes
2. Occupancy Sensors	336	40,000	3.4	10%	13	1.3	Yes
3. Perimeter Dimming	322	10,000	3.2	45%	14	0.8	No
<b>Technical Potential with all measures</b>				27%	116		
<b>Economic Potential with measures for which TRC Ratio &gt; 1.0</b>				24%	102		





# Achievable Potential

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- **The portion of the economic potential that is deemed feasible, (using various incentive levels)**
- **Addresses consumer behavior – consumers have different price points at which they will act**



# Technical, Economic and Achievable Potential

**Table 4-2**  
**Measure Specific Residential Results (Cumulative to 2013), Base Case 1**

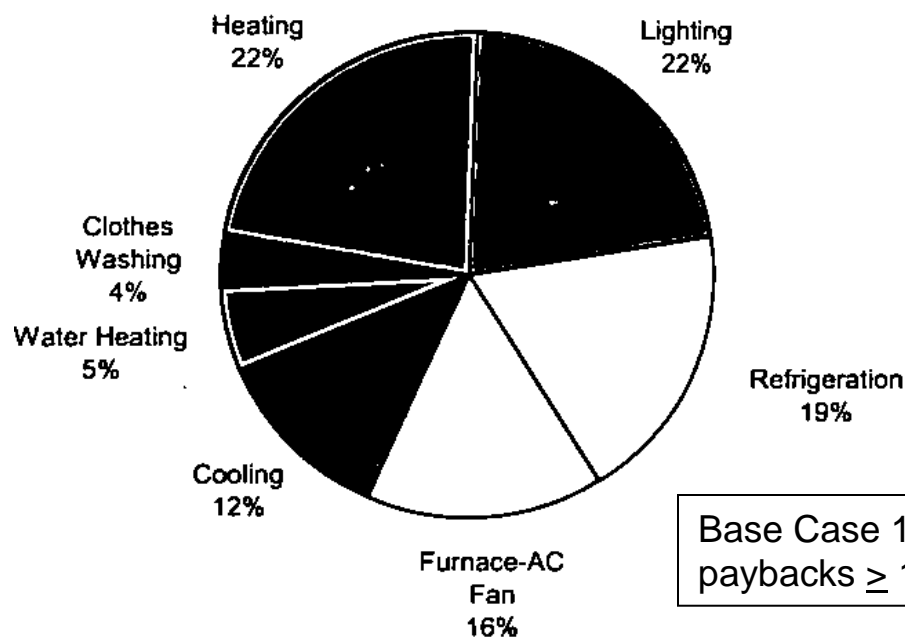
Measure	Energy - GWh					Peak Demand - MW				
	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent
CFL - 15w	461.2	461.2	7.4	8.8	11.6	46.1	46.1	0.7	0.9	1.2
Refrigerator Recycling	283.7	283.7	3.0	9.2	32.2	35.5	35.5	0.4	1.2	4.0
Variable Speed Furnace-AC Fan	250.9	250.9	3.7	7.7	21.1	116.4	116.4	1.7	3.6	9.8
Default Window With Sunscreen	217.5	217.5	0.6	2.0	7.3	289.3	289.3	0.9	2.7	9.8
Evaporative Cooler	150.5	150.5	0.3	0.9	8.0	216.9	216.9	0.4	1.2	11.5
CFL Torchiere - 55w	53.6	53.6	0.3	0.9	3.9	5.4	5.4	0.0	0.1	0.4
ROB 2L4T8, 1EB	43.6	43.6	0.6	1.2	1.9	4.4	4.4	0.1	0.1	0.2
Duct Sealing - from 40% AHU to 12%	41.5	38.7	0.0	0.0	0.3	59.8	55.8	0.0	0.0	0.4
Energy Star CW (MEF=1.42)	35.6	35.6	0.9	1.8	4.4	5.0	5.0	0.1	0.3	0.6
Typical Refrigerant Charge Adjustment	32.1	32.1	0.1	0.2	2.1	46.3	46.3	0.1	0.3	3.1
Window Film	31.9	31.9	0.1	0.2	0.7	38.7	38.7	0.1	0.2	0.8
New Const Cooling Package w/ Downsizing	31.3	31.3	0.2	0.7	4.9	45.0	45.0	0.3	1.0	7.1
New Constr Cooling Package	26.9	26.9	0.1	0.2	1.7	38.7	38.7	0.1	0.3	2.5
Infiltration Reduction, Heating	21.3	14.4	1.4	3.5	10.5	0.0	0.0	0.0	0.0	0.0
High Refrigerant Charge Adjustment	19.5	19.5	0.4	1.2	3.3	28.1	28.1	0.6	1.7	4.7
Evaporative Coolers	15.4	15.4	0.1	0.5	3.6	22.2	22.2	0.2	0.7	5.2
Wall Blow-in R-0 to R-13 Insulation, Heating	15.4	5.3	0.3	0.8	3.3	0.0	0.0	0.0	0.0	0.0
Ceiling R-0 to R-38 Insulation, Heating	15.3	15.3	4.0	6.9	8.0	0.0	0.0	0.0	0.0	0.0
Default Window With Sunscreen	10.0	4.1	0.0	0.0	0.1	13.4	5.5	0.0	0.0	0.1
Pipe Wrap	5.9	5.9	0.5	1.2	3.1	0.5	0.5	0.0	0.1	0.3
Low Flow Showerhead	4.5	4.5	0.4	1.0	2.2	0.4	0.4	0.0	0.1	0.2
Faucet Aerators	2.8	2.8	0.2	0.4	1.0	0.2	0.2	0.0	0.0	0.1
Window Film	1.6	0.9	0.0	0.0	0.0	1.9	1.1	0.0	0.0	0.0

Note: Measures are sorted by descending technical energy savings potential.



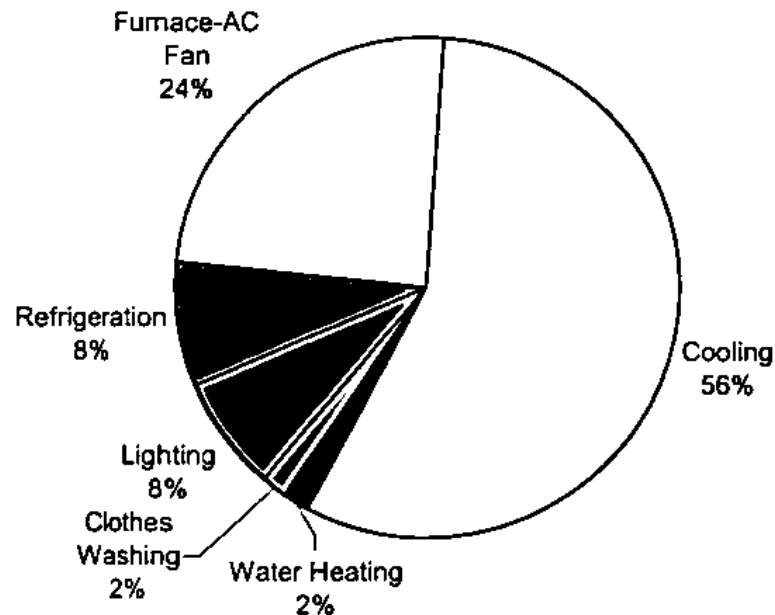
# Residential Sector: Distribution of Savings Potential

**Figure 4-21**  
**Residential Net Energy Savings Potential**  
**End Use Shares (2013) – 50% Incentives**  
**Base Case 1**



# Residential Sector: Distribution of Peak Reduction Potential

**Figure 4-22**  
**Residential Net Peak Savings Potential**  
**End Use Shares (2013) – 50% Incentives**  
**Base Case 1**



Note: end use results exclude impacts of the Saver's Switch Program.



**Table 4-3**  
**Measure Specific Commercial Results (Cumulative to 2013), Base Case 1**

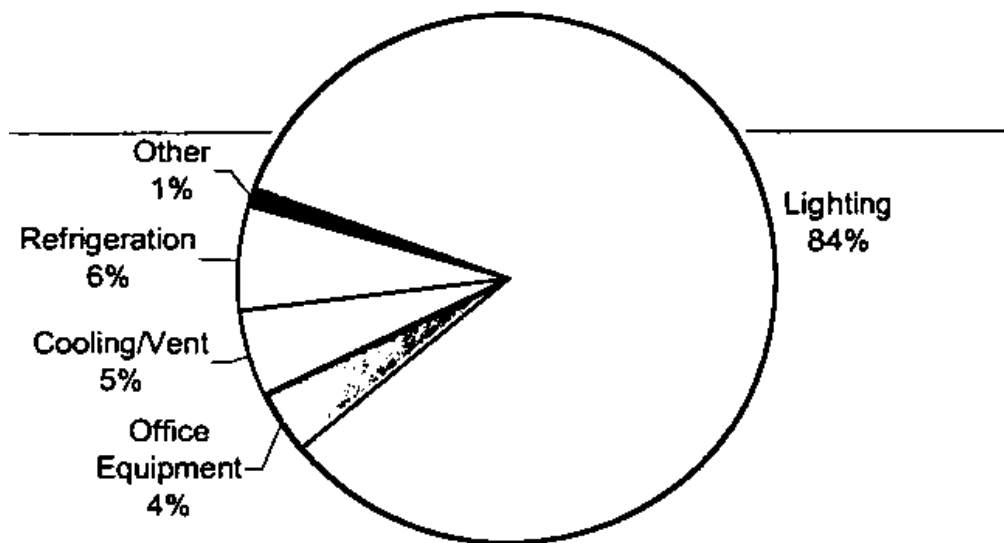
Measure	Energy - GWh					Peak Demand - MW				
	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent	Technical Potential	Economic Potential	33% Incent	50% Incent	75% Incent
Premium T8/EB	880.6	880.6	146.4	257.3	489.2	144.1	144.1	24.0	42.1	79.7
CFL Screw-in 18W	487.3	487.3	43.0	45.0	47.5	78.8	78.8	7.0	7.3	7.7
CFL Hardwired, Modular 18W	162.4	162.4	6.9	17.3	86.1	26.3	26.3	1.1	2.8	13.9
Occupancy Sensors	157.6	143.9	17.8	36.9	95.4	28.3	26.1	3.3	6.7	17.2
High Pressure Sodium 250W Lamp	156.8	156.8	42.2	65.8	107.8	9.4	9.4	2.5	3.9	6.5
PC Network Power Management Enabling	139.4	139.4	10.0	7.4	7.7	13.4	13.4	1.0	0.7	0.7
Lighting 15% More Efficient Design	123.2	123.2	11.1	23.3	47.1	20.2	20.2	1.8	3.8	7.8
High Bay T5	106.3	106.3	1.3	2.9	12.7	17.4	17.4	0.2	0.5	2.2
DX Packaged System, EER=10.9, 10 tons	76.3	76.3	1.5	2.6	6.0	49.4	49.4	1.0	1.7	3.8
PC Manual Power Management Enabling	74.4	74.4	2.2	5.3	5.6	7.1	7.1	0.2	0.5	0.5
Lighting 25% More Efficient Design	69.8	64.0	3.6	8.2	19.9	11.5	10.5	0.6	1.4	3.3
Monitor Power Management Enabling	65.8	65.8	7.0	7.3	7.7	6.3	6.3	0.7	0.7	0.7
Vending Misers (cooled machines only)	56.8	56.8	2.9	3.1	3.3	6.2	6.2	0.3	0.3	0.4
VSD Fan Motors	55.6	27.5	4.5	7.6	14.1	2.1	1.1	0.2	0.3	0.6
Printer Power Management Enabling	54.2	54.2	0.8	2.2	2.3	5.2	5.2	0.1	0.2	0.2
High-efficiency fan motors	42.4	42.4	3.7	7.9	24.3	5.0	5.0	0.4	0.9	2.9
Cool Roof - DX	40.6	4.3	1.3	2.1	3.0	28.1	3.0	0.9	1.4	2.1
Demand Defrost Electric	33.4	33.4	1.0	1.1	1.1	4.0	4.0	0.1	0.1	0.1
Window Film (Standard)	31.2	10.5	2.3	4.0	7.4	21.1	7.4	1.6	2.8	5.1
Economizers	31.2	11.4	0.9	2.0	6.7	6.0	1.8	0.1	0.3	1.1
Cool & Vent 30% More Efficient Design	27.0	27.0	1.2	2.9	7.6	17.3	17.3	0.8	1.9	4.9
Prog. Thermostat - DX	26.7	12.6	0.9	2.0	7.2	5.2	2.2	0.1	0.3	1.3
Centrifugal Chiller, 0.51 kW/ton, 500 tons	25.6	25.6	0.4	0.8	1.6	16.5	16.5	0.3	0.5	1.0
Efficient compressor motor	21.3	21.3	2.0	2.8	4.3	2.5	2.5	0.2	0.3	0.5
Energy Star or Better Monitor	17.6	17.6	0.0	0.0	0.0	2.6	2.6	0.0	0.0	0.0
LED Exit Sign	16.7	16.7	1.2	2.7	9.3	2.7	2.7	0.2	0.4	1.5
Outdoor Lighting Controls	16.5	16.5	1.9	2.0	2.1	0.0	0.0	0.0	0.0	0.0
Premium Efficiency Fan Motors	16.4	1.0	0.0	0.1	0.2	2.3	0.1	0.0	0.0	0.0
HVAC 10% More Efficient Design	15.0	15.0	1.2	2.6	5.6	9.6	9.6	0.8	1.7	3.6
Anti-sweat (humidistat) controls	14.4	14.4	4.6	6.6	8.8	0.9	0.9	0.3	0.4	0.5
Refrigeration 10% More Efficient Design	14.0	14.0	1.0	2.2	5.0	1.7	1.7	0.1	0.3	0.6
Optimize Controls	13.4	0.9	0.0	0.0	0.0	2.6	0.2	0.0	0.0	0.0
Copier Power Management Enabling	13.1	13.1	0.0	0.1	0.1	1.3	1.3	0.0	0.0	0.0
Strip curtains for walk-ins	11.6	11.6	3.5	4.6	5.6	1.4	1.4	0.4	0.5	0.7
Lighting Control Tuneup	11.4	11.4	2.6	4.3	4.4	0.5	0.5	0.1	0.2	0.2
Air Handler Optimization, 15 HP	10.1	7.3	0.2	0.6	3.2	0.4	0.3	0.0	0.0	0.1
Night covers for display cases	9.7	9.7	3.0	4.5	6.4	0.0	0.0	0.0	0.0	0.0
VSD for Chiller Pumps and Towers	9.0	6.6	0.8	1.5	4.4	5.8	4.1	0.5	1.0	2.8
Tankless Water Heater	8.3	5.8	1.7	2.6	4.4	1.0	0.7	0.2	0.3	0.5
Floating head pressure controls	6.9	6.9	1.5	1.8	2.0	0.0	0.0	0.0	0.0	0.0
Air Handler Optimization, 40 HP	6.7	5.7	0.2	0.5	2.7	0.3	0.2	0.0	0.0	0.1
Demand controlled circulating systems	3.5	1.7	0.3	0.4	0.4	0.4	0.2	0.0	0.1	0.1
Energy Star or Better Copier	3.3	3.3	0.0	0.0	0.0	0.5	0.5	0.0	0.0	0.0
Demand Hot Gas Defrost	3.1	3.1	0.5	0.6	0.7	0.4	0.4	0.1	0.1	0.1
High Efficiency Water Heater (electric)	2.8	2.8	0.1	0.2	0.2	0.3	0.3	0.0	0.0	0.0
Hot Water Pipe Insulation	1.5	1.0	0.3	0.5	0.8	0.2	0.1	0.0	0.1	0.1

Note: Measures are sorted by descending technical energy savings potential.



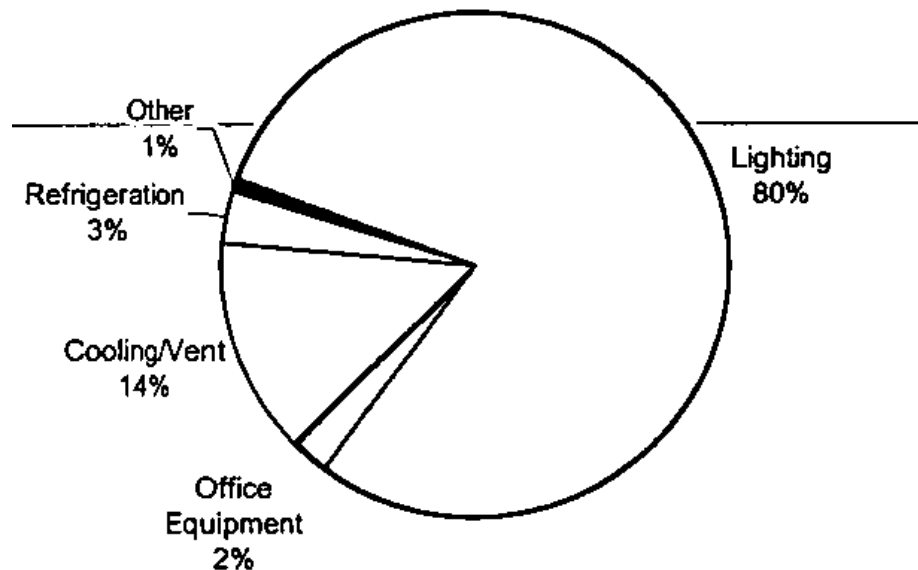
# Commercial Sector: Distribution of Savings Potential

**Figure 4-27**  
**Commercial Net Energy Savings Potential**  
**End-Use Shares (2013) – 50% Incentives**  
**Base Case 1**



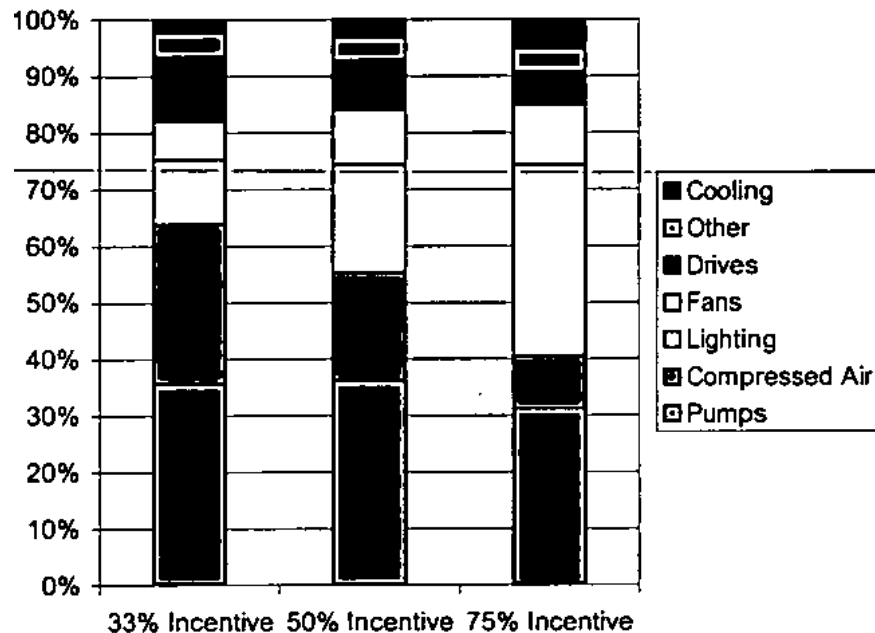
# Commercial Sector: Distribution of Peak Reduction Potential

**Figure 4-28**  
**Commercial Net Peak Savings Potential**  
**End-Use Shares (2013) – 50% Incentives**  
**Base Case 1**

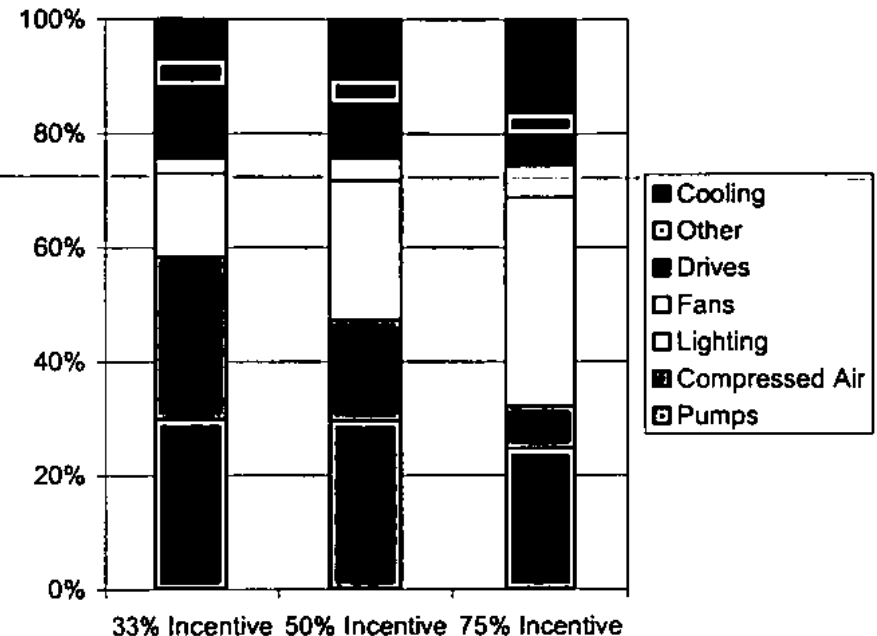


# Industrial Sector: Distribution of Savings & Peak Potential

**Figure 4-35**  
**Industrial Net Energy Savings Potential**  
**by End Use (2013) – Across Scenarios**  
**Base Case 1**



**Figure 4-36**  
**Industrial Net Peak Savings Potential**  
**by End Use (2013) – Across Scenarios**  
**Base Case 1**





# Moving From Potential to Financially Viable:

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- Measuring Cost-Effectiveness:
  - Modified Total Resource Cost (TRC) Test
    - All Costs: Utility; Participant; Society
    - All Benefits: Utility; Participant; Society
    - “Modified”: Include presumed value for societal benefits



# LIGHTING EFFICIENCY PROGRAM

## 2009 Electric Benefit-Cost Analysis per Customer kW

	Participant Test (\$/kW)	Utility Test (\$/kW)	Rate Impact Test (\$/kW)	Modified Total Resource Test (\$/kW)
<i>System Benefits (Avoided Costs)</i>				
Generation Capacity		\$1,341	\$1,341	\$1,341
Transmission & Distribution Capacity		\$275	\$275	\$275
Marginal Energy		\$2,498	\$2,498	\$2,498
Avoided Emissions (CO2, SOx)		\$611	\$611	\$611
Subtotal		\$4,724	\$4,724	\$4,724
Non-Energy Benefits Adder (10%)				\$472
Subtotal		\$4,724	\$4,724	\$5,197
<i>Other Benefits</i>				
Participant Rebates and Incentives	\$369			\$369
Vendor Incentives				\$0
Incremental Capital Savings	\$0			\$0
Incremental O&M Savings	\$0			\$0
Subtotal	\$369			\$369
<i>Reduction in Sales Revenue</i>				
Electric	\$3,091		\$2,968	
Subtotal	\$3,091		\$2,968	
<i>Utility Program Costs</i>				
Program Planning & Design		\$1	\$1	\$1
Administration & Program Delivery		\$69	\$69	\$69
Advertising/Promotion/Customer Ed		\$19	\$19	\$19
Participant Rebates and Incentives		\$369	\$369	\$369
Equipment & Installation		\$0	\$0	\$0
Measurement and Verification		\$22	\$22	\$22
Miscellaneous		\$0	\$0	\$0
Subtotal		\$480	\$480	\$480
<i>Participant Costs</i>				
Incremental Capital Costs	\$1,040			\$998
Incremental O&M Costs	\$312			\$300
Subtotal	\$1,352			\$1,298
Total Benefits	\$3,461	\$4,724	\$4,724	\$5,566
Total Costs	\$1,352	\$480	\$3,448	\$1,777
Net Benefit (Cost)	\$2,109	\$4,245	\$1,277	\$3,789
Benefit/Cost Ratio	2.56	9.85	1.37	3.13

Note: Dollar values represent present value of impacts accumulated over the lifetime of the measures.

Calculating  
Benefits  
and Costs



# Developing a DSM Portfolio

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- Measures >> Programs >> Portfolio
  - Programs: Combinations of Measures (delivered as a package)
  - Portfolio: All of the Utility's DSM Programs



# Business Sector Programs

**Table 5: Business Program Rankings**

Program Name	Program Ranking <sup>2</sup>	Type	Fuel
Boiler Efficiency	30	Prescriptive	Gas
Cooling Efficiency	12	Prescriptive	Electric
Compressed Air Efficiency	21	Custom	Electric
Custom Efficiency	19	Custom	Both
Data Center Efficiency	34	Custom	Both
Energy Management Systems	17	Custom	Both
Furnace Efficiency	35	Prescriptive	Gas
Lighting Efficiency	5	Prescriptive	Electric
Motor and Drive Efficiency	7	Prescriptive	Electric
New Construction	10	Custom	Both
Process Efficiency	28	Custom	Both
Recommissioning	25	Custom	Both
Segment Efficiency	23	Custom	Both
Self-Direct	31	Custom	Both
Small Business Lighting	32	Custom	Electric
Standard Offer	18	Custom	Both



# Residential Sector Programs

**Table 32: Residential Segment Program Rankings**

<b>Program Name</b>	<b>Program Ranking<sup>1</sup></b>	<b>Type of Program</b>	<b>Fuel</b>
Energy Efficient Showerheads	4	Prescriptive	Gas
ENERGY STAR New Homes	11	Custom	Electric/Gas
ENERGY STAR Retailer Incentive	3	Market Transformation	Electric
Evaporative Cooling Rebates	15	Prescriptive	Electric
Heating System Rebates	33	Prescriptive	Gas
Home Lighting & Recycling	1	Prescriptive	Electric
Home Performance with ENERGY STAR	22	Prescriptive	Electric/Gas
Insulation Rebates	27	Prescriptive	Gas
Refrigerator Recycling	14	Prescriptive	Electric
School Education Kits	9	Prescriptive	Electric/Gas
Water Heater Rebate	29	Prescriptive	Gas
Saver's Switch	8	Prescriptive	Electric



# Summary & Questions

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- The Steps in DSM Planning/Development:
  - Gather/Analyze consumption data (kWh; kW) by customer class and segment
  - Develop list of possible DSM measures
  - Determine Potential: Technical; Economic; Achievable
  - Calculate Avoided Costs & Cost-Effectiveness
  - Aggregate Effective Measures into Programs



# The DSM “Field Trip”

- Commercial Office Building
  - Republic Plaza
  - DSM Program Participant
- Objectives:
  - The costs & benefits of DSMFrom 3 perspectives:
  - Building owner/manager
  - Energy engineering firm
  - Utility



# "Recommissioning" Program

## RECOMMISSIONING INVESTIGATION REPORT

**Republic Plaza**  
**370 17<sup>th</sup> Street, Denver, CO**

Xcel Energy Colorado Front-Range Service Territory  
Re-commissioning Program

*Presented to:*

Brookfield Properties  
370 17<sup>th</sup> Street, Suite 3800  
Denver, Colorado 80202

*Provided by:*



1225 17<sup>th</sup> Street  
Denver, CO

October 27, 2008

- Review of existing equipment and systems





# Overview

## Republic Plaza Re-Cx Measure Summary

No.	Measure	Demand Savings		Annual Savings				Implementat ion Cost	Simple Payback
		kW-prog	kW-billing	kWh	kW\$	kWh\$	Total \$	\$	Years
1	Optimal Start	0	0	443,819	\$0	\$18,374	\$18,374	\$11,793	0.6
2	Optimal Stop Cooling	332	0	70,917	\$0	\$2,936	\$2,936	\$4,500	1.5
3	Optimal Stop Heating	0	0	83,854	\$0	\$3,472	\$3,472	\$6,100	1.8
4	Condenser Water Reset	126	960	243,319	\$16,090	\$10,073	\$26,163	\$27,650	1.1
5	Optimize Strainer Cycle	723	0	190,092	\$0	\$7,870	\$7,870	\$3,875	0.5
6	AHU Duct Pressure Reset	22	138	54,692	\$2,313	\$2,264	\$4,577	\$4,100	0.9
<b>Totals</b>		<b>1203</b>	<b>1098</b>	<b>1,086,693</b>	<b>\$18,402</b>	<b>\$44,989</b>	<b>\$63,392</b>	<b>\$58,018</b>	<b>0.92</b>
<b>Annual totals 2007</b>		<b>6676</b>		<b>32,265,833</b>			<b>\$2,297,954</b>		
<b>Savings Percentage</b>		<b>18.02%</b>		<b>3.37%</b>			<b>2.76%</b>		

*Note: Table utilizes Xcel SG rates for Oct. 1, 2008 & includes all riders, fees & taxes* kWh rate \$0.0414  
kW rate \$16.76



# Projected Outcomes

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If all the recommended measures are implemented, the facility would experience a reduction of **1203 kW** from their billed kW during the program peak period, and an electric consumption savings of **1,086,693 kWh**. The annual savings from the facility's electric bill will be approximately **\$63,392** yielding a simple payback period of **0.92 years**.

