



Submitted To:



## Demand Side Management Potential Study – Volume I

Submitted By:



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## 1.1 OVERVIEW

In August, 2008, City Public Service (CPS) Energy retained Nexant, Inc. (Nexant) to conduct a demand side management (DSM) potential study of the DSM resource available in the CPS Energy service territory and model the DSM potential available through 2020.

This study provides an evaluation of the DSM resource available to each of CPS Energy's primary sectors with a focus on energy efficiency (EE) programs<sup>1</sup>. EE DSM programs encourage customers to install energy efficient equipment thereby saving electricity and reducing system demand. Nexant used its experience with similar utility DSM programs, knowledge of the EE market, and familiarity with DSM technologies to create a comprehensive, end-use forecast of CPS Energy's achievable savings.

## 1.2 CPS ENERGY BASELINE

In 2008 CPS Energy provided electric service to a total of 692,478 customers in San Antonio and surrounding areas. CPS Energy sold a total of 19,342 GWh of electricity and averaged a firm load of 4,258 MW in 2008. Figure 1-1 shows the breakdown of CPS Energy's 2008 sales by primary sector<sup>2</sup>.

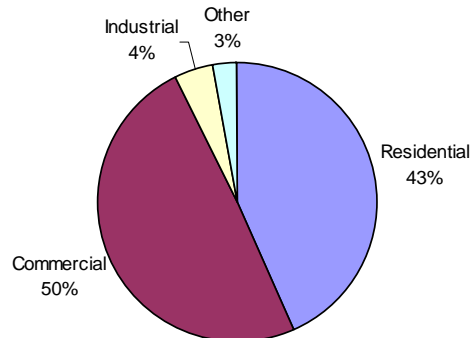


Figure 1-1: 2008 CPS Energy Electricity Sales by Sector<sup>2</sup>

<sup>1</sup> Demand Response (DR) programs, which target reduction of peak summer loads through customer curtailment of energy intensive processes during peak hours, were not included in this evaluation, and will be analyzed separately.

<sup>2</sup> The Industrial Sector was defined by Nexant based on NAICS codes, as described in Section 5.

### 1.3 CALCULATION METHODOLOGY

The DSM resource for EE programs can be characterized by the technical potential, economic potential, and achievable potential. The technical potential describes the savings available if all baseline equipment stock was replaced with every applicable measure. The economic potential is a calculation of savings when all measures that are cost-effective are installed. Applying appropriate market constraints and program considerations to the economic potential yields the calculation of achievable potential which represents the savings that CPS Energy can expect to achieve from EE programs. Because CPS Energy's goal for this study to identify and focus on cost-effective, achievable DSM opportunities that can be implemented into program offerings, the remainder of this evaluation will focus on the economic and achievable potential scenarios.

Nexant conducted the evaluation of EE programs using a bottom-up modeling approach following a general three (3) step process. The following core steps employed to develop a model of CPS Energy and its potential DSM resource are described below.

- **Step 1: Characterize CPS consumption.** Nexant first created a baseline energy consumption model of each primary sector. Nexant used resources available through CPS Energy, past projects, and other DSM studies to define the sector energy consumption by sub-sectors and end-uses.
- **Step 2: Define applicable measures.** The breakdown of energy consumption by end-use allowed Nexant to identify suitable measures for each sector. For each measure the savings, cost, and lifetime were assembled and used to evaluate the measure for cost-effectiveness. Measures that did not pass this screening were excluded from the calculation of the economic and achievable potential.
- **Step 3: Calculate Achievable Potential.** Selected measures were applied to the baseline forecast and the achievable potential was calculated through the application of market penetration rates. Nexant drew from its large breadth of experience in the field of DSM forecasting and program implementation to develop accurate and consistent market penetration rate curves.

### 1.4 RESULTS

#### 1.4.1 Savings Potential

Nexant calculated CPS Energy's DSM potential through 2020 and found there to be significant room for program growth. Total cumulative achievable savings through the 2020 program year are expected to be 2,618 GWh of electricity savings and 569 MW of peak load reduction. Figure 1-2 and Figure 1-3 show the electricity and demand savings respectively. Complete forecasts for each sector can be found in Appendix A.

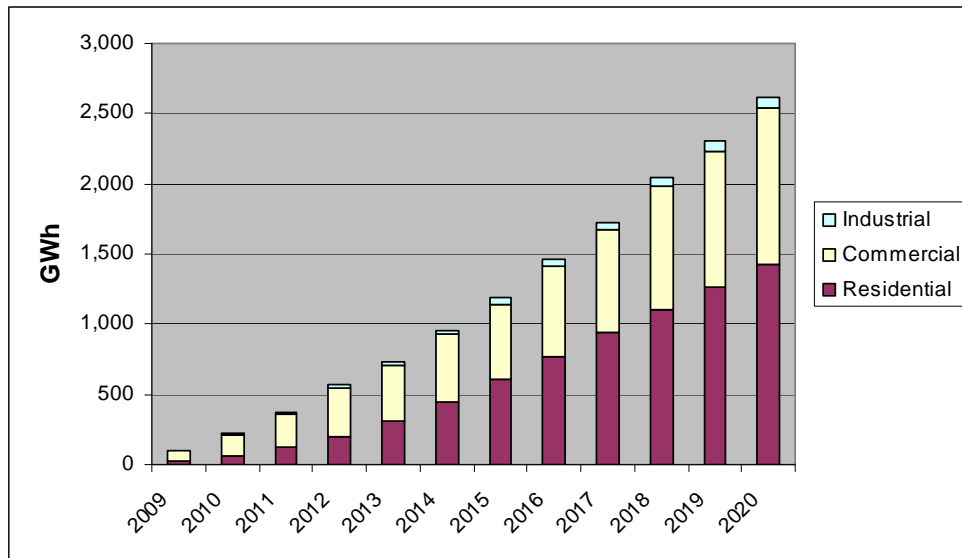


Figure 1-2: Achievable Electricity Savings Forecast

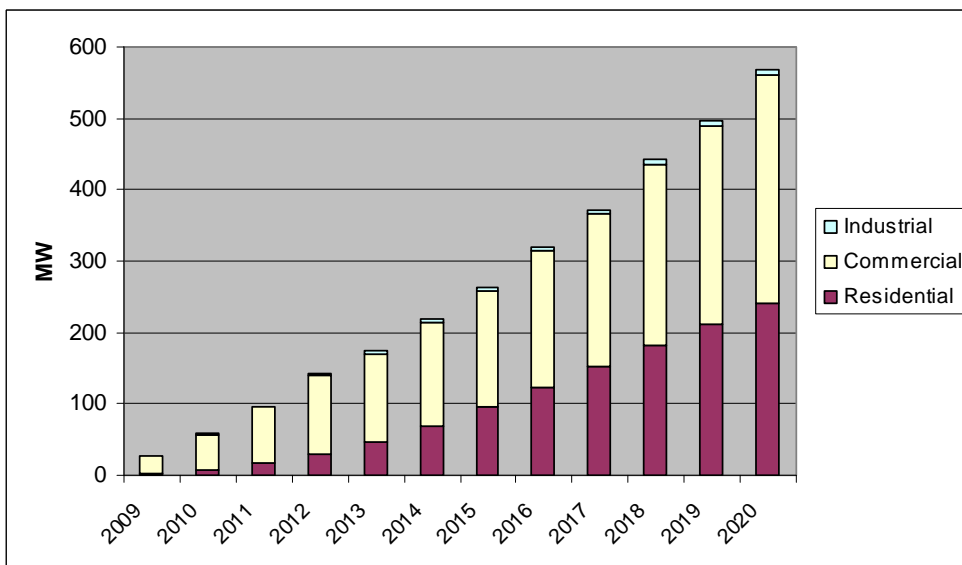


Figure 1-3: Achievable Peak Demand Reduction Forecast

Lighting and HVAC are the two end-uses that contribute the largest energy savings and demand reductions. The breakdown of electricity savings by end-use can be seen in Figure 1-4. Figure 1-5 shows the breakdown of peak demand savings by end-use.

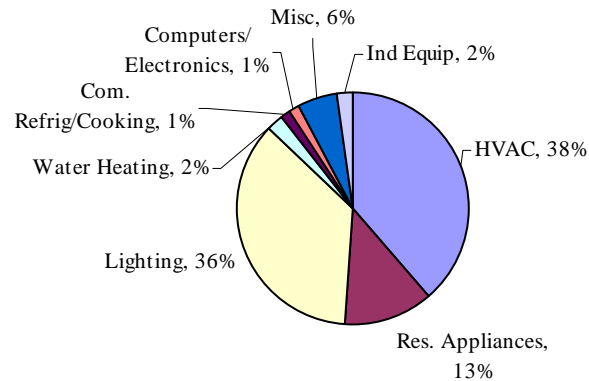


Figure 1-4: Achievable Potential Electricity Savings by End-Use

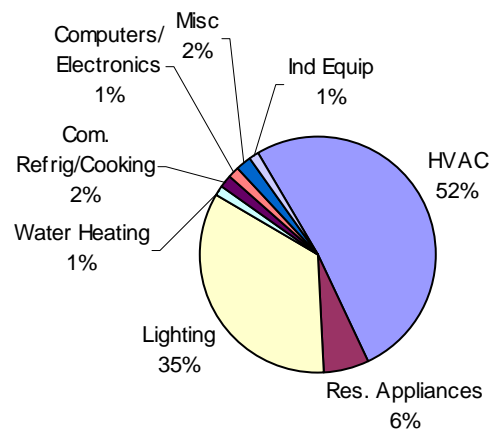


Figure 1-5: Achievable Potential Peak Demand Reduction by End-Use

#### 1.4.2 Cost-Effectiveness Analysis

Table 1-1 and Table 1-2 present cost-effectiveness indicators from Utility Cost Test (UCT) and Total Resource Cost (TRC) perspectives of the effects of achievable energy efficiency impacts from 2009 through 2020. The tables present economic indicators for each scenario of theoretically achievable potential. Benefits and costs are measured in the following way from UCT and TRC perspectives:

- Both the UCT and TRC perspectives measure benefits as the reductions in costs utilities experience as a result of reduced demand for energy.
- UCT perspective costs include incentive costs paid by the program administrator (the utility), plus administrative costs required to implement energy efficiency programs.

- TRC perspective costs include all costs incurred to purchase, install, and maintain efficiency technologies, plus administrative costs required to implement energy efficiency programs.

Table 1-1: UCT Net Benefits and Benefit-Cost Ratios

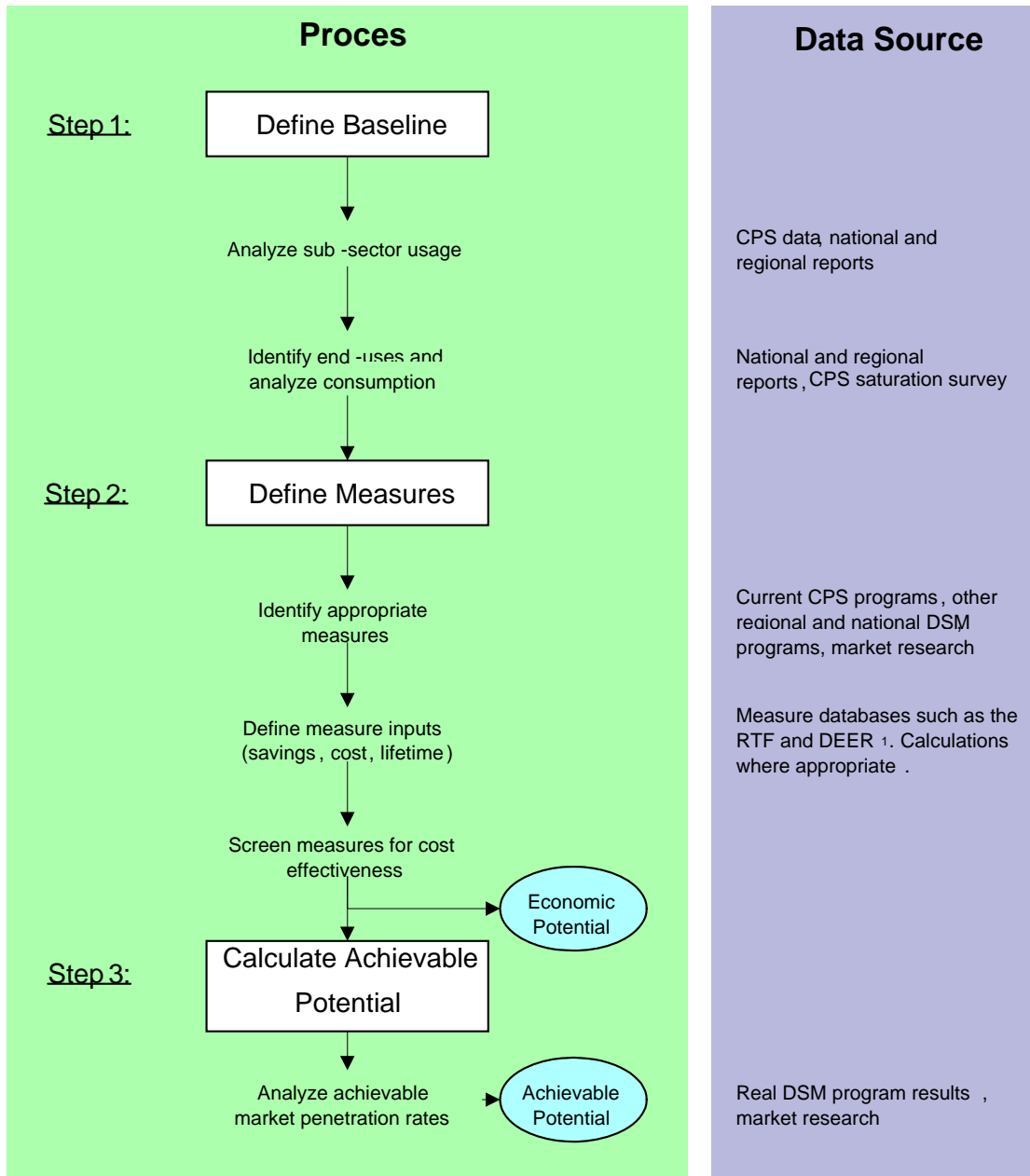
<b>Scenario</b>	<b>Net Benefits (Millions)</b>	<b>Benefit-Cost Ratio</b>
Low Incentive	\$633.9	4.7
Moderate Incentive	\$594.3	2.8
Aggressive Incentive	\$795.1	2.3

Table 1-2: TRC Net Benefits and Benefit-Cost Ratios

<b>Scenario</b>	<b>Net Benefits (Millions)</b>	<b>Benefit-Cost Ratio</b>
Low Incentive	\$524.7	2.9
Moderate Incentive	\$482.2	2.1
Aggressive Incentive	\$705.5	2.0

2.1 OVERVIEW OF CALCULATION METHODOLOGY

The general process used by Nexant in the DSM potential study is shown in Figure 2-1 and described in detail below.



<sup>1</sup> The Regional Technical Forum and the Database for Energy Efficient Resources

Figure 2-1: DSM Potential Calculation Process

While the specific process of evaluation for each sector varied slightly, the general process for calculating the savings potential was the same across all sectors. Nexant conducted this analysis using three primary steps as described below.

### 2.1.1 Baseline Definition

Nexant first characterized the baseline characteristics of CPS Energy's electricity consumption and building stock by breaking it down in sub-sectors and end-uses. Defining a baseline allowed Nexant to calculate the expected saturation and prevalence of energy efficient measures. Nexant drew from a large collection of sources including data provided by CPS Energy, regional reports, and sector-specific trend data.

### 2.1.2 Measure Definition

The second overall step in the process was to identify measures that may be applicable to CPS Energy's customers. To ensure a comprehensive analysis of energy end uses and potentially achievable savings, Nexant's analysis began with a "bottom up" approach that examined measure-specific impacts and cost data. Nexant pulled measures from CPS Energy's current programs, other utility DSM programs, and market research of emerging technologies to build a list of potential DSM measures and group by end-use.

Once a comprehensive list of measures was assembled, a database was built defining the energy and demand impact, cost, and lifetime of each measure. Nexant used its extensive experience with implementing DSM programs to determine much of this information. Data was also taken from large DSM databases such as the Northwest Power and Conservation Council's Regional Technical Forum (RTF) and California's Database for Energy Efficient Resources (DEER).

- The measure cost data differentiate between type of cost (capital, installation labor, maintenance, etc.). In this way, retrofit (capital plus installation labor plus incremental maintenance), new construction (incremental capital and maintenance), and burnout costs (incremental capital and maintenance) can be separately evaluated for measures that can be adopted in different implementation modes.
- Where appropriate, measure savings were calculated to best reflect CPS Energy's service territory. Weather-sensitive end uses were analyzed based on typical climate data for San Antonio. Home and building prototypes were modeled for both existing and new dwellings and facilities

Once measure data was assembled, measures were individually screened for cost effectiveness using the Total Resource Cost (TRC) test. The TRC test analyzes cost-effectiveness from a broad societal perspective, which seeks to determine whether the cost of generating and delivering a particular amount of energy is greater or less than the cost of implementing a particular DSM measure to save that amount of energy. Benefits are measured by the avoided costs of utility energy supply (e.g., electrical, gas, and other energy costs, as well as avoided capacity costs). TRC costs include the incremental costs of purchasing, installing, and maintaining the energy efficiency measure and is shown in Equation 2.1:

$$TRC = \frac{\Delta kWh \times \text{Utility Avoided Cost}}{\text{Measure Cost}} \quad \text{Equation 2.1}$$

For add-on measures, such as control systems on existing, operational equipment (such as occupancy sensors and variable speed drives), the measure cost includes the full equipment and labor cost for measure installation. For measures that are implemented upon burnout of existing equipment or new construction measures, the incremental cost of the high efficiency option versus the standard efficiency option was applied as the measure cost.

To incorporate the contribution of free ridership, the formula is multiplied by a Net to Gross ratio that accounts for the share of the savings due to free ridership. Net to Gross Ratio values were derived from the values recommended by the California Public Utilities Commission.

Measures that do not pass the TRC test are screened out and not included in the calculation of economic or achievable potential.

### 2.1.3 Economic and Achievable Potential Calculation

Economic potential is an alternative forecast to the baseline forecast that was calculated by substituting the most efficient “economic” DSM technologies (i.e., measures that pass the TRC test) at the measure and end-use level for all applicable facilities and customers in CPS Energy’s service territory. The concept of economic potential, in use by DSM practitioners since the late 1980s, has often been used to identify the sectors and end uses that appear to be associated with the largest amounts of energy savings potential. The concepts have not been used to represent how much potential *could* be achieved, but simply to focus research efforts on the sectors and end uses that have higher savings potentials.

Achievable potential applies customer and market characteristics to the economic DSM technologies to determine the potential that could be achieved based on the type of program treatment applied. The achievable potential was calculated by incorporating the cost effective measures into the defined baseline and applying appropriate market penetration rates. The market penetration rate is the rate of acceptance of a DSM program or measure over time. Nexant’s extensive experience with DSM program implementation and forecasting was used to construct market penetration rate curves for each measure or end-use. Because program implementation scenarios have a direct influence over such market penetration rates, Nexant’s approach also incorporated sets of market penetration curves corresponding to the following implementation scenarios:

- “Low” incentives: This scenario assumes market penetration rates projected for financial incentives that subsidize 25% of an energy end-user’s incremental measure costs, and a program implementation strategy centered on marketing/outreach tactics.
- “Moderate” incentives: Market penetration rates are projected for financial incentives that subsidize 50% of an energy end-user’s incremental measure costs, and a program implementation strategy that features increased marketing/outreach activities.

- “Aggressive” incentives: Market penetration rates are projected for financial incentives that subsidize 75% of the incremental cost of energy efficiency measures, coupled with a program implementation strategy that features much more aggressive marketing, direct outreach, and technical service offerings.

Figure 2-2 and Figure 2-3 present families of market penetration curves utilized in the Nexant analysis. Nexant’s market penetration curves differentiate between retrofit opportunities, and market opportunities available when end users are already considering energy technology purchase (e.g., upon natural replacement of equipment that burns out, or in new construction applications). The curves further differentiate penetration rates according to how quickly various technologies are typically adopted into the market.

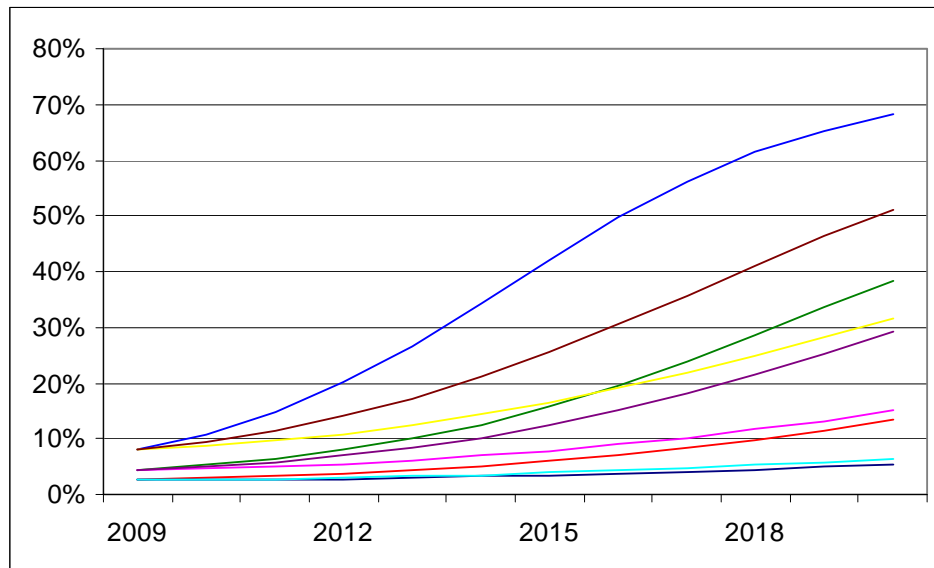


Figure 2-2: Market Penetration Curves – Retrofit Opportunities

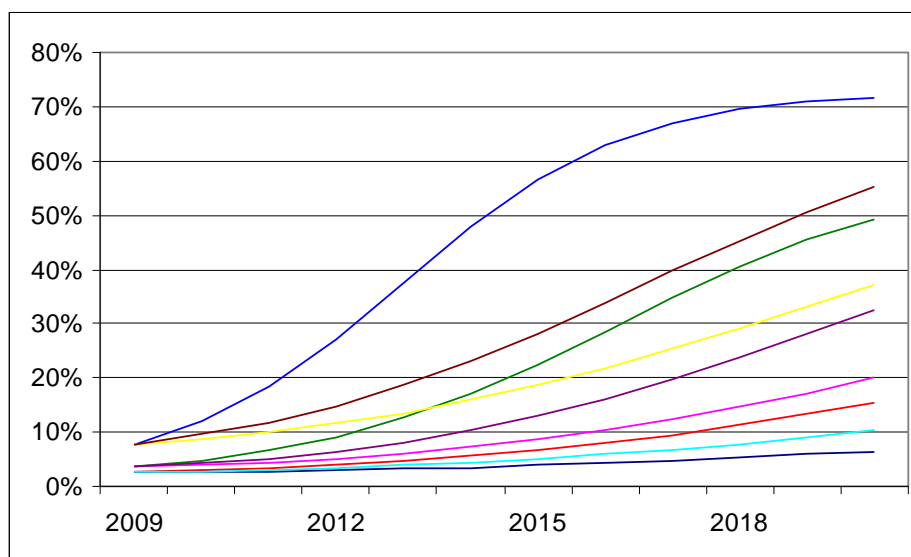


Figure 2-3: Turnover/New Construction Opportunities

For each market segment and end-use combination, Nexant estimated the potential efficiency and costs of future measures serving the same segments and end uses. The measures modeled in the initial year are all available in the marketplace, and costs and impact estimates are relatively well known. Future measures are expected to be available at *approximately* the magnitude of cost and proportionate impacts, but actual impacts and costs depend on a variety of factors (e.g., new codes and standards, future technology development, commercialization and market acceptance, etc.).

Program costs, including administrative and marketing costs are estimated as a portion of the overall cost of program implementation (i.e., including incentives). For the low incentive scenario, administrative costs are estimated to have a higher share of overall costs. For the moderate and aggressive incentive scenarios, the administrative costs have a lower share of overall program costs. Market penetration rates applied to each end-use and market segment included consideration of the level of program marketing.

#### 2.1.4 Program Economic Analysis

Nexant's economic analyses summarized cost-effectiveness for the overall portfolio of savings, as well as the sector level and end-use level from four perspectives—the Utility Cost Test (UCT), Total Resource Cost (TRC), the Ratepayer Impact Measure (RIM), and the Participant Cost Test (PCT) perspectives.

- The UCT perspective assesses cost-effectiveness to the utility (or program administrator), and indicates whether the cost of implementing energy efficiency measures or programs is greater or less than the cost of generating and delivering a particular amount of energy. Benefits are measured by the avoided costs of utility energy supply (e.g., electrical, gas, and other energy costs, as well as avoided capacity costs). Costs include the total program costs

to the utility including incentive payments plus any administrative costs to implement programs.

$$UCT = \frac{\Delta kWh \times \text{Utility Avoided Cost}}{\text{Incentives} + \text{Program Admin \& Marketing}} \quad \text{Equation 2.2}$$

- The TRC test, described in Section 2.1.2 above, seeks to determine whether the cost of generating and delivering a particular amount of energy is greater or less than the cost of implementing measures or programs to save that amount of energy. Benefits are measured by the avoided costs of utility energy supply. From a DSM program perspective, TRC costs include both the incremental costs of purchasing, installing, and maintaining energy efficiency measures plus any administrative costs to implement programs (program administrative costs were not included in the measure-level analysis).

$$TRC_{\text{Program}} = \frac{\Delta kWh \times \text{Utility Avoided Cost}}{\text{Measure Cost} + \text{Program Admin \& Marketing}} \quad \text{Equation 2.3}$$

- The RIM test analyzes cost-effectiveness from an electricity ratepayer perspective, which seeks to determine whether the effects of energy program implementation would cause electricity rates to go up or go down as compared to a baseline resource plan without the program. Benefits are measured by the avoided costs of electric utility energy supply (e.g., electrical energy costs, as well as avoided capacity costs). RIM costs include any administrative costs to implement programs, plus any direct financial incentives given to customers who implement energy efficiency measures, plus revenues lost as a direct result of the energy efficiency programs.

$$RIM = \frac{\Delta kWh \times \text{Utility Avoided Cost}}{\text{Incentives} + \text{Program Admin \& Marketing} + \text{Utility Lost Revenues}} \quad \text{Equation 2.4}$$

- The PCT perspective assesses cost-effectiveness to participants, and indicates whether participation in a program would result in net benefits to a customer. Benefits are measured by the reduction in participants' energy costs plus any incentives received to offset energy-efficiency measure costs. Costs include the incremental costs of purchasing, installing, and maintaining energy-efficiency measures.

$$PCT = \frac{\Delta kWh \times \text{Retail Electric Rate} + \text{Incentives}}{\text{Measure Cost}} \quad \text{Equation 2.5}$$

### 3.1 SUMMARY OF RESIDENTIAL POTENTIAL

In 2009, the residential sector will account for 43% of CPS Energy sales with 8,647 GWh of electricity sold. CPS Energy has several existing energy efficiency programs for the residential sector: Central AC Rebates, Window AC Rebates, Home Efficiency and CFL rebates among others. Building on its experience assessing DSM programs for various utilities throughout the United States, Nexant has developed a Residential Model tailored to CPS Energy market specificities which forecasts energy and demand savings from 2009 through 2020.

Through year 2020, Nexant's residential model forecasts a cumulative achievable peak demand reduction potential of 241 MW along with a cumulative energy savings potential of 1,424 GWh (for the aggressive incentive scenario). This stream of savings will be supplied at a total cumulative cost of \$366 million (incentives, administrative and marketing costs) over the next 12 years.

The residential sector economical potential, which assumes 100% market penetration of all cost-effective measures, amounts to 2,403 GWh, with a peak demand reduction of 417 MW. A summary of the cumulative energy savings through 2020 for the economic and the three achievable potential scenarios, as well as the percent reduction of the 2020 residential baseline forecast, are listed in Figure 3-1.

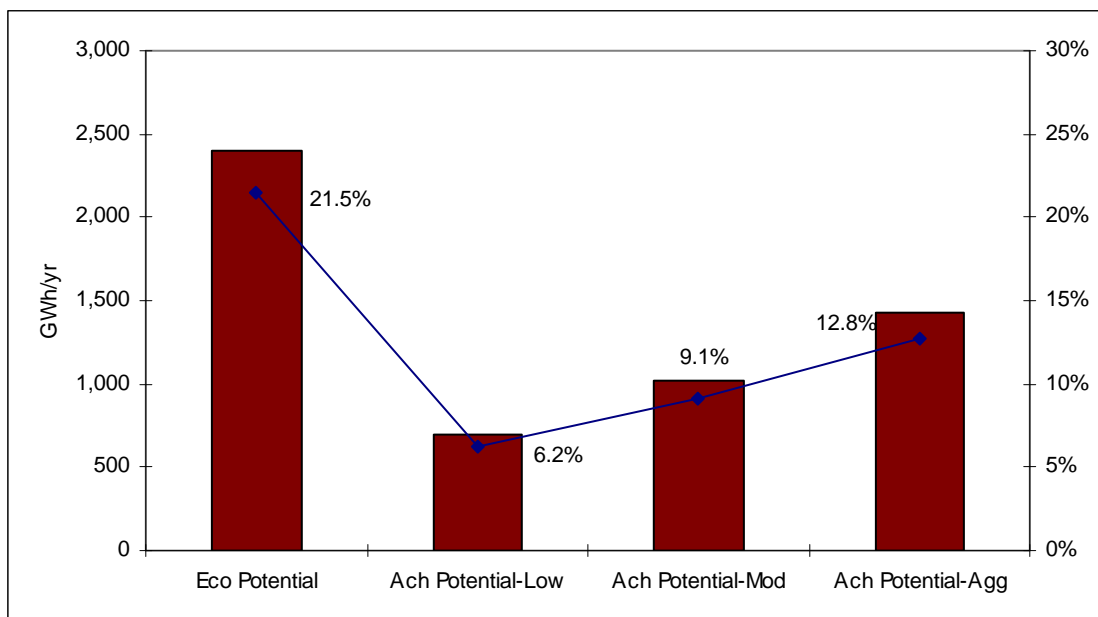


Figure 3-1: Residential Sector Energy Saving Potentials

The peak-demand savings and percent reduction in the 2020 baseline peak demand forecast for each scenario are summarized in Figure 3-2:

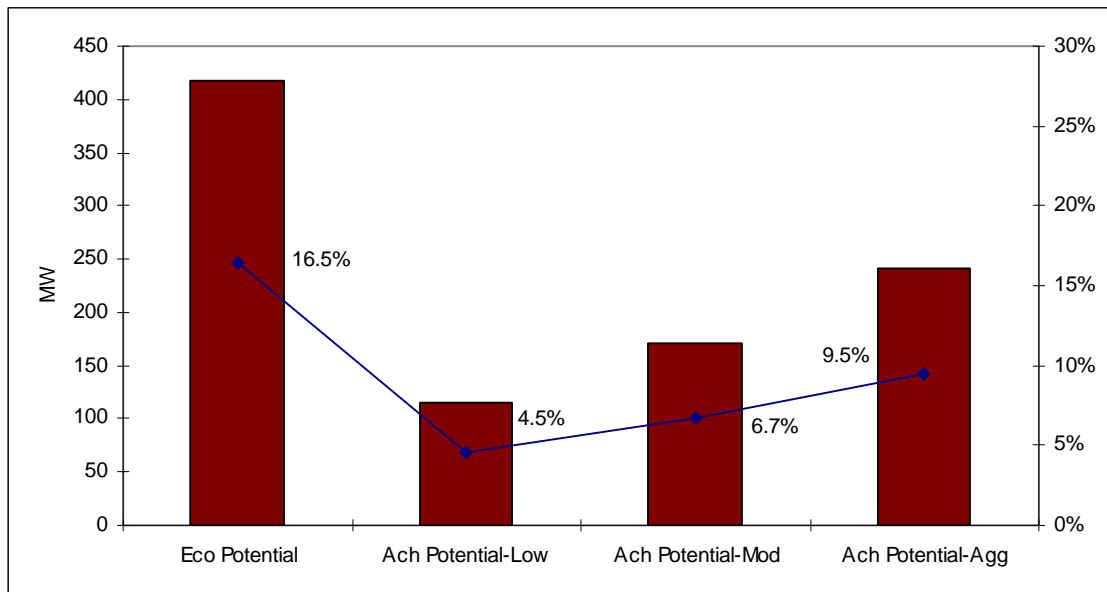


Figure 3-2: Residential Sector Peak Demand Reduction Potentials

For both energy and peak demand savings, the end-uses contributing the most to the savings are HVAC and lighting (with savings between 70% and 82% of the total potential). The rest of the potential is shared between end-uses such as Appliances, Water Heating and Home Electronics. Figure 3-3 and Figure 3-4 detail the end-use breakdown of achievable energy savings and peak-demand savings in 2020.

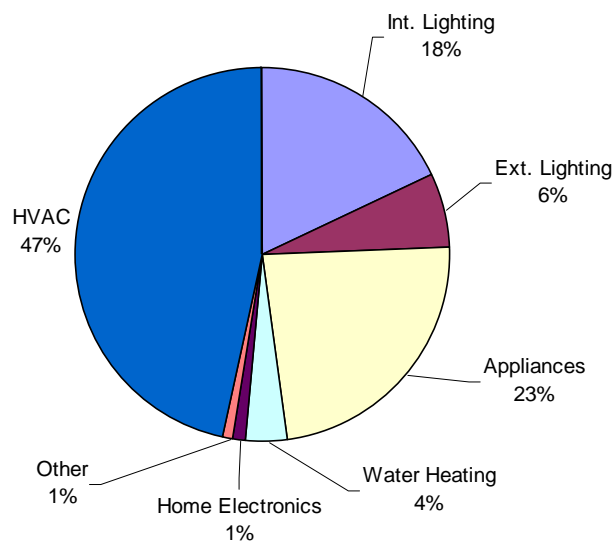


Figure 3-3: Energy Savings Breakdown by End-use (Aggressive Incentive)

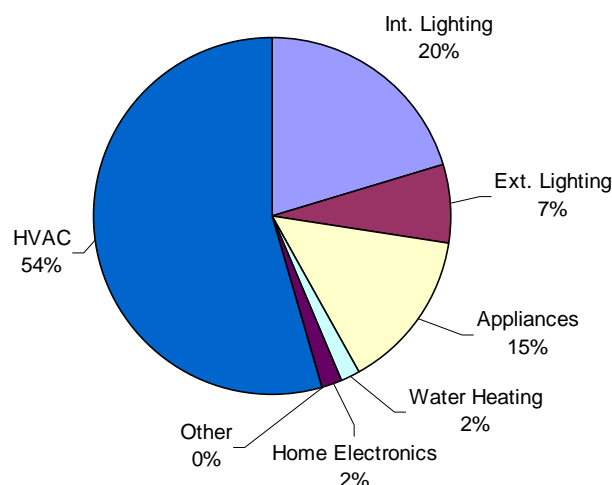


Figure 3-4: Peak Demand Reduction Breakdown by End-use (Aggressive Incentive)

## 3.2 RESIDENTIAL POTENTIAL MODEL

### 3.2.1 Overview

The Residential DSM Potential Model was developed in three successive steps. First, Nexant developed a baseline of the residential sector energy consumption using a bottom-up approach broken down by end-uses (refrigerator, air conditioner, lighting, etc.). Once the baseline was developed and the most energy intensive end-uses identified, Nexant built a list of potential energy efficiency measures. Those measures then underwent a screening process based on a Total Resource Cost Test. In the last step the selected measures were incorporated into Nexant's DSM model. The model applies program-specific market penetrations to each measure and forecasts energy savings for the 2009-2020 period.

### 3.2.2 Baseline Energy consumption

In the residential sector the development of achievable potential requires using the following methodology to disaggregate the energy use forecast and create a bottom-up model that breaks out energy consumption by end use:

- Use population forecast data for the residential sector for the next twelve years
- Calculate end use saturations for the following end-uses:
  - Electric Furnace
  - Electric Room Heating
  - Heat Pumps (Heating)
  - Central AC Units
  - First Refrigerators
  - Second Refrigerators
  - Freezers
  - Electric Clothes Dryers

- Heat Pumps (AC)
  - Room AC Units
  - Cooking Range
  - Dishwashers
  - Clothes Washers
  - Electric Water Heaters
  - Televisions
  - Lighting
  - Plug Load
- Determine end use Unit Energy Consumptions (UEC) for each separate end use (kWh/year for each home).
  - Use the population data, end use saturations, and end use intensities to build a bottom-up model of CPS Energy's residential sector energy usage.

Data from similar Nexant market potential studies, as well as available data from other DSM potential and saturation studies throughout the US (including the PacifiCorp 2006 Potential DSM Study, California Statewide Appliance Saturation Survey, and Colorado 2006 DSM Market Potential Assessment) was used to determine both UECs and saturations.

### 3.2.3 Measure Screening

Once the baseline established, a list of energy efficiency measures was created using data from Nexant's database. This database includes several hundred energy efficiency measures. Information such as measure lifetime, energy savings, administrative costs, and incremental costs was extracted from the database. Each measure was then screened using the TRC test as described in Section 2. A full list of measures and the screening results is included in Appendix B.

### 3.2.4 Achievable Potential

The achievable potential was calculated based on the measures passing the cost-effectiveness screening. Individual market penetration rates were applied to each measure. The market penetrations are average market penetration values achievable at the given scenario's incentive level. Those values are drawn from a large panel of DSM Potential studies conducted for various utilities throughout the US (PacifiCorp, PG&E, NYSERDA, Bonneville Power Administration, Northwestern Energy, Georgia Power, PG&E, Southern California Edison, and others) and from Nexant's staff experience administering and evaluating various residential DSM programs.

## 3.3 RESIDENTIAL END-USE SUMMARY

The end-uses yielding the most savings and the measures they encompass are detailed below. All figures mentioned thereafter refer to the aggressive incentive scenario.

### 3.3.1 Residential HVAC

The HVAC end-use accounts for 47% of the achievable energy savings for the residential sector in 2020. This end-use encompasses a wide array of measures that apply to both upgrades for

HVAC equipment as well as measures that improve the performance of the building shell (such as increased levels of insulation, air infiltration control, and duct sealing). The relative contributions from these measures to the overall HVAC savings potential in 2020 include:

- Central Air Conditioner upgrade: 13%
- Energy Star Home: 12%
- Programmable Thermostat: 17.4%
- Insulation: 4%
- Duct Sealing: 4%

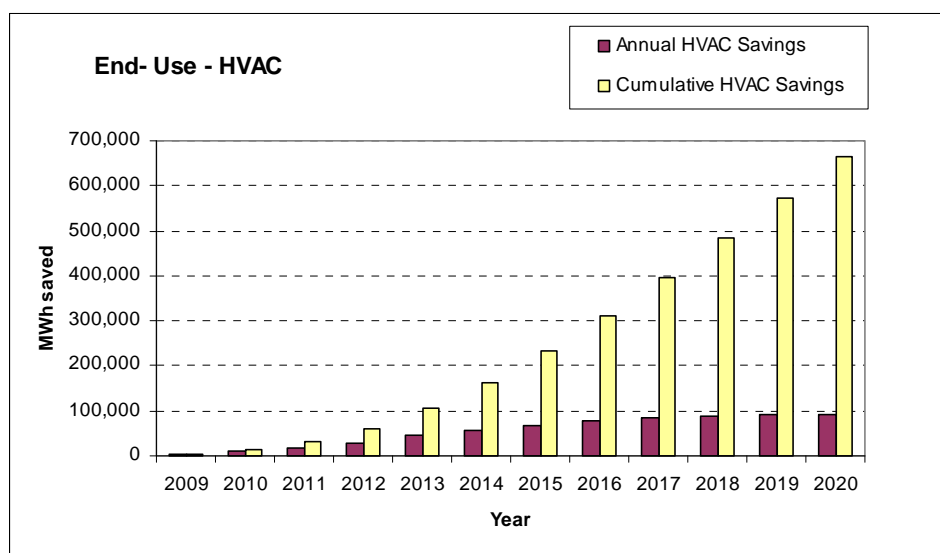


Figure 3-5: Residential HVAC Energy Saving Forecast

### 3.3.2 Residential Lighting

Lighting alone will yield 24% of the cumulative energy demand savings for the residential sector by 2020. This end-use primarily includes compact fluorescent (CFL) lamps and ENERGY STAR light fixtures for both indoor and outdoor applications.

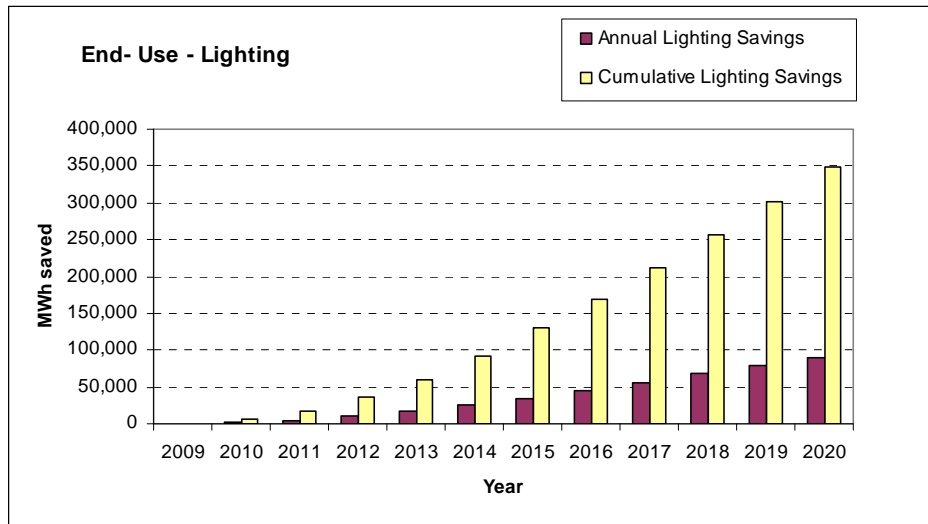


Figure 3-6: Residential Lighting Energy Savings Forecast

### 3.3.3 Residential Appliances

Appliance energy efficiency measures will provide 23% of the total residential energy savings by 2020. Most of the demand reduction will come from measures such as ENERGY STAR Refrigerators, Freezers, Clothes Washers, and Dishwashers, as well as recycling of old and secondary refrigerators and freezers.

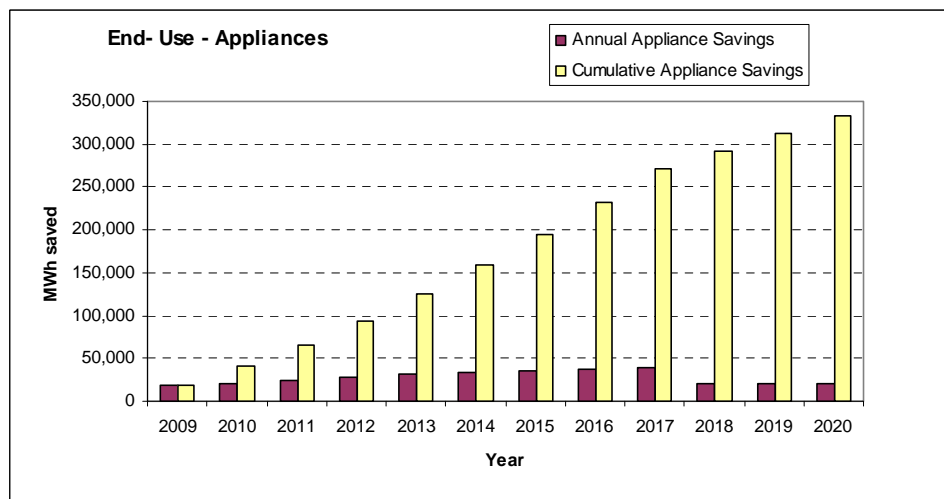


Figure 3-7: Residential Appliances Energy Saving Forecast

### 3.3.4 Home Electronics, Water Heating, and Miscellaneous

The remainder of the residential energy and demand savings result from measures included in the home electronics, water heating, and miscellaneous categories. Some of the cost-effective measures contributing to the savings total include:

- Smart Strip Surge Protector .This device automatically shuts down electronic devices drawing idle current when being on stand-by mode.
- Water heater pipe and tank insulation, water heater upgrade, reduced-flow showerheads and gravity film heat exchanger.

### 3.4 RESIDENTIAL END-USE ECONOMIC ANALYSIS

The total implementation and program costs have been estimated to assess the cost-effectiveness of the proposed residential sector measures, and are listed in Table 3-1:

Table 3-1: Residential Sector Implementation and Program Costs

Scenario	Participant Costs (NPV million \$)	Program Incentives (NPV million \$)	Program Admin & Marketing (NPV million \$)
Low Incentive	\$104	\$26	\$78
Moderate Incentive	\$142	\$71	\$132
Aggressive Incentive	\$195	\$146	\$219

Figure 3-8 and Figure 3-9 compare the residential sector UCT and TRC benefits and costs.

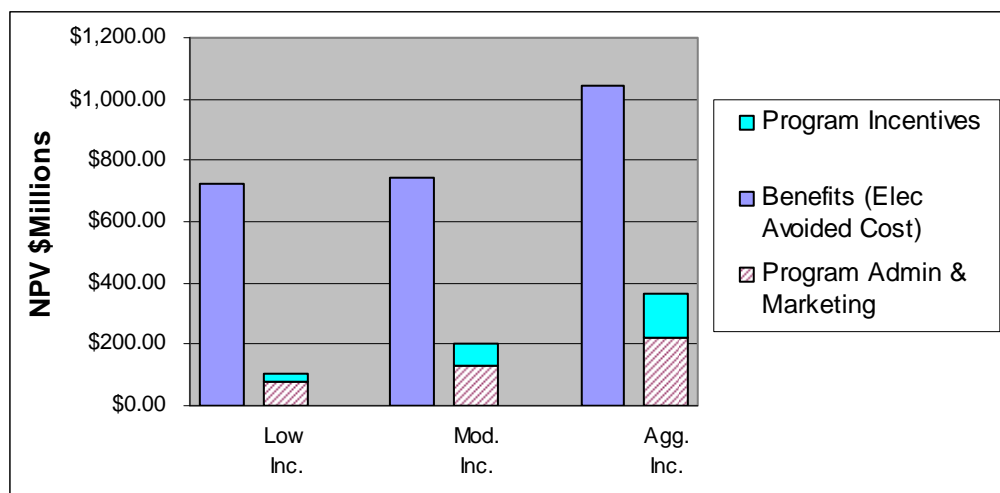


Figure 3-8: Residential Sector UCT Benefits and Costs

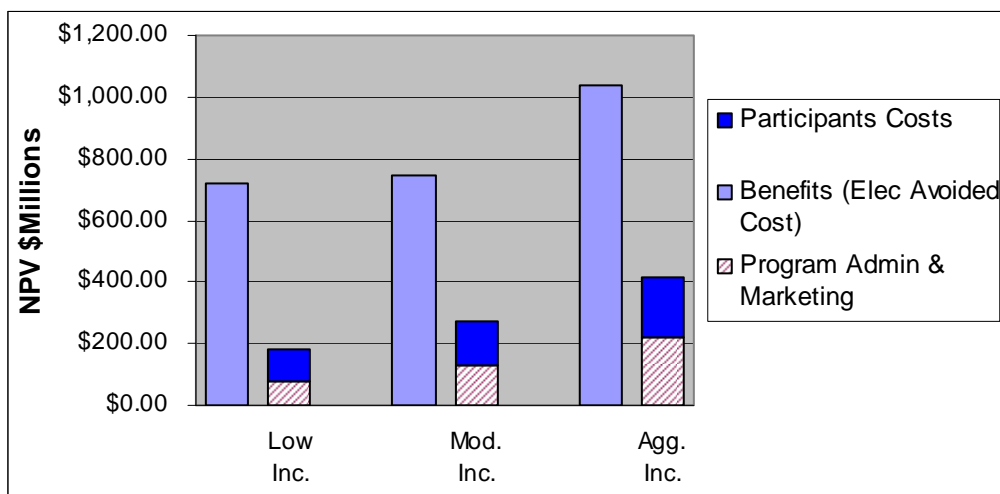


Figure 3-9: Residential Sector TRC Benefits and Costs

Table 3-2 lists the benefits and costs from UCT and TRC perspective by end-use, of the aggressive incentive scenario.

Table 3-2: UCT and TRC Net Benefits and Benefit-Cost Ratios for Residential Sector by End Use (Aggressive Incentive)

Scenario	UCT (NPV million \$)		TRC (NPV million \$)	
	Net Benefits	BC Ratio	Net Benefits	BC Ratio
Residential HVAC	\$484	2.9	\$451	2.6
Residential Lighting	\$104	6.4	\$102	5.6
Residential Appliances	\$67	1.9	\$57	1.7
Residential Water Heating	\$19	2.2	\$17	2.0
Residential Home Electronics	-\$2	0.7	-\$3	0.6
Residential Other	\$2	6.6	\$2	5.9
<b>Total</b>	<b>\$675</b>	<b>2.8</b>	<b>\$626</b>	<b>2.5</b>

4.1 SUMMARY OF COMMERCIAL POTENTIAL

CPS Energy’s commercial sector consumes 50% of the total 2009 electricity sales and accounts for a 60% of the total demand. The commercial sector covers a large spectrum of customers and is characterized by a high degree of variation in electricity consumption.

Nexant calculated total achievable potential energy savings to be 1,119 GWh in 2020 with peak demand savings of 319 MW. These energy savings and demand reduction will result in a total cumulative cost of \$259 million (incentives, administrative and marketing costs) over the next 12 years.

The commercial sector economical potential amounts to 3,263 GWh, with a peak demand reduction of 889 MW. A summary of the cumulative energy savings for the economic and the three achievable potential scenarios through 2020, as well as the percent reduction of the 2020 commercial baseline forecast, are listed in Figure 4-1 and Figure 4-2.

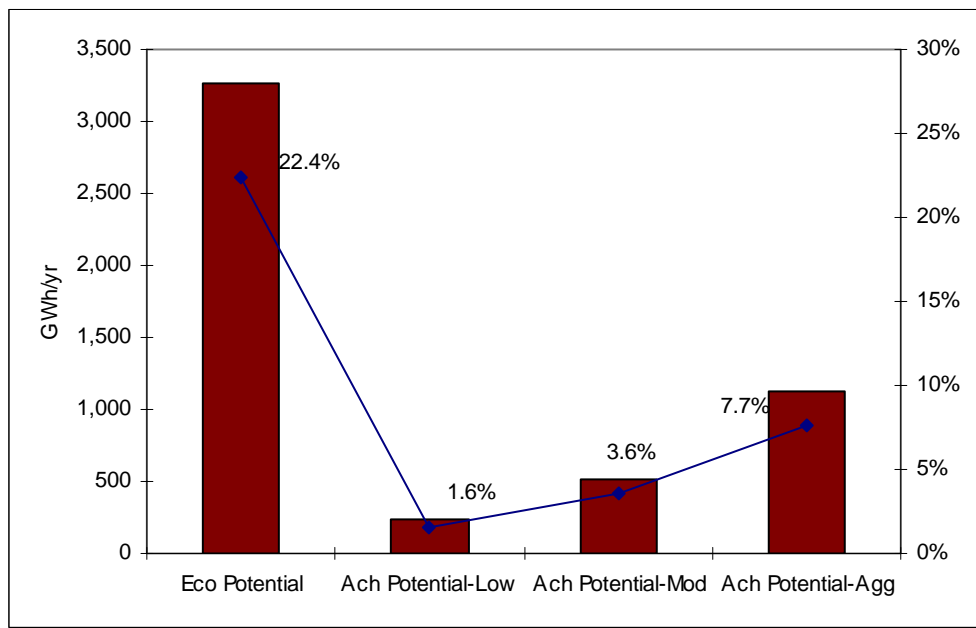


Figure 4-1: Commercial Sector Energy Saving Potentials

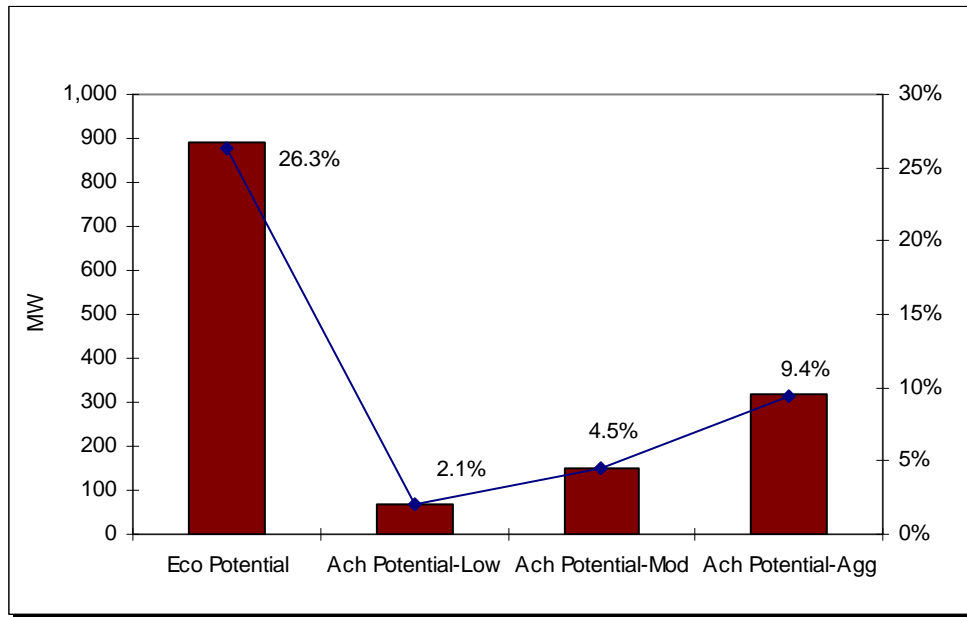


Figure 4-2: Commercial Sector Demand Reductions Potentials

The suite of potential energy efficiency measures which were evaluated for the commercial sector was aggregated into the appropriate end-use categories. The achievable energy savings and peak demand reduction potential broken by end-use is shown in Figure 4-3 and Figure 4-4, respectively.

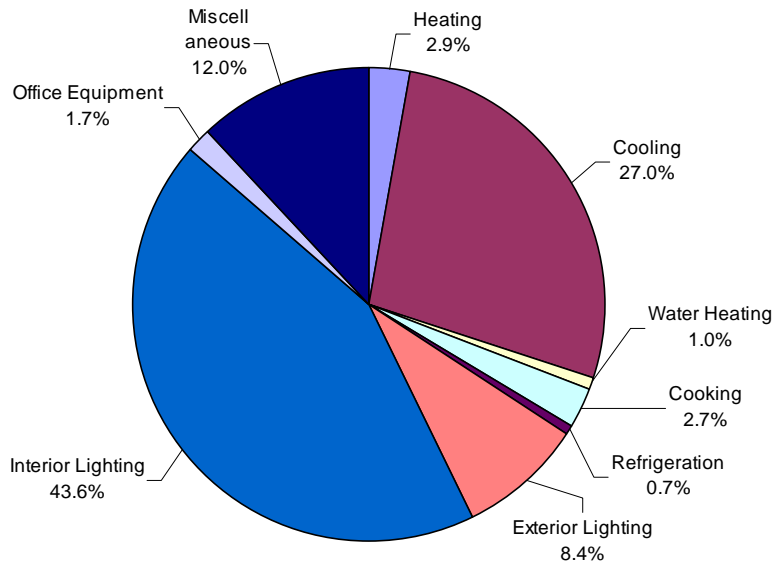


Figure 4-3: Achievable Energy Savings by End Use

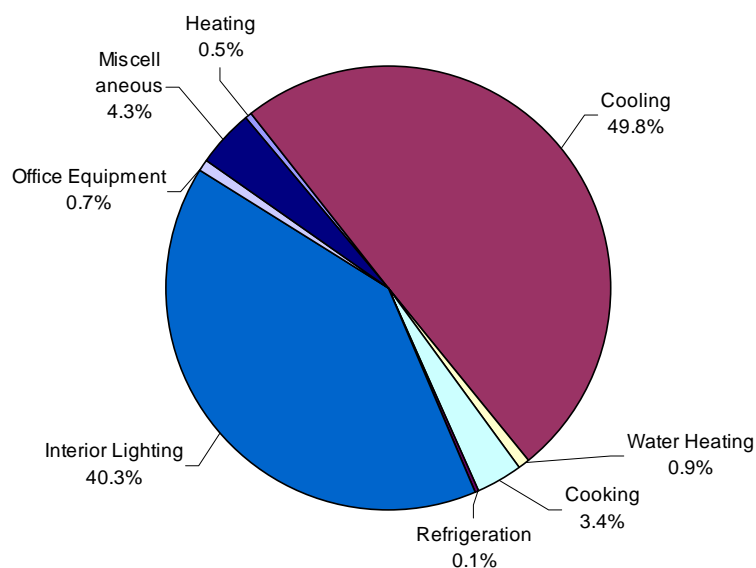


Figure 4-4: Achievable Peak Demand Reduction by End Use

## 4.2 COMMERCIAL POTENTIAL MODEL

### 4.2.1 Overview

The commercial potential model was developed following the same general steps as the residential model. First the baseline energy consumption of the CPS Energy commercial sector was classified by sector. Next a database of energy efficient measures was created which drew from the measures offered by other utility companies as well as emerging technologies. Like the residential sector, these measures were screened using the Total Resource Cost Test. Nexant then built a model which applies the selected measures to CPS Energy's baseline data and calculates the demand reduction energy savings for each measure.

### 4.2.2 Baseline Energy Consumption

The commercial sector's energy consumption was broken down according to the sub-sectors typical of DSM forecast studies. These sub-sectors are readily defined and recognized as predominant building types for DSM forecasting. The sectors include:

- Office
- Food Service
- Retail
- Food Store
- Warehouse
- Education
- Health
- Lodging
- Miscellaneous
- Military

Nexant calculated each sector's share of the total commercial electricity consumption using data provided by CPS Energy. In addition to characterizing the energy consumption by sub-sector,

commercial building energy use data from the U.S. DOE Energy Information Administration's West South Central region was also used to break down commercial building energy use and to establish estimates of the equipment stock and end-use intensity (EUI) for each measure evaluated. Figure 4-5 shows the existing energy consumption breakdown per sector as a percentage of the entire commercial stock.

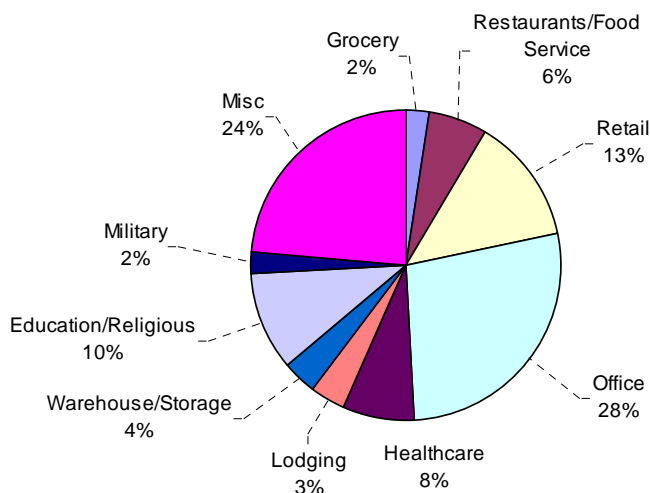


Figure 4-5: Commercial Sector Energy Breakdown

### 4.2.3 Measure Evaluation

Nexant created a database of measures to be evaluated for the commercial potential model. The database drew measures from the current CPS Energy programs, other utility DSM programs, and studies of emerging technologies. Once the list of measures was complete, the database was expanded to include energy savings, demand savings, measure lifetime, and customer costs for each measure. This information was either calculated or pulled from other measure databases. In all cases where measure information was taken from existing databases, the data was evaluated for appropriateness for the CPS Energy service territory. Key resources included:

- California Energy Commission's Database for Energy Efficient Resources (DEER)
- EIA Data
- PacifiCorp's 2008 Market Characterization Report

The measures were grouped based on their end-use savings. The following measure categories were used:

- Heating
- Cooling

- Water Heating
- Cooking
- Exterior Lighting
- Interior Lighting
- Refrigeration
- Office Equipment
- Miscellaneous

The measures were then screened using the Total Resource Cost test (TRC) described in Section 2. Appendix B lists the measures evaluated as part of the study and the results of the cost-effectiveness screening for each measure. To determine the applicable stock of measures present in CPS Energy's service territory, Nexant characterized each measure by a number of factors in each sub-sector. Nexant developed each factor by drawing from a host of DSM studies and past evaluations. Nexant evaluated the following factors to determine the eligible equipment stock for each measure:

- **Measure Applicability Factor.** The applicability factor is the fraction of floor stock that is applicable for each technology.
- **Incomplete Factor.** The incomplete factor is the fraction of applicable floor space that has not yet been converted to the measure.
- **Measure Share.** The measure share is the fraction of floor space that is feasible for conversion to the measure.
- **Measure Saturation.** Measure saturation describes the number of units of measure per square foot.

#### 4.2.4 Achievable Potential

The achievable potential is calculated by incorporating the feasible and economic measures into the commercial model. A market penetration rate is applied to the total savings to account for the percentage of eligible customers choosing to participate in the DSM program.

### 4.3 END USE SAVINGS SUMMARY

#### 4.3.1 Commercial HVAC

Commercial HVAC measures accounted for 30% of the achievable energy savings through 2020. Measures analyzed under this end use included:

- Equipment efficiency improvements such as high efficiency package air-conditioners, chillers, and heat pumps
- Equipment controls such as variable speed drives and energy management systems, and
- Building shell improvements, such as increased insulation, duct sealing, and window film.

Figure 4-6 lists the annual incremental and cumulative energy savings for commercial HVAC.

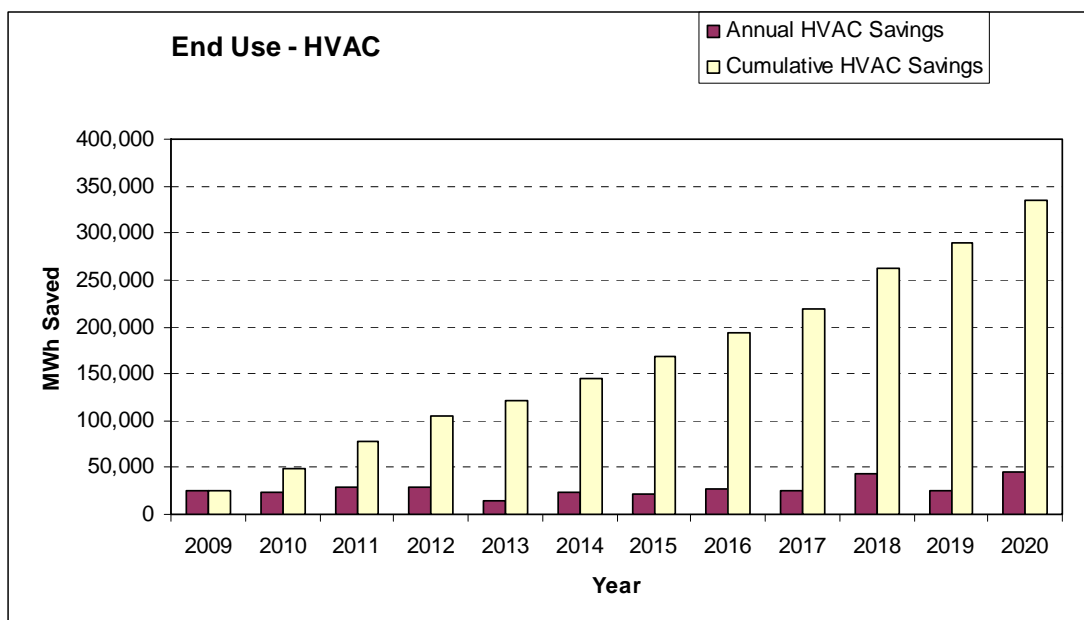


Figure 4-6: Commercial HVAC Annual and Cumulative Energy Savings

### 4.3.2 Commercial Lighting

52% of the cumulative energy savings in 2020 result from commercial lighting measures. Measures analyzed under this end use included

- Equipment efficiency improvements, such as the replacement of T-12 and first generation T-8 fluorescent fixtures with reduced wattage T-8 or T-5 fixtures, T-5 and HID high bay lighting, and metal halide or high pressure sodium exterior lighting,
- Lighting controls, such as occupancy sensors and daylighting opportunities, and
- Improved design in new buildings.

Figure 4-7 details the annual incremental and cumulative achievable potential calculated for commercial lighting.

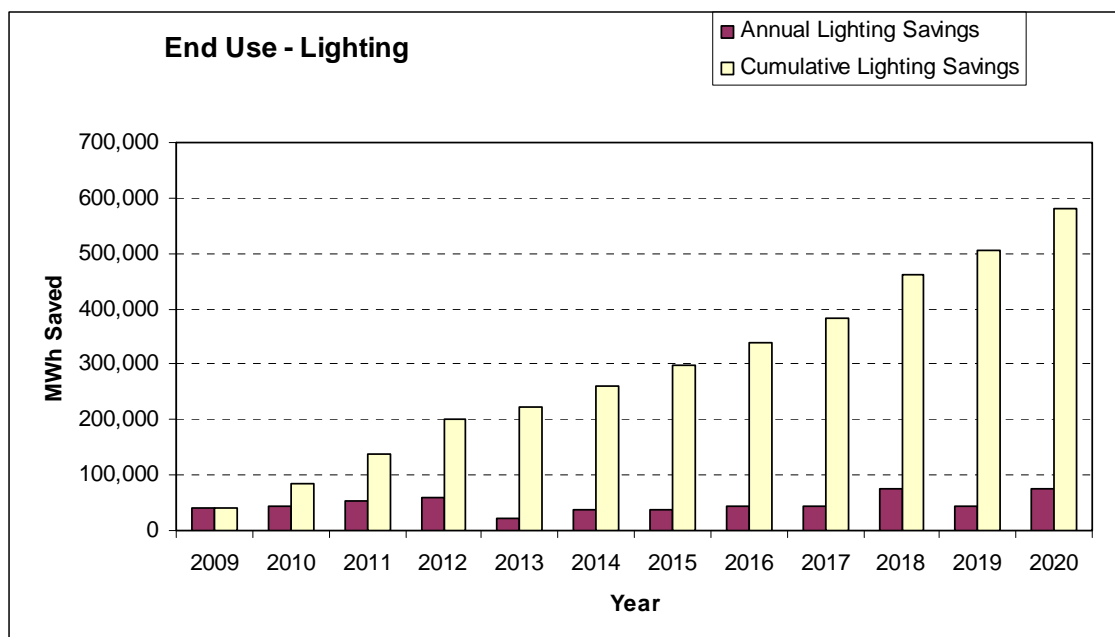


Figure 4-7: Commercial Lighting Annual and Cumulative Energy Savings

#### 4.3.3 Other Commercial End-Uses

The remaining 18% of the 2020 achievable energy savings is comprised of water heating, commercial cooking, refrigeration, office equipment, and miscellaneous categories. Cost-effective measures that contributed to the energy savings and demand reduction included:

- Water heating efficiency upgrades including tankless water heaters, as well as hot water pipe insulation.
- ENERGY STAR commercial cooking equipment including griddles, ovens, dishwashers, fryers, cookers, food holding cabinets and demand-controlled ventilation hoods.
- Grocery refrigeration equipment such as high efficiency display cases, anti-sweat heater controls, night covers, as well as control upgrades for commercial refrigeration equipment such as variable speed drives and floating head pressure control.
- Office equipment upgrades such as ENERGY STAR computers, monitors, and copiers, as well as network power management and plug load occupancy sensors.
- Data center and server efficiency improvements such as data center virtualization.
- High efficiency vending machines and vending machine controls.

#### 4.4 SAVINGS BY FACILITY TYPE

Figure 4-8 summarizes the energy savings by facility type, with offices have the highest savings potential of the facility categories analyzed.

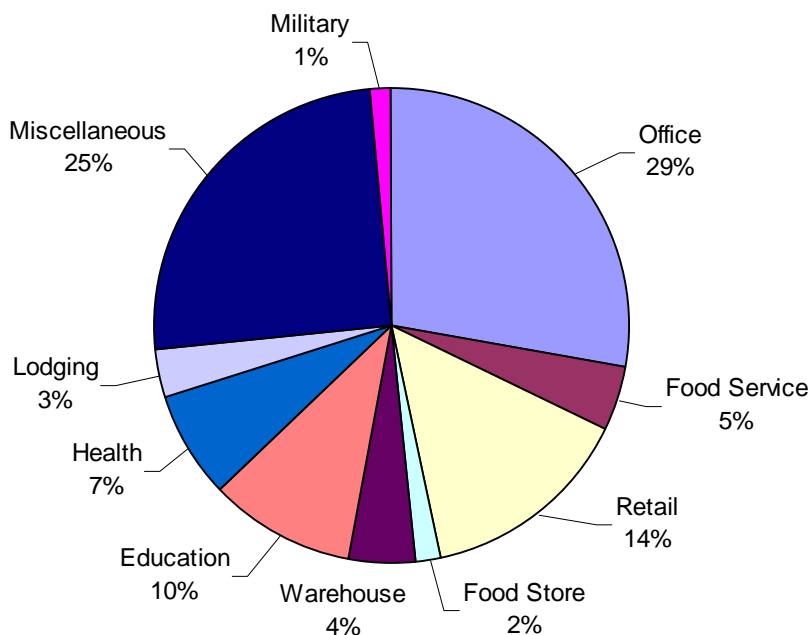


Figure 4-8: Energy Savings by Facility Type

#### 4.5 COMMERCIAL END-USE ECONOMIC ANALYSIS

The total implementation and program costs have been estimated to assess the cost-effectiveness of the proposed commercial sector measures, and are listed in Table 4-1:

Table 4-1: Commercial Sector Implementation and Program Costs

Scenario	Participant Costs (NPV million \$)	Program Incentives (NPV million \$)	Program Admin & Marketing (NPV million \$)
Low Incentive	\$40	\$10	\$56
Moderate Incentive	\$79	\$39	\$92
Aggressive Incentive	\$158	\$119	\$140

Figure 4-9 and Figure 4-10 display the commercial sector UCT and TRC benefits and costs.

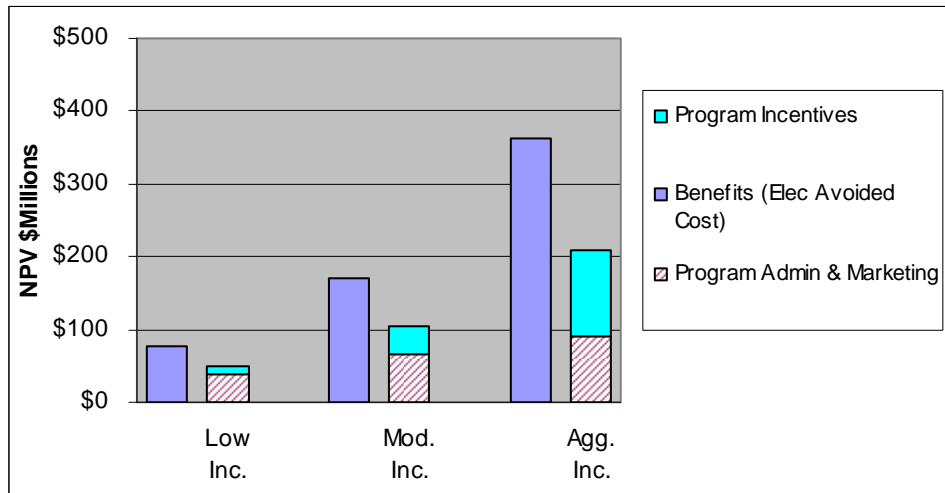


Figure 4-9: Commercial Sector UCT Benefits and Costs

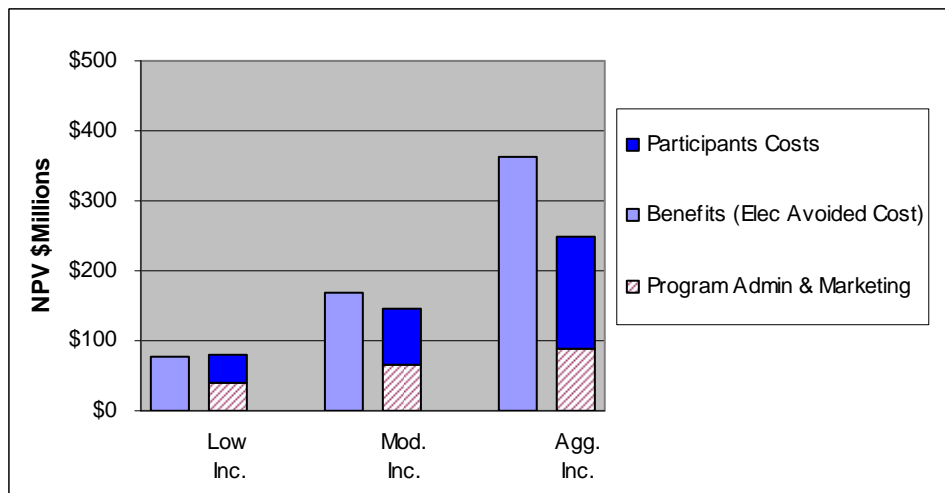


Figure 4-10: Commercial Sector TRC Benefits and Costs

Table 4-2 lists the benefits and costs from UCT and TRC perspective, by end use, of the aggressive incentive scenario.

Table 4-2: UCT and TRC Net Benefits and Benefit-Cost Ratios for Commercial Sector by End Use (Aggressive Incentive)

Scenario	UCT (NPV million \$)		TRC (NPV million \$)	
	Net Benefits	BC Ratio	Net Benefits	BC Ratio
Commercial HVAC	\$18	1.2	\$2	1.0
Commercial Refrigeration	\$20	4.2	\$2	3.7
Commercial Water Heating	\$31	2.4	\$3	2.1
Commercial Cooking	\$2	1.3	\$1	1.1
Commercial Lighting	\$62	1.5	\$44	1.3
Commercial Office Equipment	\$3	2.5	\$3	2.2
Commercial Other	\$12	1.5	\$9	1.3
<b>Total</b>	<b>\$103</b>	<b>1.4</b>	<b>\$63</b>	<b>1.2</b>

### 5.1 SUMMARY OF INDUSTRIAL POTENTIAL

Industrial facilities include unique equipment, processes, and operations. Therefore, while the industrial sector encompasses a relatively small percentage of CPS Energy's customers, because of the distinctive energy efficiency measures applicable to this sector, Nexant conducted an independent analysis of the industrial sector. As described in Section 5.2.2 below, Nexant included five NAICS codes (11, 21, 31, 32, and 33) in defining the industrial sector for the purposes of this potential study, which consumes 4% of the total 2009 electricity sales.

Nexant calculated total achievable potential energy savings to be 75 GWh in 2020 with demand savings of 9 MW. These energy savings and demand reduction will result in a total cumulative program cost of \$10 million (incentives, administrative and marketing costs) over the next 12 years.

The industrial sector economical potential amounts to 218 GWh, with a peak demand reduction of 26 MW. A summary of the cumulative energy savings for the economic and the three achievable potential scenarios through 2020, as well as the percent reduction of the 2020 commercial baseline forecast, are listed in Figure 5-1 and Figure 5-2.

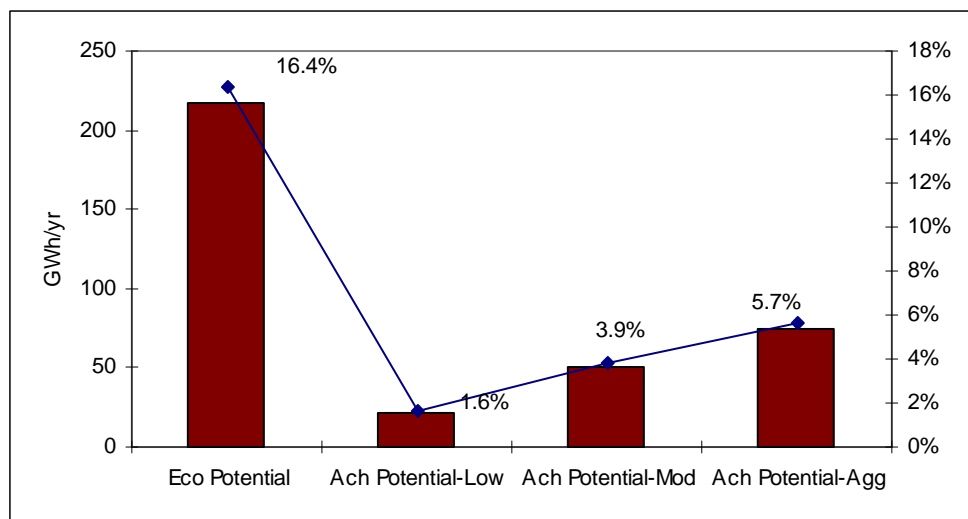


Figure 5-1: Industrial Sector Energy Savings Potentials

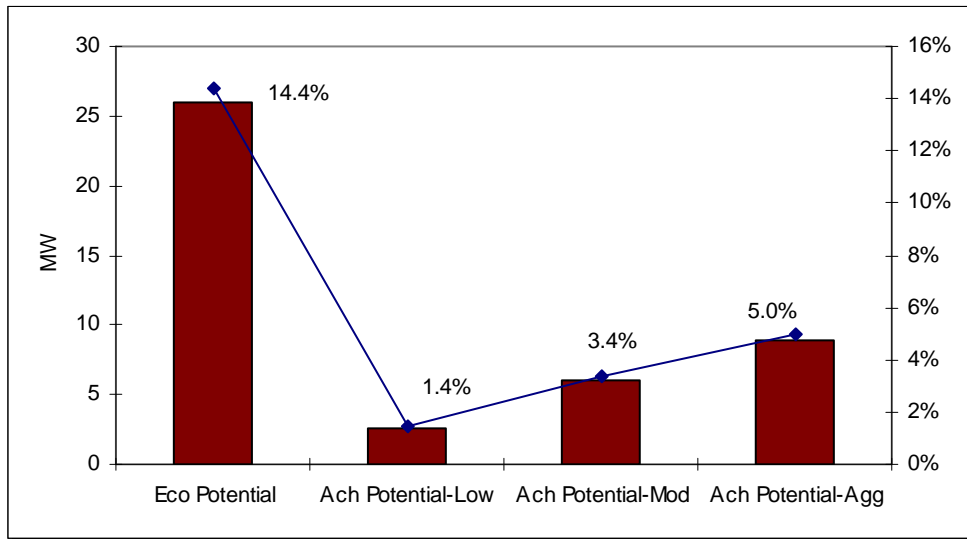


Figure 5-2: Industrial Sector Demand Reductions Potentials

The potential energy efficiency measures evaluated for the industrial sector were aggregated into the appropriate end-use categories. The achievable potential broken by end-use is shown in Figure 5-3.

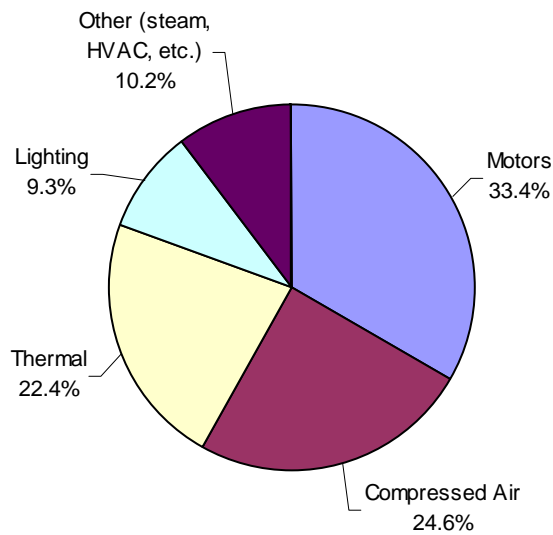


Figure 5-3: Achievable Energy Savings by End Use

## 5.2 INDUSTRIAL POTENTIAL MODEL

### 5.2.1 Overview

The industrial potential model was developed following the same general steps as the residential and commercial models, with the exception that energy sales, rather than floor area was used as the basis of the savings model. A database of energy efficient measures was created which drew from the measures offered by other utility companies and emerging technologies. Nexant then built a model which applies the selected measures to CPS Energy's baseline data and calculates the demand reduction energy savings for each measure.

### 5.2.2 Baseline Energy Consumption

The industrial sector's energy consumption was broken down according to the NAICS codes provided by CPS Energy. The primary industries in San Antonio included in the industrial sector analysis are:

- Agriculture, Forestry, Fishing and Hunting (NAICS Code: 11)
- Mining, Quarrying, and Oil and Gas Extraction (NAICS Code: 21)
- Textile (NAICS Code: 31)
- Plastic, paper and soap (NAICS Code: 32)
- Metal/Equipment (NAICS Code: 33)

Nexant calculated each industry's share of the total industrial electricity consumption using data provided by CPS Energy. Figure 5-4 shows the existing energy consumption breakdown per industry type as a percentage of the entire industrial stock.

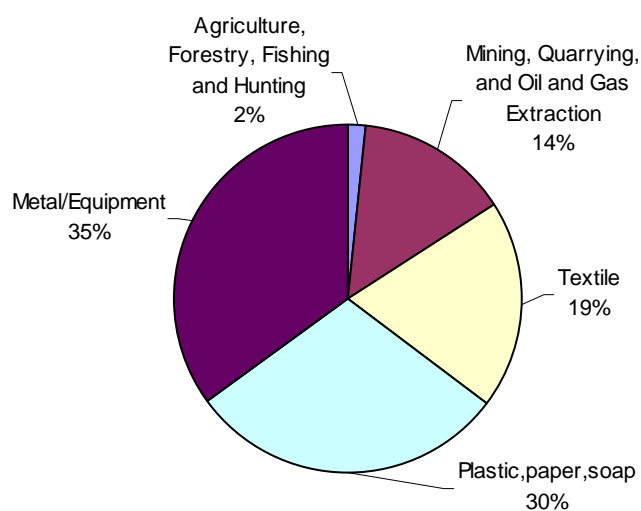


Figure 5-4: Industrial Sector Energy Consumption

### 5.2.3 Measure Evaluation

Nexant created a database of measures to be evaluated for the industrial potential model. The database drew measures from other utility DSM programs and studies of emerging technologies. Once the list of measures was complete, the database was expanded to include energy savings, demand savings, measure lifetime, and customer costs for each measure. This information was either calculated or pulled from other measure databases. In all cases where measure information was taken from existing databases, the data was evaluated for appropriateness for the CPS Energy service territory. Key resources included:

- California Energy Commission’s Database for Energy Efficient Resources (DEER)
- EIA Data
- PacifiCorp’s 2008 Market Characterization Report

The measures were grouped based on their end-use savings. The following measure categories were used for the industrial sector:

- Motors
- Compressed Air
- Thermal
- Lighting
- HVAC
- Miscellaneous

The measures were then screened using the Total Resource Cost test (TRC) described in Section 2. Measures that were found to be cost-effective were included in the calculation of economic and achievable potential. A list of measures and the results of the cost-effectiveness screening is included in Appendix B.

## 5.3 INDUSTRIAL END-USE ECONOMIC ANALYSIS

The total implementation and program costs have been estimated to assess the cost-effectiveness of the proposed industrial sector measures, and are listed in Table 5-1:

Table 5-1: Industrial Sector Implementation and Program Costs

Scenario	Participant Costs (NPV million \$)	Program Incentives (NPV million \$)	Program Admin & Marketing (NPV million \$)
Low Incentive	\$2	\$0.4	\$2
Moderate Incentive	\$4	\$2	\$3
Aggressive Incentive	\$5	\$4	\$6

Figure 5-5 and Figure 5-6 display the industrial sector UCT and TRC benefits and costs.

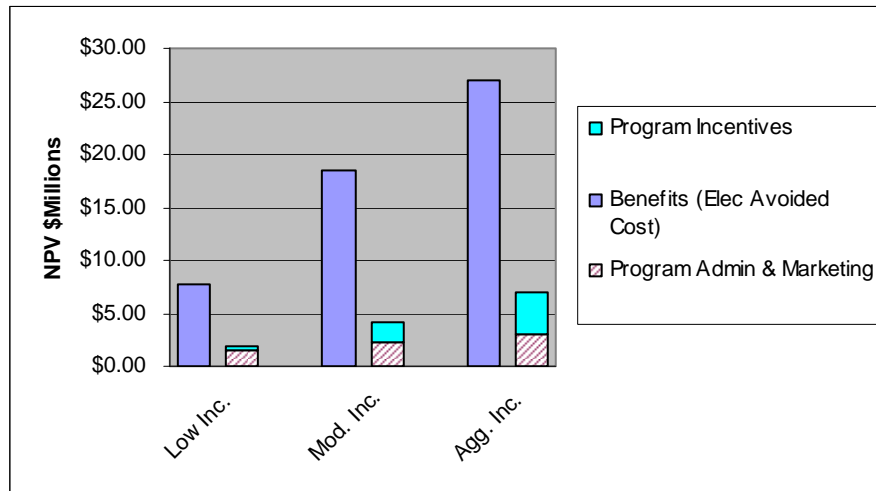


Figure 5-5: Industrial Sector UCT Benefits and Costs

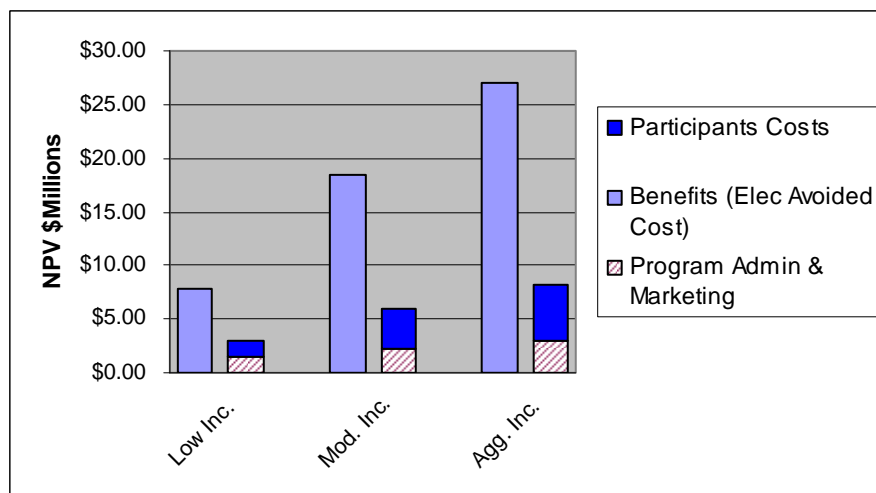


Figure 5-6: Industrial Sector TRC Benefits and Costs

Table 5-2 lists the benefits and costs from UCT and TRC perspective, by end use, of the aggressive incentive scenario.

Table 5-2: UCT and TRC Net Benefits and Benefit-Cost Ratios for Industrial Sector by End Use (Aggressive Incentive)

Scenario	UCT (NPV million \$)		TRC (NPV million \$)	
	Net Benefits	BC Ratio	Net Benefits	BC Ratio
Industrial Process Motors	\$7.5	6.0	\$7.3	5.3
Industrial Compressed Air	\$5.3	4.9	\$5.1	4.4
Industrial Process Thermal	\$5.0	5.5	\$4.8	4.9
Industrial HVAC	-\$0.9	0.7	-\$1.3	0.6
Industrial Lighting	\$0.5	1.2	\$0.1	1.0
Industrial Other	-\$0.1	0.0	-\$0.1	0.0
<b>Total</b>	<b>\$17</b>	<b>2.8</b>	<b>\$16</b>	<b>2.5</b>

6.1 TOTAL DSM POTENTIAL

The results of the residential, commercial, and industrial sector analysis were combined to calculate the total economic and achievable potential for CPS Energy, as shown in Table 6-1:

Table 6-1: Economic and Achievable Potential (Absolute and Percent of 2020 Forecast)

Load Type	Economic Potential		Achievable-Low Incentive		Achievable-Mod Incentive		Achievable-Agg Incentive	
<b>Residential</b>								
Reduction in Electricity Sales (MWh)	2,403,262	22%	695,546	6%	1,019,647	9%	1,424,499	13%
Reduction in Peak Demand (MW)	417	16%	115	4%	171	7%	241	9%
<b>Commercial</b>								
Reduction in Electricity Sales (MWh)	3,262,585	22%	233,111	2%	520,288	4%	1,118,773	8%
Reduction in Peak Demand (MW)	889	26%	70	2%	151	4%	319	9%
<b>Industrial</b>								
Reduction in Electricity Sales (MWh)	217,525	16%	21,647	2%	51,221	4%	75,202	6%
Reduction in Peak Demand (MW)	26	14%	3	1%	6	3%	9	5%
<b>Total</b>								
Reduction in Electricity Sales (MWh)	5,883,371	21%	950,304	3%	1,591,157	6%	2,618,474	9%
Reduction in Peak Demand (MW)	1,332	21%	187	3%	327	5%	569	9%

Figure 6-1 and Figure 6-2 detail the achievable cumulative annual peak demand reduction and energy savings contributions by sector (based on the aggressive incentive scenario):

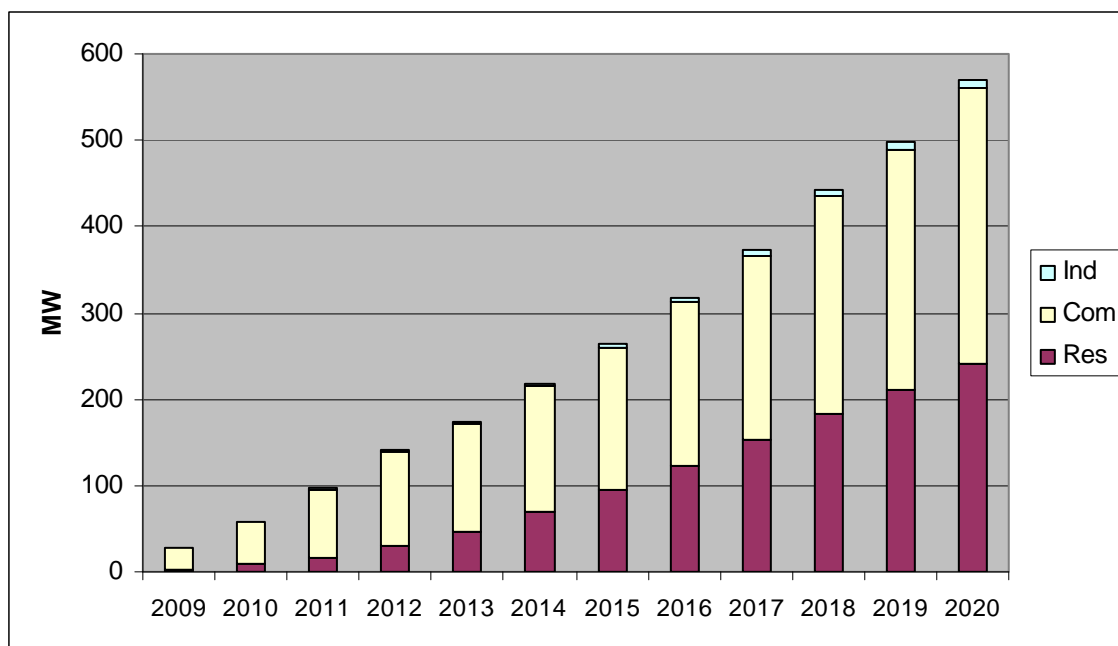


Figure 6-1: Total Annual Cumulative Peak Demand Reduction

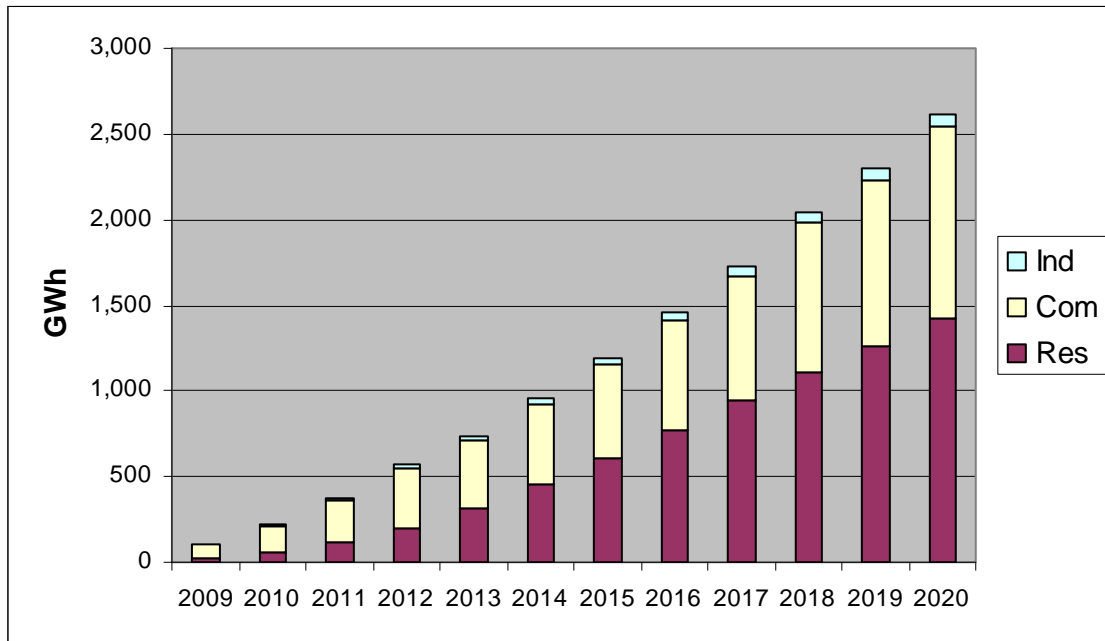


Figure 6-2: Total Annual Cumulative Energy Savings

Figure 6-3 and Figure 6-4 show the 2020 achievable energy savings potential by sector. The residential sector accounts for slightly more than half of theoretically achievable energy savings potential, while the commercial sector accounts for approximately 56% of the peak reduction potential.

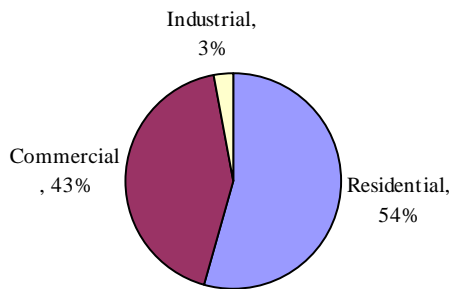


Figure 6-3: Achievable Potential by Sector (Electricity Sales)

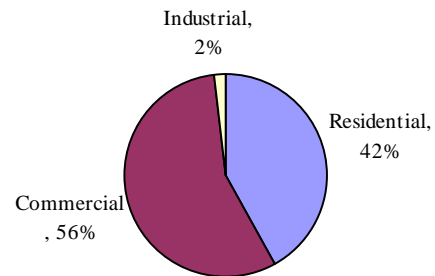


Figure 6-4: Achievable Potential by Sector (Demand Reduction)

A further understanding of the achievable potential is aided by consideration of contributing end uses. Figure 18 and Figure 19 illustrate that—in terms of potential savings—the most significant end uses are lighting (more than 30% of potential savings) and space conditioning (more than 20%).

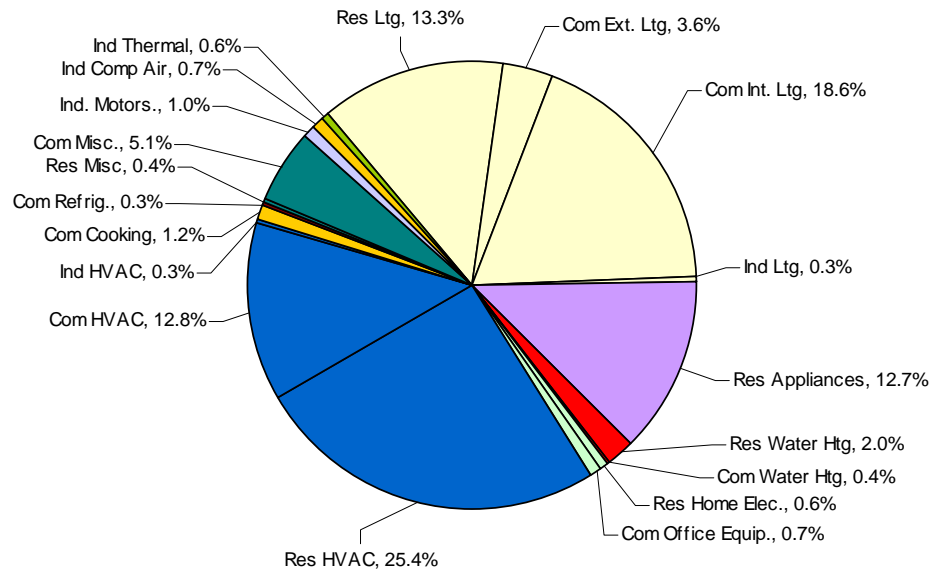


Figure 6-5: 2020 Achievable Energy Savings by Sector and End Use

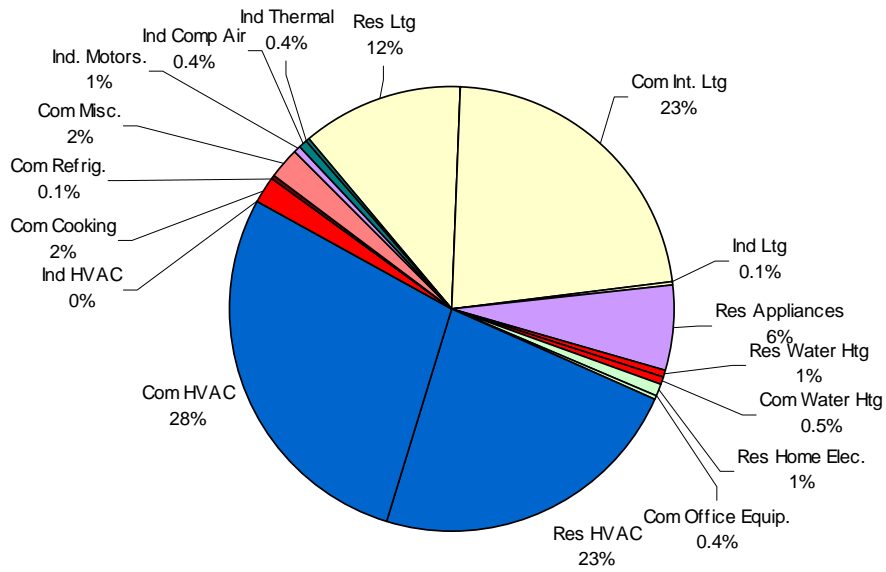


Figure 6-6: 2020 Achievable Peak Demand by Sector and End Use

## 6.2 COST-EFFECTIVENESS ANALYSIS

Nexant conducted economic analyses using each of the four cost-effectiveness tests described in Section 2. Figure 6-7, Figure 6-8, Figure 6-9, and Figure 6-10 show benefits and costs from UCT, TRC, RIM, and PCT perspectives of the achievable scenarios.

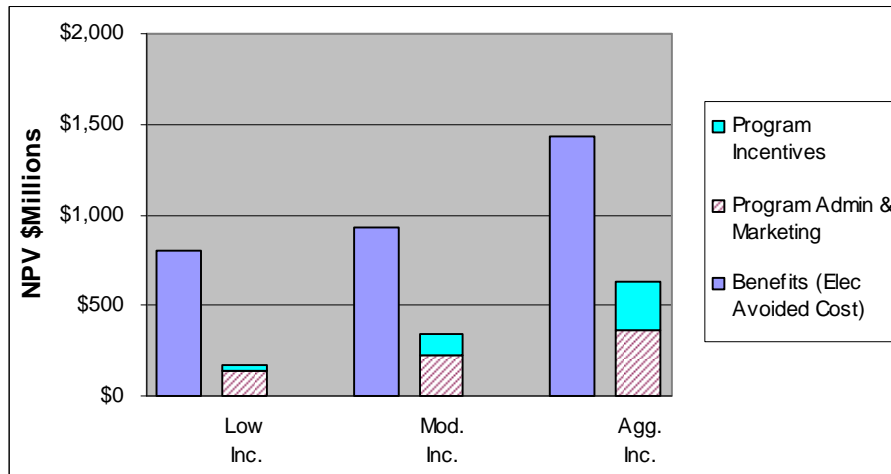


Figure 6-7: UCT Benefits and Cost

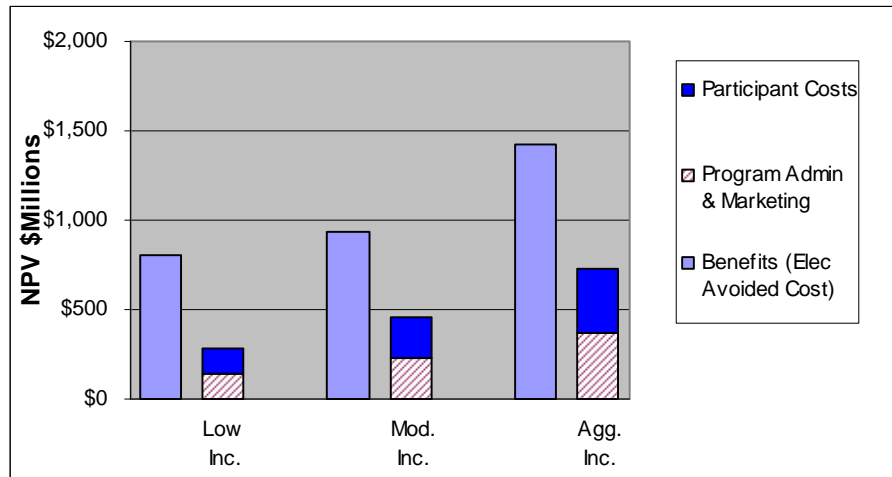


Figure 6-8: TRC Benefits and Cost

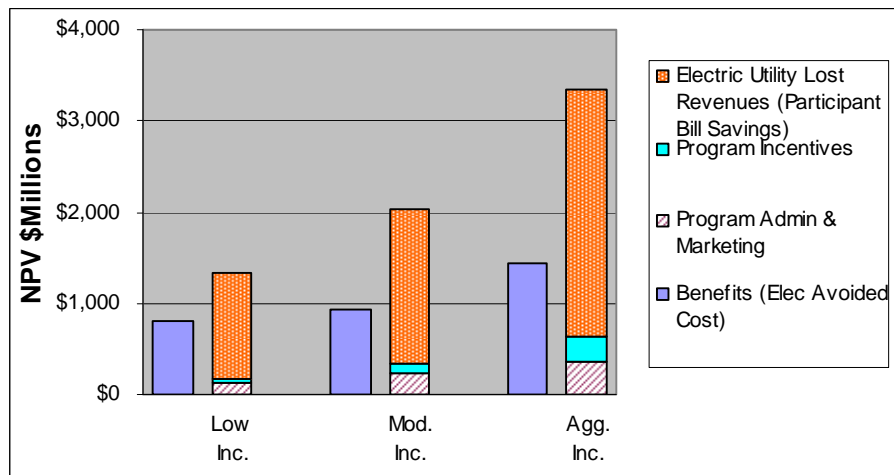


Figure 6-9: RIM Benefits and Cost

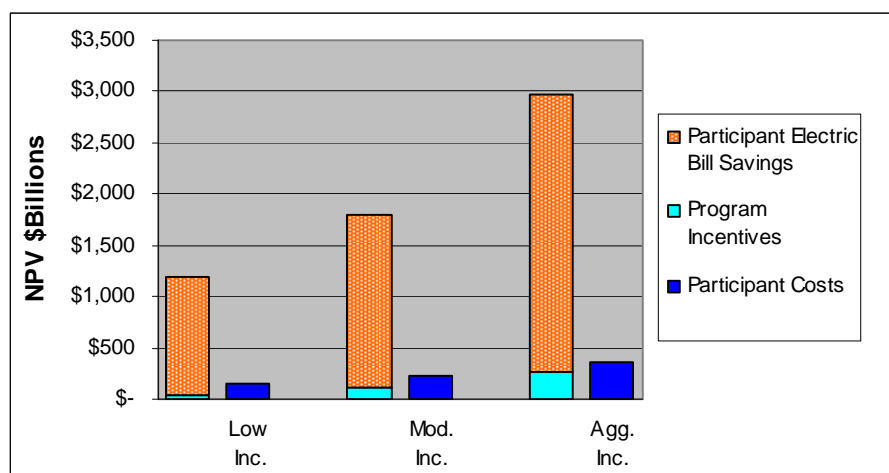


Figure 6-10: PCT Benefits and Cost

Table 6-2 lists net economic benefits and benefit-to-cost ratios for each scenario from the TRC, RIM, and PCT perspectives.

Table 6-2: UCT, TRC, RIM, and PCT Net Benefits (\$M) and Benefit-Cost Ratios

Scenario	UCT (NPV million \$)		TRC (NPV million \$)	
	Net Benefits	BC Ratio	Net Benefits	BC Ratio
Low Incentive	\$633.9	4.7	\$524.7	2.9
Moderate Incentive	\$594.3	2.8	\$482.2	2.1
Aggressive Incentive	\$795.1	2.3	\$705.5	2.0

Scenario	PCT (NPV million \$)		RIM (NPV million \$)	
	Net Benefits	BC Ratio	Net Benefits	BC Ratio
Low Incentive	\$1,045.6	8.2	-\$520.9	0.6
Moderate Incentive	\$1,578.6	8.0	-\$1,096.4	0.5
Aggressive Incentive	\$2,612.2	8.3	-\$1,906.8	0.4

### 6.3 FINDINGS AND CONCLUSIONS

An apparently significant potential for increased energy efficiency exists in CPS Energy's service territory, where the economy could benefit from effects associated with reduced energy consumption and peak power requirements.

Each of the achievable scenarios analyzed in this potential study involves substantial expenditures on incentives and program administration and marketing, with cumulative costs totaling \$634 million for the aggressive incentive scenario. However, the benefits of these scenarios to the utility through avoided energy costs total over \$1.4 billion. Figure 6-11 shows the achievable potential supply curve representing the levelized cost of energy saved for implementing the cost-effective efficiency measures included in the aggressive incentive scenario.

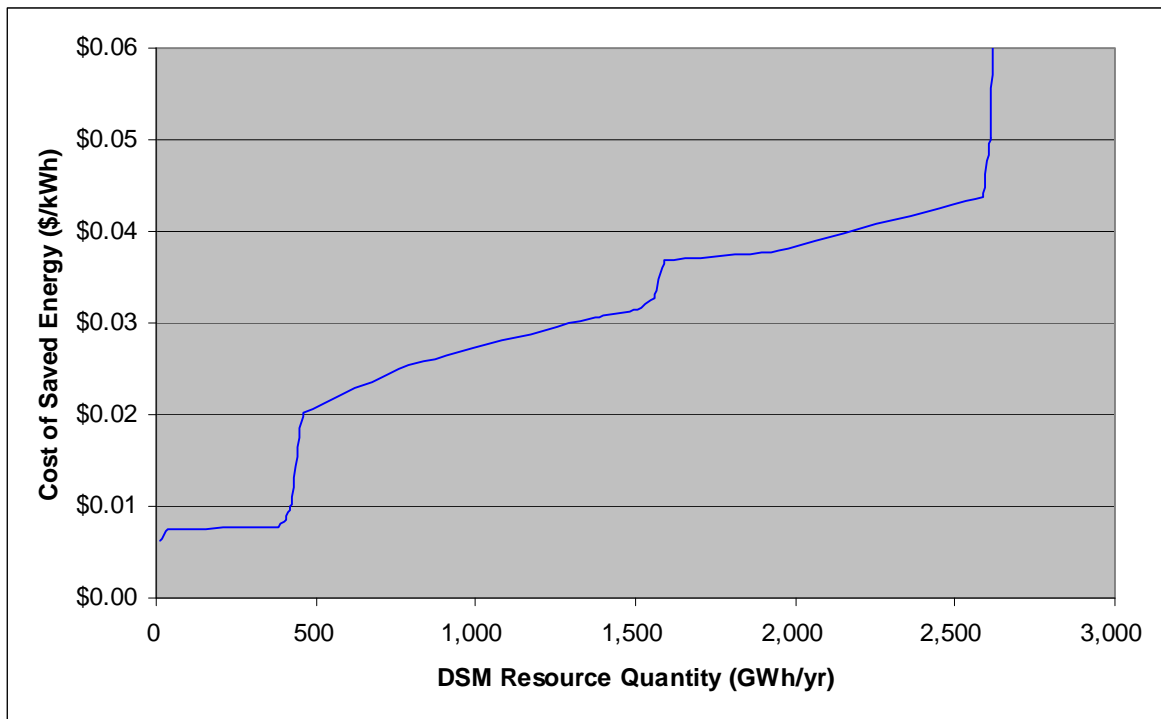


Figure 6-11: Achievable Potential Electric Supply Curve (Aggressive Scenario)

The entire portfolio of DSM measures that comprise the 2020 achievable energy savings of 2,618 GWh and peak demand reduction of 569 MW is made up of cost-effective technologies. The identified measures and program opportunities are a robust set that includes all types of customers (residential, low-income, all major commercial facility types, and industrial), so all of CPS Energy's customer segments will have the opportunity to realize benefits from the programs. Customer benefits include both economic benefits directly from reductions in their energy bills as well as from any financial incentives that might be offered by programs intended to accelerate markets for the purchase and installation of high-efficiency measures.

Building on the findings of this potential study, the next steps for CPS Energy should include:

- Finalization of broad DSM resource strategy, including consideration of appropriate goals and level of expenditures.
- Detailed program design that incorporates the cost-effective measures identified, setting appropriate incentive levels to maximize program cost-effectiveness, developing marketing strategies to achieve optimal program penetration, identifying personnel and information resource requirements, and establishing a schedule of milestones.
- Development of evaluation process and plans to ensure objective analysis of DSM program performance, as well as to assess effectiveness of program processes and marketing strategies.



Corporate Headquarters

101 Second Street, 10th Floor  
San Francisco, CA 94105-3672  
tel: +1 415 369 1000  
fax: +1 415 369 9700

[www.nexant.com](http://www.nexant.com)