

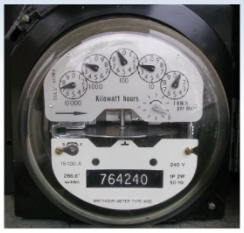


Measurement and Verification of CPS Energy's FY2013 DSM Program Offerings

Submitted to CPS Energy

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Nexant

CONTENTS

Tables

Figures

1 EXECUTIVE SUMMARY

CPS Energy retained Nexant, Inc. (Nexant) to conduct a comprehensive, independent measurement and verification (M&V) evaluation of CPS Energy's FY2013 demand side management (DSM) programs. This report describes the M&V methodology and process and presents the findings of the evaluation.

The evaluation primarily focused on calculating the energy and demand savings achieved by CPS Energy's FY2013 DSM programs on an annualized basis. Additionally, the evaluation reviewed program expenditures to calculate program cost-effectiveness and briefly addressed some changes in program operations implemented in FY2013.

1.1 SUMMARY OF ENERGY AND DEMAND IMPACTS

Net energy and demand savings are listed in **Table 1-1**. The savings below is represented on an ***annualized basis*** in order to simplify the reporting structure and for easy comparison from year to year.

1.2 SUMMARY OF ECONOMIC IMPACTS

Nexant's evaluation included collecting administrative, management, and marketing costs as well as total rebates paid. The following economic impact metrics were calculated:

- Cost of Saved Energy (CSE), which represents the levelized program cost per annual kWh saved, was **$0.037/kWh**.
- Net Reduction in Revenue Requirements (RRR), which represents the net reduction in utility costs due to the impact of the energy efficiency improvements, was **$31,327,079**.

1.3 KEY PROCESS FINDINGS AND RECOMMENDATIONS

Process findings are included in each individual program section. Most programs remain unchanged from previous years. However, the Commercial New Construction and Commercial Custom programs' internal review processes were adjusted last year. Measurement and verification (M&V) is now being done on every Custom project according to a detailed M&V plan developed at the outset of each project. New Construction projects involve detailed reviews of whole building energy models and complete sets of design documents. These processes ensure a high level of confidence in reported savings for these programs.

Table 1-1: FY2013 Net Energy and Demand Savings

Program	Net Impacts			BC Ratio
	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-Coinc. Demand Savings (kW)	
Energy Efficiency Programs				
Home Efficiency	1,864,887	247	560	0.86
Weatherization	2,843,308	951	1,415	0.31
Air Flow Performance	394,374	243	243	0.39
Residential HVAC	8,549,361	2,557	3,197	2.09
Residential Solar	3,393,361	1,760	1,760	0.55
New Homes Construction	9,872,843	1,924	1,924	2.75
Refrigerator Recycling	1,064,287	98	122	1.85
Residential Subtotal	**27,982,420**	**7,781**	**9,221**	**1.02**
Lighting	57,531,863	9,847	11,097	1.87
Commercial HVAC	6,849,717	4,360	6,009	1.90
Commercial Solar	3,520,372	2,011	2,011	0.76
Cool Roof	61,939	8	9	0.62
New Construction	3,420,560	643	643	2.36
LED Street Lights	3,048,190	0	716	0.40
Custom	6,140,233	634	634	3.67
Commercial Subtotal	**80,572,874**	**17,503**	**21,118**	**1.54**
Energy Efficiency Total	**108,555,295**	**25,284**	**30,340**	**1.33**
Demand Response/Load Control Programs				
Smart Thermostat	995,279	30,836	30,836	5.49
Home Manager	89,365	14,461	14,461	0.97
C&I Demand Response	2,795,334	63,969	63,969	0.94
Demand Response Total	**3,879,978**	**109,266**	**109,266**	**1.92**
Grand Total	**112,435,273**	**134,550**	**139,606**	**1.53**

2 EVALUATION METHODOLOGY

2.1 OVERVIEW OF EVALUATION METHODOLOGY

While the specific evaluation procedures varied slightly for each sector, the general process for calculating the savings was the same across all sectors. This analysis was performed using the steps described below.

- **Collect Program Data.** CPS Energy provided Excel files containing all the individual FY2013 project data.[1]
- **Calculate Gross Savings.** Gross savings are the energy and demand savings that are found at a customer site as the direct result of the installation of eligible energy efficiency measures and are determined through data collection, site inspections, and engineering analysis.

  For a subset of projects, site inspections were performed to verify equipment installation and operation. To determine gross energy and demand savings, individual project savings were calculated and summed using industry standard savings calculation methods, including standard baselines for existing facilities and new construction. Where applicable, the interactive effects of particular energy efficiency measures were incorporated (i.e. reduced internal HVAC loads due to improved lighting efficiency).

  Rather than attempt site inspections across all programs, this year's effort was focused on select programs, e.g. solar. It is recommended that different programs receive focused fieldwork each year on a rotating basis. Leveraging the fact that many key program analysis factors do not change significantly from year to year enables a more thorough investigation of each individual program (every 2-3 years) without the budgetary impact of performing that level of effort each year. It is expected that next year's evaluation would focus fieldwork on commercial lighting and HVAC.
- **Determine Net Impacts.** Net program impacts incorporate customer and market behavior into the gross program savings, which can add to or subtract from a program's direct results. Net impacts typically include two metrics: *free ridership*, the proportion of measures that would have been installed in the absence of the program; and *spillover*, additional savings that have occurred because of a program's operations but outside of its administrative framework. To determine net impacts, these metrics are combined into a net-to-gross (NTG) ratio, which is applied to the gross program savings.

  To remain consistent with previous evaluations, the same methodology was used for developing program NTG ratios - through market research of similar programs around the country, which were applied to the calculated gross savings for each program.

[1] All calculations based on revised databases provided by CPS Energy in March 2013.

- **Program Economic Analysis.** The economic analysis summarized cost-effectiveness for the overall portfolio of savings from three perspectives: Cost of Saved Energy, Reduction in Revenue Requirements, and Program Administrator Benefit Cost Ratio:

  Cost of Saved Energy (CSE). The Cost of Saved Energy is the total cost per kWh of realizing the efficiency improvement. CSE is determined by dividing levelized program costs by the annual energy savings, as shown in the following equation. Levelized program costs are calculated using an Economic Carrying Cost (ECC), which incorporates the number of years that the energy savings persist and an annual discount rate.

  $$CSE = \frac{Program\ Costs\ (\$)\ x\ ECC}{Annual\ Energy\ Savings\ (kWh)}$$

  Program Administrator Benefit Cost Ratio. The benefit cost ratio calculation used for energy efficiency programs consists of the net present value of avoided energy and capacity cost (benefit) divided by the sum of rebate and administrative costs (cost).

  $$Benefit\,Cost\ Ratio = \frac{Net\ Present\ Value\ (NPV)\ Avoided\ Cost}{Rebates + Admin/Marketing\ Costs}$$

  Reduction in Revenue Requirements (RRR). The reduction in revenue requirements is the net reduction in utility costs from the energy saved through the presence of the DSM program offerings. RRR is calculated based on the difference of avoided energy and demand costs from the DSM impacts and the DSM program costs, as shown in the following equation:

  $$RRR = Avoided\ Energy\ and\ Demand\ Costs - Program\ Costs$$

3.1 SUMMARY OF RESIDENTIAL IMPACTS

CPS Energy offered the following programs for the residential sector in FY2013:

- Home Efficiency
- Weatherization
- Air Flow Performance
- HVAC
- Solar Initiative (Residential)
- New Homes Construction
- Refrigerator Recycling

The following sections include a brief summary of each program and describe the methodology and the results of the impact analysis.

3.2 HOME EFFICIENCY PROGRAM

3.2.1 Overview

CPS Energy's Home Efficiency Program targets a wide range of energy efficiency measures that save cooling and heating energy in existing homes. In FY2013, rebates were provided for the following list of measures:

- Attic insulation (contractor installed)
- Do-it-Yourself attic insulation
- Spray foam insulation

CPS Energy discontinued incentives for the following measures which had been offered in previous years:

- Cool Roof
- Wall insulation
- Window film or solar screens

The Home Efficiency Program had 2,167 projects in FY2013, including 25 projects from the discontinued measures which were projects approved during the previous year but paid during this year. This corresponds to a 31% decrease in program participation from last year. All rebates paid in FY2013 are accounted for in the savings roll-up for this program.

Figure 3-1 shows the total number of installations of each type of measure in FY2013:

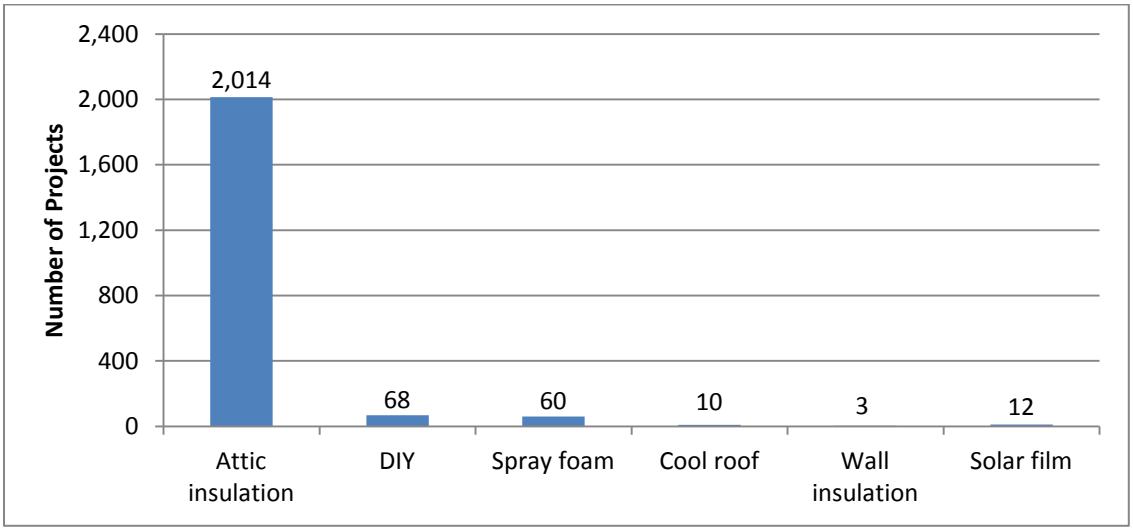


Figure 3-1: Number of Installations of Home Efficiency Measures

3.2.2 Savings Calculations

Nexant estimated the energy savings and demand savings for individual measures based both on the Texas Public Utilities Commission approved deemed values[1] and engineering calculations. For households where multiple measures had been installed, the interactive effects between measures were taken into account in order to avoid overestimating the savings. For each measure, the savings mentioned below are gross savings.

3.2.2.1 Attic Insulation

Nexant used engineering calculations for energy and demand savings for the ceiling insulation measure. Texas PUC deemed savings are available for this measure, however, the deemed savings are based on the installation of R-30 ceiling insulation. Participating CPS Energy customers installed insulation up to R-60; therefore, to capture the impacts of the additional insulation beyond the deemed values, Nexant calculated the reduction in heat loss through the insulation material and took into account the size and the efficiency of the household's air conditioner. For equations used for this calculation, please refer to document '2011 CPS Energy STEP (Save for Tomorrow Energy Plan) -RESIDENTIAL REFERENCE MANUAL' obtained from CPS Energy.

Homes with electric heating, including electric resistance heaters and heat pumps, will also realize electric savings during the heating season. Based on CPS Energy's Residential Saturation Study[2] and the Energy Information Agency's (EIA) West-South-Central Regional residential consumption data, Nexant estimated 41% of customers used electric heating in their homes.

[1] Deemed Savings, Installation & Efficiency Standards, Residential and Small Commercial Standard Offer Program and Hard to Reach Standard Offer Program, prepared by Frontier Associates, LLC, February, 2006.
[2] San Antonio 2004 Residential Appliance Saturation Study, KEMA, Inc., April 2004

The total gross energy and demand savings for FY2013 attic insulation installations are as follows:

Table 3-1: Attic Insulation Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
Attic Insulation (contractor installed)	1,871,962	244	561
Attic Insulation (Do-it-Yourself)	66,959	9	20
Total	**1,938,921**	**253**	**581**

3.2.2.1 Spray Foam Insulation

Nexant used engineering calculations for energy and demand savings for the spray foam insulation measure similar to the ceiling insulation measure. Savings are based on the reduction in heat loss through the insulation material and took into account the R-value of the installed insulation and the size and efficiency of the household's air conditioner using the same equation listed above for ceiling insulation.

The available data supported the fact that the required program insulation depths for closed cell or open cell insulation were achieved in order to provide an insulation value of R-30. Nexant also assumed an average baseline insulation value of existing insulation in the home of R-11 and a building structure insulation value of R-4.

Total energy and demand savings for FY2013 projects that installed spray foam insulation are listed in the following table:

Table 3-2: Spray Foam Insulation Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
48,718	7	15

3.2.2.2 Cool Roof

Incentives for this measure were not offered in FY2013, but a few rebates were paid early in FY2013 to projects that were approved the previous year. Only 10 Cool Roof incentives were paid.

Savings calculations for the residential cool roofs measure were based on online Department of Energy calculator software that evaluates cooling and heating savings for roof products (http://www.ornl.gov/sci/roofs+walls/SteepSlopeCalc/index.htm). Assumptions for the calculation were as follows:

- R-30 ceiling insulation,
- Air conditioner COP of 2.34 (equivalent to 8 EER)
- Roof reflectance and emittance were set at 43 and 79, respectively, which represent average values for metal cool roof products based on the ENERGY STAR product list[1] (based on available project data, all participating projects appear to have metal roofs)

Based on the assumptions listed above, the DOE calculator estimated 0.0738 watts per square foot of cooling savings for the roof. This average savings value was multiplied by the square footage of roof product installed to estimate the savings per home. Total energy and demand savings for this measure for FY2013 projects are listed in the table below.

Table 3-3: Residential Cool Roof Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
5,533	1	2

3.2.2.3 Wall Insulation

Incentives for this measure were not offered in FY2013, but a few rebates were paid early in FY2013 to projects that were approved the previous year. Only 3 incentives for wall insulation were paid.

Wall insulation energy and demand savings were calculated using engineering calculations similar to the ceiling insulation calculation, incorporating the increase in R-value, square feet of wall area insulated, and the HVAC equipment efficiencies. For equations used for this calculation, please refer to document '2011 CPS Energy STEP (Save for Tomorrow Energy Plan) -RESIDENTIAL REFERENCE MANUAL' obtained from CPS Energy.

The baseline wall insulation was assumed to be R-2, which would include the insulating properties of exterior and interior wall materials and the air pocket in the wall cavity. The post-installation R-value was recorded in the program database or assumed to be R-15 where absent.

The total energy and demand savings for wall insulation installations are listed in the following table:

Table 3-4: Wall Insulation Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
5,521	3	3

[1] http://downloads.energystar.gov/bi/qplist/roofs_prod_list.pdf

3.2.2.4 Window Film or Solar Screens

Incentives for this measure were not offered in FY2013, but a few rebates were paid early in FY2013 to projects that were approved the previous year. 12 incentives for window film were paid.

The window film and solar screen measures reduce the amount of solar radiation that enters a house through its windows, thus decreasing the load on the air conditioner in the summer. Nexant used the Texas PUC deemed savings data for Climate Zone 3 to evaluate the window film and solar screen savings. Based on the market shares of heating equipment, a weighted average of 5.03 kWh/sq ft of solar film was multiplied by the square feet of films or screen installed on each home. Deemed demand savings of 0.00159 kW/sq ft were used to calculate peak demand savings.

Total energy and demand savings for window film and solar screen installations are included in the following table:

Table 3-5: Window Film and Solar Screen Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
6,562	2	2

3.2.3 Findings and Recommendations

The gross energy and demand savings calculated for all measures included in the Home Efficiency Program are listed in Table 3-6 below:

Table 3-6: Home Efficiency Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
Attic Insulation (contractor installed)	1,871,962	244	561
Attic Insulation (Do-it-Yourself)	66,959	9	20
Spray foam	48,718	7	15
Cool Roof	5,533	1	2
Wall insulation	5,521	3	3
Window film & solar screen	6,562	2	2
Total	**2,005,255**	**266**	**602**

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- Nexant found that the Home Efficiency database is well-designed, comprehensive, and for the majority of measures, collects the appropriate data to evaluate project compliance with program rules and calculate energy and demand savings.

3.3 AIR FLOW PERFORMANCE PROGRAM

3.3.1 Overview

CPS Energy's Air Flow Performance Program aims to improve the energy efficiency of conditioned air distribution systems by providing rebates for duct testing and duct repair/replacement. The program had 325 projects in FY2013. This corresponds to a 26% increase in program participation from last year.

3.3.2 Savings Calculations

Nexant estimated the energy savings and demand savings based on the Texas Public Utilities Commission approved deemed values for Climate Zone 3, as issued in 2006.[1] The following values were applied based on the type of heating and the conditioned square footage recorded in the CPS Energy program database for each project (with a maximum allowed savings limit of 30% of total estimated annual home energy consumption):

- gas: 0.74378 kWh/SF
- electric: 1.80968 kWh/SF
- heat pump: 1.13027 kWh/SF
- all: 0.000486 kW/SF

The PUC has released updated deemed values in FY2013, but current CPS Energy project tracking does not include sufficient information to use the updated tables.

3.3.3 Findings and Recommendations

Total energy and demand savings for duct repairs and replacements are included in the following table:

Table 3-7: Duct Repair & Replacement Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
438,193	270	270

[1] Deemed Savings, Installation & Efficiency Standards, Residential and Small Commercial Standard Offer Program and Hard to Reach Standard Offer Program, prepared by Frontier Associates, LLC, February, 2006.

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- Nexant recommends that the following information be collected for each project, to allow for alignment with the updated PUC deemed savings methodology:
  - Foundation type (slab or crawlspace/basement) and location of air handler (attic, interior, or crawlspace/basement), which would allow for alignment of the savings calculation with PUC values.
  - Total system airflow, which would allow direct calculation of cooling energy savings from leakage test results to compare to deemed savings estimates.

3.4 HVAC PROGRAM

3.4.1 Overview

The residential HVAC program provides customers with rebates for the purchase of eligible central air conditioners, heat pumps and room air conditioners. Rebates for the FY2013 program year were issued as a bill credit to the customer and varied depending on the size efficiency of the unit installed as follows:

- Central Air Conditioners:

  $110/ton for 15 SEER/12.0 EER units

  $125/ton for 16 SEER/12.5 EER units

  $160/ton for 16 SEER/13.0 EER units

  $225/ton for 17 SEER/13.0 EER or greater units

- Heat Pumps:

  $110/ton for 15 SEER/12.0 EER/8.2 HSPF units

  $125/ton for 15 SEER/12.5 EER/8.5 HSPF units

  $160/ton for 16 SEER/12.5 EER/8.5 HSPF units

  $225/ton for 17 SEER/12.5 EER/8.5 HSPF or greater units

- Room Air Conditioners:

  $50 for ENERGY STAR-certified units 8,000 Btu or less

  $100 for ENERGY STAR-certified units greater than 8,000 Btu

In FY2013, a total of 9,998 residential HVAC rebates were paid to participating customers, including 2,935 central A/C rebates, 1,753 heat pump rebates, and 5,310 room air-conditioner rebates. This corresponds to a 18% decrease in program participation from last year. Figure 3-2 shows the breakdown of participating central air conditioners and heat pumps by SEER rating:

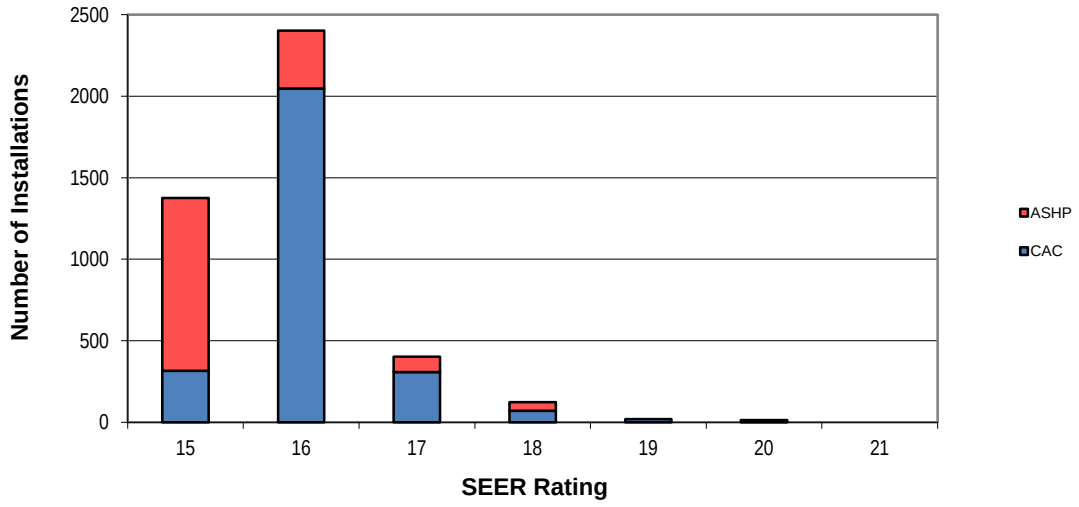


Figure 3-2: SEER Ratings of CAC and ASHP Installations

3.4.2 Savings Calculations

Nexant received program data from CPS Energy's residential HVAC database, which includes detailed information on each unit installed including: brand, model number, and serial number, and equipment size and efficiency. Texas PUC published savings[1] were used for both energy and peak demand savings, for all three equipment types (central air conditioners, heat pumps, and room air conditioners). Energy and peak demand savings were calculated for each project based on the size and efficiency of the installed equipment. Non-peak demand savings were calculated by assuming an 80% coincidence factor is applied to the peak demand values published by the PUC.

Base case cooling efficiency for CAC and ASHP was assumed to be 13 SEER, which is the minimum federal efficiency standard for residential equipment. Base case heating efficiency was assumed to be 7.7 HSPF, which is also the minimum federal efficiency standard. The PUC does allow for the use of a 12.44 SEER baseline for early replacement projects, but the 13 SEER "new construction" baseline was selected to be conservative.

3.4.3 Equipment Verification

To verify the accuracy of the efficiency data listed in the program database, Nexant randomly selected samples of 11 CAC projects, 11 HP projects, and 11 Room A/C projects to verify equipment information and efficiency based on the brand, model number, and serial number provided. Nexant used equipment information listed in databases maintained by the Air Conditioning, Heating, and

[1] Deemed Savings, Installation & Efficiency Standards. Residential and Small Commercial Standard Offer Program. Frontier Associates LLC. January 2012.

Refrigeration Institute (AHRI)[1] and the federal ENERGY STAR website[2]. The results of the equipment verification are as follows:

- 11 of 11 CAC units were verified as having the correct SEER or EER rating or better according to the AHRI directory
- 11 of 11 heat pump units (100%) were verified as having the correct SEER rating or better according to the AHRI directory
- 11 of the 11 room air conditioners were verified as having the correct EER rating according to ENERGY STAR.

No adjustments to the overall population of projects were made based on the equipment verification findings.

3.4.4 Findings and Recommendations

The gross energy and demand savings calculated for the FY2013 Residential HVAC program are listed in the table below:

Table 3-8: Residential HVAC Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
ENERGY STAR Central AC	4,162,008	1,488	1,861
ENERGY STAR Heat Pump	3,594,528	759	949
ENERGY STAR Room AC	1,242,791	444	556
Total	**8,999,327**	**2,692**	**3,365**

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- Nexant found the data collected in the program database to be accurate, comprehensive, and sufficient for assessing participation and determining program impacts.
- The program should also continue to verify equipment efficiencies based on industry databases, such as AHRI and ENERGY STAR, including conducting secondary reviews of a sample of projects to validate the accuracy of the data stored in the program database.

[1] http://www.ahridirectory.org/ahridirectory/pages/home.aspx
[2] http://www.energystar.gov/index.cfm?c=roomac.pr_room_ac

- The program should track whether projects are new construction or retrofit applications. Retrofit applications can be considered to have a slightly lower baseline SEER under the PUC framework.

3.5 SOLAR INITIATIVE - RESIDENTIAL

3.5.1 Overview

CPS Energy's Solar Initiative provides incentives for the installation of both solar photovoltaic (PV) systems and solar water heaters. Regarding the solar PV systems, once energized, CPS Energy rebated systems must adhere to strict CPS Energy policies and cannot be disconnected or moved without CPS Energy approval. CPS Energy requires completion of an Interconnection Application & Agreement for Distributed Generation as the PV system is based on a net metering configuration.

Participation records show a total of 305 residential solar photovoltaic systems installed in FY2013. This corresponds to an 12% increase in program participation from last year. No rebates for solar hot water heaters were issued in FY2013.

The following sections describe Nexant's approach to evaluating the energy and demand savings provided by the Solar Initiative. All the numbers mentioned below are gross savings.

3.5.2 Savings Calculations

Texas PUC deemed savings values are available for this measure[1]. Deemed energy and demand savings are calculated based on each system's factory rated output using the following equations.

$$\text{Deemed Energy Savings (kWh)} = 1.60 * \text{watts } DC_{STC} \text{ installed}$$

$$\text{Deemed Demand Savings (kW)} = 0.83 * \text{kW } DC_{STC} \text{ installed}$$

"Watts DC_{STC}" refers to the system's factory rated output at standard test conditions, which assumes 1,000 w/m^2 of solar radiation and 25 degree Celsius cell operating temperature. This rating is recorded by CPS Energy for each installation in the program database.

3.5.3 Findings and Recommendations

The gross energy and demand savings for the Solar Initiative program are listed in the table below:

[1] Deemed Savings, Installation & Efficiency Standards. Residential and Small Commercial Standard Offer Program. Frontier Associates LLC. January 2012.

Table 3-9: Solar Initiative Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
Residential Solar PV	3,393,361	1,760	1,760

There are no recommendations for this program at this time.

3.6 NEW HOMES CONSTRUCTION

3.6.1 Overview

In FY2013, CPS Energy offered incentives to builders and contractors for new construction projects that exceed City of San Antonio building codes (IECC 2009) by 15% or more. The program provides different incentive levels based on the building's performance above code. The incentive tears are as follows:

Using ENERGY STAR®:

- ENERGY STAR® compliant (HERS rating of 75 to 58) = $800 per structure
- ENERGY STAR® compliant (HERS rating of 57 or less) = $1,500 per structure

Using other testing methods:

- Other methods under (2009 IECC) energy codes at (15% to 30% above code) = $800 per structure
- Other methods under (2009 IECC) energy codes at (31% or greater above code) = $1,500 per structure

CPS Energy provided Nexant with a listing of 1,749 ENERGY STAR® compliant homes receiving a FY2013 CPS Energy Incentive for Builders and Contractors for New Constructions. This corresponds to a 33% increase in program participation from last year.

3.6.2 Savings Calculations

To estimate annual energy savings (kWh) for a participating new home, Nexant applied HERS rating data supplied by builders and multiplied the savings by the average annual consumption of a typical home in Texas provided by Energy Information Administration 2005 Survey[1].

Based on an impact evaluation study conducted by Nexant in 2009 for a utility company with a similar New Homes Construction program, deemed savings of 1.1 kW was used to calculate peak demand savings.

[1] *2005 Energy Consumption Survey*, Energy Information Administration, 2008.

3.6.3 Findings and Recommendations

The gross energy and demand savings for the New Homes Construction program are listed in the table below:

Table 3-10: New Homes Construction Gross Energy and Demand Savings

Gross Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
9,872,843	1,924	1,924

For future project tracking and to enable a more precise estimation of energy savings, Nexant recommends CPS Energy collect the following information for each home:

- Annual energy usage projection of designed home
- Annual energy consumption projection of baseline home

3.7 REFRIGERATOR RECYCLING

3.7.1 Overview

CPS Energy began a refrigerator and freezer recycling program in 2010 with the intent of removing old refrigerators and freezers from the electric grid and incentivizing purchases of new Energy Star units over new standard efficiency units. In FY2013, customers were offered a $65 rebate for recycling their appliance and offered an additional $35 rebate if an Energy Star certified unit was purchased to replace the old unit. CPS Energy's subcontractor, Appliance Recycling Centers of America, Inc. (ARCA), was responsible for picking up and recycling appliances. ARCA records each appliance pick-up in a database and recycles the appliance in an environmentally responsible manner.

In FY2013, a total of 1,475 units were recycled by CPS Energy customers and a total of 1,185 new Energy Star units were purchased. This represents an 18% decrease in recycling and a 29% decrease in new unit purchases compared to FY2012.

3.7.2 Savings Calculations

For new Energy Star purchases, the savings calculations are based on Energy Star Calculator and the difference between energy consumption of a new Energy Star unit and a new standard efficiency unit.

For recycling an existing refrigerator or freezer, estimated annual energy savings are based on the removed appliance's Unit Energy Consumption (UEC), or annual energy consumption. For this evaluation, average UEC values were calculated using a regression equation developed for the

California Public Utilities Commission[1]. Using Equation 1 and averaged values from the database, such as age and size, the average refrigerator UEC was calculated.

Equation 1

$$UEC = (Intercept) - (A_1)(\%Single\ Door\ Configuration) + (A_2)(\%\ Side-by-Side\ Configuration) + (A_3)(Average\ Age) + (A_4)(\%\ Primary\ Appliance) + (A_5)(Household\ Occupants) + (A_6)(Climate\ Variable)$$

Where:

Coefficient	Value	T-value
A_1	-629.71	-3.2
A_2	435.71	6
A_3	25.88	5.4
A_4	256.47	3.4
A_5	71.15	2.8
A_6	225.77	3.2

Variable	CPS Energy Average
% Single Door Configuration	0.007
% Side-by-Side Configuration	0.284
Average Age (Years)	19.13
% Primary Appliance	.369
Household Occupants	2.74
Climate Variable	0.268

Once the average refrigerator UEC was established, the average freezer UEC needed to be calculated. This regression equation does not apply to freezers. Therefore, a ratio of refrigerator to freezer UEC values, from other similar studies, was calculated and multiplied by the calculated refrigerator UEC to determine the average freezer UEC using Equation 2:

Equation 2

$$Freezer\ UEC = Refrigerator\ UEC \times UEC\ Ratio$$

Where:

Freezer UEC = Average UEC for all freezers in database
Refrigerator UEC = Average UEC for refrigerators calculated with Equation 1
UEC Ratio = Ratio of refrigerator to freezer UECs from similar studies

The average refrigerator and freezer UECs are then multiplied by the corresponding number of recycled appliances and the part-use factor using Equation 3. The part-use factor accounts for the small percentage of appliances that do not run for the entire year, and adjusts the gross savings accordingly. For this evaluation, the part-use factor is a deemed value from a similar evaluation[2].

[1] Residential Retrofit High Impact Measure Evaluation Report, The Cadmus Group, Inc. February 2010
[2] Process and Impact Evaluation of Georgia Power Company's Refrigerator and Freezer Recycling Pilot Program, Nexant, Inc. March FY2013

Equation 3

$$Gross\ Savings = [(Refrigerator\ UEC \times RR) + (Freezer\ UEC \times FR)] \times U$$

Where:
RR = Number of refrigerators recycled
RF = Number of freezers recycled
U = Part-use factor

3.7.2.1 Demand Savings

Demand savings for appliance recycling programs are simply the sum of the kW for all removed appliances. Per unit demand savings are calculated using Equation 5:

Equation 5

$$Demand = UEC_{Gross} \div Operating\ Hours$$

Where:
Demand = Per unit demand reduction
UEC_{Gross} = Gross unit UEC (refrigerator 1007, freezer 930)
Operating Hours = Annual operating hours (8,760)

3.7.3 Findings and Recommendations

The savings calculated for the appliance recycling program are listed in the table below:

Table 3-11: Refrigerator Program Gross Energy and Demand Savings

	Gross Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
Recycled Refrigerator/Freezer	1,532,925	140	175
Purchased Energy Star	156,420	15	19
Total	**1,689,345**	**155**	**194**

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- Record all model numbers: Recording appliance model numbers will assist in future evaluations.
- Perform *In-Situ* metering: CPS Energy should consider performing in-situ metering tests either as part of in-program on-going Measurement & Verification activities, a separate market research study or as part of the next full evaluation.
- Conduct customer surveys: Conducting surveys with customer at the time of appliance pick-up provides insight into program effectiveness and queries customers when they are most familiar with their participation in the program.

3.8 WEATHERIZATION

3.8.1 Overview

CPS Energy's Weatherization was funded by STEP for a portion of FY2013, specifically, the months of September through January. Through this program, a variety of energy efficiency measures are provided to low-income residences. Upgrades are provided at no cost to the participant. Installed measures include:

- CFL light bulbs
- Wall Insulation
- Attic Insulation
- Floor Insulation
- Solar window screens
- Hot water pipe insulation
- Water heater wrap
- Low flow shower heads
- Infiltration reduction

3.8.2 Savings Calculations

Nexant used the '2011 CPS Energy STEP (Save for Tomorrow Energy Plan) -RESIDENTIAL REFERENCE MANUAL' to calculate demand and energy savings for included measure types. For measure types not included in the manual, equations and deemed savings values published by the Texas PUC are used[1]. The following table summarizes the savings calculation source for each measure type:

Source	Measures
2011 CPS Energy Residential Reference Manual	CFL Light Bulbs
	Wall Insulation
	Attic Insulation
	Solar Window screens
Texas PUC methods[1]	Floor Insulation
	Hot water pipe insulation
	Water heater wrap
	Low-flow shower heads
	Infiltration reduction

[1] Deemed Savings, Installation & Efficiency Standards. Residential and Small Commercial Standard Offer Program. Frontier Associates LLC. January 2012.

3.8.3 Findings and Recommendations

The gross energy and demand savings for the Weatherization program are listed in the table below:

Table 3-12: Weatherization Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
Weatherization	3,057,320	1,023	1,522

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- Going forward, CPS Energy should start tracking additional project-level information such as residence air conditioning type (window unit vs central) and heating type (gas vs electric vs heat pump) in order to more accurately appropriate savings from envelope measures.

4.1 SUMMARY OF NON-RESIDENTIAL IMPACTS

The non-residential sector included the following program offerings in FY2013:

- Lighting
- HVAC
- Solar Initiative (Commercial/School)
- New Construction
- Custom

The following sections include a brief summary of each program and describe the methodology and the results of the impact analysis.

4.2 LIGHTING PROGRAM

4.2.1 Overview

The Lighting Program offers incentives to customers who install efficient lighting in their facilities. Incentives are offered for building improvement and retrofit projects. In FY2013, this program was open to all businesses, regardless of the size of the retrofit.

Energy and demand savings are calculated for retrofit projects using pre-retrofit conditions as a baseline.

In FY2013, a total of 397 commercial lighting projects received funding through the program. This corresponds to a 31% increase in program participation from FY2012.

The LED Street Lights program is included in the savings numbers provided in this section.

4.2.2 Savings Calculations

Nexant gathered available program data from the CPS Energy Commercial Lighting Program database. For FY2013, in light of the recent high level of participation by the City of San Antonio, site inspections were conducted on a sample of City of San Antonio projects to verify energy savings and operating hours. Fixture information including wattages for lamp/ballast combinations was verified during the on-site inspection. Peak demand coincidence factors, or the percentage of the facility demand that occurs during the peak period, was estimated for each project based on the facility type. The estimated annual hours of operation were verified during the site inspection. Table 4-1 highlights the coincidence factors used in the savings calculation methodology for each building type.

Table 4-1: Coincidence factor and Operating Hours for Building Types

Building Type	Description	Coincidence Factor
Office	Office buildings and other commercial properties in operation during normal business hours	78%
Retail	Retail facilities, including restaurants	94%
Warehouse	Warehouse and storage facilities	96%
Major Healthcare	Hospitals and in-patient health clinics	84%
24 Hour Facilities	Any facility that operates 24 hours/day or has high occupancy during peak hours	94%
K-12 Schools	Primary education facilities	73%
Colleges & Universities	Secondary education facilities.	71%
Assembly	Conference facilities and public gathering spaces	89%
Hotel	Lodging facilities	51%

Retrofit project energy and peak demand savings were calculated based on the difference in lighting wattages between the baseline fixtures and the newly installed fixtures using the following formulas for each fixture type:

$$kW\ savings = (FixtureWattage_{base} - FixtureWattage_{post})\ x\ N_{fixtures}\ x\ \frac{1kW}{1{,}000\ watts}$$

$$Peak\ kW\ savings = kW\ savings \times CF$$

$$kWh\ savings = kW\ savings \times Annual\ Operating\ Hours$$

Where:

$FixtureWattage_{base}$ = Fixture wattage from standard wattage table for pre-retrofit fixture

$FixtureWattage_{post}$ = Fixture wattage from standard wattage table for post-retrofit fixture

$N_{fixtures}$ = Number of fixtures

CF = Deemed coincident demand factor based on building type.

$AnnualOperating\ Hours$ = Deemed annual operating hours for the affected space.

The energy and demand savings for each fixture type included in the project was summed to determine the total facility savings.

To capture the reduction in HVAC load from the energy efficient fixtures, an additional 10% demand savings and 5% energy savings for interactive effects were attributed to projects where the retrofit occurred in conditioned spaces.

The total verified savings for the sampled projects was used to calculate a realization rate for City of San Antonio projects. This realization rate was then applied to the total COSA participant population to determine the gross verified savings.

For non-COSA participants, the realization rates determined during site inspections for the FY2012 Annual M&V were carried over to this year's population.

4.2.3 Findings and Recommendations

The gross energy and demand savings calculated for the commercial lighting program are listed in Table 4-2 below:

Table 4-2: Commercial Lighting Gross Energy and Demand Savings

Program	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
Lighting	67,684,545	11,585	13,055
LED Street Lights	3,386,878	0	796

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- Create and utilize a standardized fixture wattage lookup table and standardized customer-input friendly lighting spreadsheets/database.
- Include interactive HVAC effects in savings calculations
- Track the facility type for each project, and use deemed operational hours and coincidence factors based on facility type

4.3 HVAC PROGRAM

4.3.1 Overview

The HVAC program offers incentives for the installation of high efficiency unitary AC equipment, heat pumps and chillers. Two tiers of efficiency were established for the FY2013 program year for each equipment size and category. Rebates are paid at the following amounts:

- $65/ton for Step 1
- $150/ton for Step 2

In FY2013, a total of 126 facilities received funding through the program. This corresponds to a 2% increase in program participation from FY2012.

4.3.2 Savings Calculations

Nexant gathered available data from the commercial program database . Random samples of both chiller and unitary projects were selected. Hard copies of project information were requested for the sampled projects as necessary. All the data was subsequently input into the standardized HVAC spreadsheets, which included standard baseline COP/IPLV values for each equipment size, type, and category. Baseline equipment efficiencies for all unitary equipment projects were assumed to be the ASHRAE 90.1-2007, which is San Antonio's code minimum since 2010. ASHRAE 90.1-2007 was also used as the baseline for new construction chiller projects. For retrofit chiller projects, ASHRAE 90.1-1999 was used to account for the fact that chiller plants can typically be rebuilt rather than replaced. The following equations were used to calculate HVAC program savings:

Unitary AC Equipment

$$kW\ savings = Capacity \times CF \times ConversionFactor \times \left(\frac{1}{EER_{pre}} - \frac{1}{EER_{post}}\right)$$

$$kWh\,savings_{AC} = Capacity \times ConversionFactor \times EFLH_C \times \left(\frac{1}{IPLV_{pre}} - \frac{1}{IPLV_{post}}\right)$$

$$EFLH_C = A \times (CDD^{b+1})$$

where:

Capacity = Rated equipment cooling capacity, Btu/hr

CF = Deemed coincident demand factor based on building type.

Conversion Factor = 1 kW / 1000 Watt

$EFLH_C$ = Equivalent full load hours for cooling.

CDD = Cooling degree days.

EER_{pre} = Cooling equipment baseline efficiency. ASHRAE 90.1-2007 standard.

EER_{post} = Efficiency of the new cooling equipment

$IPLV_{pre}$ = Cooling equipment integrated part load value. ASHRAE 90.1-2007 standard.

$IPLV_{post}$ = Integrated part load value of the new cooling equipment

Chillers

$$kW\ savings = Capacity \times CF \times ConversionFactor \times (\frac{1}{IPLV_{pre}} - \frac{1}{IPLV_{post}})$$

$$kWh\ savings = Capacity \times EFLH_C \times ConversionFactor \times (\frac{1}{IPLV_{pre}} - \frac{1}{IPLV_{post}})$$

$$EFLH_C = A \times (CDD^{b+1})$$

where:

Capacity = Rated equipment cooling capacity, ton

Conversion Factor = 3.517 kW / ton

CDD = Cooling degree days

CF = Deemed coincident demand factor based on building type.

$EFLH_C$ = Equivalent full load hours, regression of $EFLH_C$ for various facility types was developed from DEER savings data. See for coefficients A and b.

$IPLV_{pre}$ = Cooling equipment integrated part load value. ASHRAE 90.1-2007 or -1999 standard, as appropriate.[1]

$IPLV_{post}$ = Integrated part load value of the new cooling equipment

Table 4-3: Coincidence factor and Coefficients for Building Types

Building Type	A	b	CF
Education - Community College	327.8300	-0.8835	0.71
Education - Secondary School	240.9800	-0.9174	0.73
Education - University	512.1100	-0.9148	0.71
Health/Medical - Clinic	313.5400	-0.8437	0.84
Health/Medical - Hospital	730.7600	-0.8836	0.84
Lodging	589.6100	-0.8750	0.51
Office	657.9100	-0.9437	0.78
Retail	404.0000	-0.8645	0.94

4.3.3 Findings and Recommendations

The gross energy and demand savings calculated for the Commercial HVAC program are listed in the following table:

Table 4-4: Commercial HVAC Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
7,135,122	4,542	6,259

[1] IPLV values are used to calculated peak demand savings for chillers because chiller plants rarely operate at maximum loads, even during peak weather conditions.

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- Update internal calculators for tracking savings to reflect ASHRAE 90.1-2007 code for baseline efficiencies.
- Track the facility type for each project, and use deemed operational hours and coincidence factors based on facility type

4.4 SOLAR INITIATIVE - COMMERCIAL

4.4.1 Overview

CPS Energy's Solar Initiative provides incentives for the installation of solar photovoltaic (PV) systems. Regarding the solar PV systems, once energized, CPS Energy rebated systems must adhere to strict CPS Energy policies and cannot be disconnected or moved without CPS Energy approval. CPS Energy requires completion of an Interconnection Application & Agreement for Distributed Generation as the PV system is based on a net metering configuration.

Participation records show a total of 72 commercial solar photovoltaic systems installed in FY2013, a 44% increase over participation in FY2012. The following sections describe Nexant's approach to evaluating the energy and demand savings provided by the Solar Initiative. All the numbers mentioned below are gross savings.

4.4.2 Savings Calculations

4.4.2.1 CPS Energy Savings Methodology

CPS Energy uses PV Watts, a free, publicly available, online calculator to determine project impacts. This tool estimates peak power production and annual energy production using array rated power, the location (latitude) of the site, and the tilt and azimuth angles of the solar modules. The calculation methodology is based on local weather patterns that result in an average solar insolation value for the installed location. The calculation methodology then adjusts the solar power captured by the array based on the tilt and azimuth angles. CPS Energy records the output from the PV Watts calculator as the claimed savings for each PV project.

Rebates are calculated based on number of modules multiplied by PTC rating (per http://www.gosolarcalifornia.ca.gov/equipment/pv_modules.php) multiplied by inverter efficiency (per http://www.gosolarcalifornia.ca.gov/equipment/inverters.php) multiplied by rebate amount per associated Tier rating.

4.4.2.2 Site Inspections

Given the increasing level of participation and interest in this program, Nexant added on-site inspections to the M&V methodology for this program for FY2013. A Nexant engineer visited 11 randomly selected solar PV installations. The site visit protocol included the following steps:

- Verification that the installed equipment matched the project information recorded in the CPS database, including module and inverter quantities, manufacturers, and serial numbers.
- Visual inspection of the installation.
- Measurement of the system's installed azimuth and inclination angles.
- Collection of any available energy generation data, via inverter digital displays, online web portals, or owner records.

4.4.2.3 Nexant Savings Methodology

Data collected during the site visits was used to calculate verified energy and demand savings for each site. Measurements taken on-site were used as inputs to the System Advisor Model (SAM)[1], which is a robust solar system performance model developed by the National Renewable Energy Laboratory (NREL). The tool is most commonly used for system planning and sensitivity analyses, but lends itself well to evaluation of existing systems. Inputs into the model include specific system component makes and models, layout of the array, site shading characteristics, system derate coefficients for factors such as soiling, panel mismatch, and wiring, as well as weather data such as direct normal solar insolation and average wind speed. The outputs from SAM were calibrated to the collected generation data for each site. A realization rate relating the verified energy and demand savings as compared to the values recorded by CPS Energy was calculated. The following table shows the realization rates for both energy and demand savings.

Table 4-5: Verified Savings Realization Rates for Commercial Solar Projects

kWh Realization Rate	kW Realization Rate
109%	**95%**

These realization rates indicate that the method used by CPS Energy for savings estimates is working well and producing results.

4.4.3 Findings and Recommendations

The gross energy and demand savings for the Solar Initiative program are listed in the table below:

Table 4-6: Commercial Solar Gross Energy and Demand Savings

Measure	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
Commercial Solar PV	3,520,372	2,011	2,011

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

[1] https://sam.nrel.gov

- Nexant recommends CPS Energy continue its savings calculation methodology relying on PVWatts.

4.5 CUSTOM PROGRAM

4.5.1 Overview

In FY2013, CPS Energy offered incentives for custom commercial measures at $0.08/kWh and $200/kW. There were a total of five custom projects totaling $613,769.

The internal review process for this program was revised in FY2013. Customers are now required to submit explanations for their projected savings along with equipment information. Each project is reviewed individually, and an appropriate measurement and verification (M&V) plan is developed and provided to the customer. M&V is performed both before and after installation of new equipment, providing a high confidence in the calculation of actual energy savings achieved on each project.

4.5.2 Savings Calculations

Savings calculations followed standard industry procedures for each given application. A combination of measured data and manufacturer specifications was generally used, along with engineering assumptions where appropriate.

4.5.3 Findings and Recommendations

The gross energy and demand savings calculated for the Custom Program are listed in the table below:

Table 4-7: Commercial Custom Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
6,396,076	660	660

The following are program findings and recommendations that CPS Energy may consider for this program in the future:

- Continue requiring customers to submit information and calculations before projects begin work
- Continue performing M&V on each project until project volume increases significantly, at which point a threshold approach should be considered that would send projects to either M&V or simplified desk review based on factors such as rebate level and project complexity

4.6 NEW CONSTRUCTION

4.6.1 Overview

In FY2013, CPS Energy paid incentives for three commercial new construction projects at the following rates:

- $0.08/kWh and $125/kW for savings 15-25% above code
- $0.12/kWh and $150/kW for savings 25-35% above code
- $0.20/kWh and $200/kW for savings beyond 35% above code

The internal review process for this program was revised in FY2013. Customers are now required to submit whole building energy models in approved software and complete sets of design documents. Each project is reviewed, with energy models first compared to design documents to confirm accurate modeling and then compared to ASHRAE baselines to confirm calculations of savings relative to code.

4.6.2 Savings Calculations

Savings calculations were based on confirmed energy models. The models provide savings between the new building design and a corresponding baseline designed to meet minimum code requirements.

4.6.3 Findings and Recommendations

The gross energy and demand savings calculated for the New Construction program are listed in the table below:

Table 4-8: Commercial New Construction Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (kW)	Non-coinc. Demand Savings (kW)
3,420,560	643	643

The following are program findings and recommendations that CPS Energy may consider for this program in the future:

- Continue requiring customers to submit whole building energy models and complete sets of design documents
- Because of the relatively small number of projects, continue requiring detailed reviews of models and design documents relative to ASHRAE guidelines

4.7 INSPECTION METHODOLOGY

As part of the measurement and verification process for commercial projects, Nexant randomly selected the following projects for inspection. Site inspections were included in the process for strategically selected programs. Solar PV was selected because of the program's growing popularity. Within the Commercial Lighting program, projects submitted by the City of San Antonio were selected because their proportion of the overall program was significantly higher in FY2013 than in previous years.

Table 4-9: Initial Random Sample for Inspection

Category	Customer Name
Lighting (COSA Projects)	Lincoln Community Center
	Claude W Black/Eastside MSC
	Fire Station # 16
	St Marys LLDC
	McCreeless Library
	Woodard Community Center
	Harlandale Community Center
	Southside Lions Community Center
	Fire Station # 43
	Columbia Heights LLDC
	Fire Station # 8
Solar PV	Bauhaus Media
	Brooklyn Properties,
	Bullet Hole Shooting Range
	CAM Solar Inc
	GABLG, LLC
	Grace Bible Chapel
	Medical Center Shell
	Mort Roszell Company
	TexStar National Bank – Commerce
	TexStar National Bank – Langley
	The University of Texas

All the selected sites were inspected for reported measures. All projects were inspected to verify that the site conditions matched the post-retrofit conditions as stated in the customer submittal.

Within each program, projects for inspection were selected randomly. A secondary check was performed to ensure that the variation of project sizes within the sample roughly matched the variation of project sizes within the entire population.

The table below shows the total number of inspected projects within each program. The number of inspections to be conducted was determined based on the program's total number of participants,

in order to achieve 80% confidence and 20% precision within each program, assuming a coefficient of variation of 0.5. The coefficient of variation is a measure of variance in the parameter being investigated and is defined as the standard deviation of the particular value being divided by the mean.

Table 4-10: Inspected Sample

Program	Number of Program Participants	Number of Inspected Projects
Lighting (COSA)	66	11
Commercial Solar PV	305	11

5.1 SUMMARY OF DEMAND RESPONSE IMPACTS

CPS Energy offered the following programs for demand response in FY2013:

- Residential Smart Thermostat Program
- Residential Home Manager Program
- Commercial and Industrial Demand Response Program

The following sections include a brief summary of each program and describe the methodology and the results of the impact analysis.

5.2 SMART THERMOSTAT PROGRAM

5.2.1 Overview

CPS Energy's Smart Thermostat Program (formerly Peak Savers Program) is a direct load control program for residential, multi-family, and small business customers wherein a free programmable thermostat is installed in the residence/facility in exchange for the customer's agreement to allow CPS Energy remote access to their central air conditioning system. Through the program, CPS Energy can cycle on and off the air conditioner compressor for short periods of time on defined event days.

In FY2013, enrollment in the Smart Thermostat program reached a total of 70,144 customers by the end of the program year. This corresponds to a 9% increase over program participation levels from FY2012.

During the summer of FY2013, 19 control events were called for system wide program participants for an average duration of slightly more than two and a half hours each event. In comparison, 29 control events were called in the summer of FY2012, due to record high temperatures.

5.2.2 Savings Calculations

For FY2013, kW savings was calculated based on results from an impact evaluation conducted by Nexant in 2010. Results of that study are listed in Table 5-1 below. FY2013 participation levels and weather conditions were applied to the three temperature bins and two cycling strategies to calculate kW savings for each event for three customer sectors. The enrolled kW available for curtailment is 30,836 kW.

To determine the achieved energy impacts (kWh) during the summer of FY2013, CPS Energy provided Nexant with information on the events called during the year, including the event date, event duration, and the number of participants enrolled on the event day. The achieved energy savings is 995,279 kWh.

Average air conditioning load impact results per customer and various temperature bins are presented in the table below.

Table 5-1: Load Impact Results by Cycling Strategy

Segment	Temperature Bin	33% Cycling	50% Cycling
Residential	90-94°F	0.20	0.35
	95-99°F	0.36	0.63
	100°F +	0.49	0.78
Multi-Family	90-94°F	0.10	0.15
	95-99°F	0.10	0.20
	100°F +	0.15	0.06
Commercial	90-94°F	0.57	0.88
	95-99°F	0.84	1.28
	100°F +	1.00	1.46

5.2.3 Findings and Recommendations

The gross energy and demand savings calculated for the Smart Thermostat program are listed in the following table:

Table 5-2: Smart Thermostat Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (enrolled kW)	Non-coinc. Demand Savings (enrolled kW)
995,279	30,836	30,836

Nexant recommends continuing to collect program event data, including duration, outside temperature, and number of participants.

5.3 HOME MANAGER PROGRAM

5.3.1 Overview

CPS Energy's Home Manager Program is a comprehensive electric load monitoring and direct load control program for residential customers. Equipment controlled through the program includes HVAC units, electric hot water heaters, and pool pumps. Enrollment in the program is free, and the program equipment and web-based interface are the incentive for participation. Enrollment includes installation of the free programmable thermostat and web-based access to equipment scheduling capabilities in exchange for the agreement to allow CPS Energy remote access to take control of equipment during system peak periods.

This program was newly offered in FY2013 and achieved a population of 7,814 residential customers by the end of the program year.

The Home Manager system controls three types of devices: HVAC units, electric water heaters, and pool pumps. CPS Energy can call load reduction events for the Home Manager population as

necessary to reduce system electric loads. When an event is called, all Home Manager thermostats are adjusted upward by four degrees Fahrenheit from their pre-event setpoints. Water heaters and pool pumps are powered off for the duration of the event. Customers have the ability to reset their thermostat setpoints or drop completely out of the event at any time. In FY2013, CPS Energy called 10 official System Test Events, from June 25 through September 7, ranging from one to three hours in duration.

5.3.2 Event kW and kWh Savings

To determine peak kW savings attributable to the Home Manager program, Nexant conducted a linear regression analysis on premise-level and device-level energy consumption data collected by the Home Manager system. Regression analysis is a statistical method of quantifying the impact of event participation by isolating the effect of other independent variables such as weather conditions. Load data from non-event days is used to form a mathematical baseline which is then extrapolated to the conditions experienced on event days. Load data during events is analyzed collectively, resulting in a mathematical relationship that also describes event impacts.

All residences with complete datasets were included in the analysis (over 92% of the population) in order to minimize uncertainty associated with sampling. Throughout the regression analysis process, Nexant reviewed key fit statistics to assess the predictive accuracy of the model. The final regression model exhibited strong statistical accuracy and goodness of fit, indicating that the results of the regression analysis are unbiased and exhibit a narrow margin of error (±4.9%).

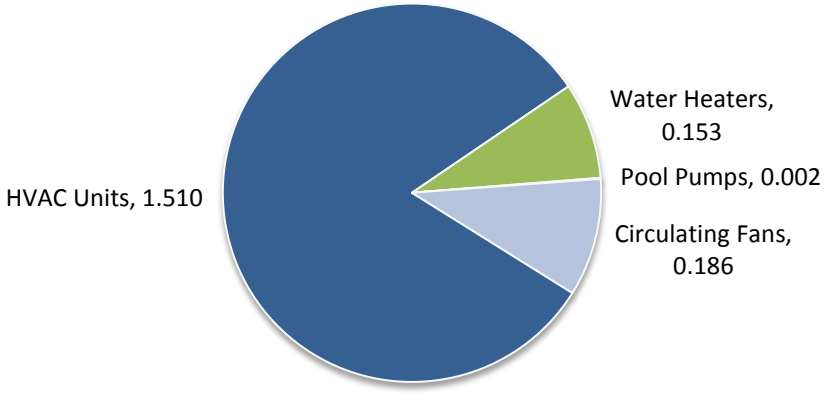
The average impact achieved by the program across all 10 System Test Events was 1.851 kW per customer. This value is averaged across all participants and all event hours. Table 5-3 lists the impact of each of the 10 System Test Events.

Table 5-3: Home Manager System Test Event Impacts, Summer FY2013

Event Day	Event Duration (hrs)	Max Temperature (F)	Average Impact per Home (kW)
6/25/FY2013	2.25	102	1.953
6/26/FY2013	3	105	1.815
7/20/FY2013	2.25	93	1.399
7/31/FY2013	2.25	99	1.798
8/1/FY2013	2	101	1.990
8/2/FY2013	2.25	100	1.866
8/7/FY2013	2.25	98	1.750
9/4/FY2013	2	98	1.799
9/5/FY2013	2	97	1.769
9/7/FY2013	1	98	2.367
System Test Value			**1.851**

Figure 5-1 is a graphical representation of the impact results at the device level, showing the makeup of event impact attributable to each device type.

Figure 5-1: Device Contributions to Event Impact (kW)



Nexant also conducted analysis on the post-event snapback energy usage to quantify the average energy impact of event participation. The snapback was conducted by extending the premise-level regression analysis into the post-event time period. Snapback was investigated from the end of each event until midnight of the event day.

Table 5-4 shows the results of the snapback analysis for the Summer FY2013 period. On average, Home Manager customers save 3.87 kWh during event participation. After the event ends, energy consumption in the residences is higher by about 1.41 kWh. The net effect on the average residence is a savings of 2.46 kWh. Average event day kWh consumption was determined to be 78.25 kWh per residence, so the event participation energy savings equates to a 3.04% reduction in daily energy use.

Table 5-4: Snapback Results

Parameter	kWh
Event Period kWh Saved	3.87
Snapback kWh	-1.41
Net Energy Savings	2.46

5.3.3 Findings and Recommendations

The gross energy and demand savings calculated for the Home Manager program are listed in the following table:

Table 5-5: Home Manager Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (enrolled kW)	Non-coinc. Demand Savings (enrolled kW)
89,365	14,461	14,461

Since this program is new and still developing, Nexant recommends that the program's performance be re-analyzed next year. Some key changes related to the program structure have been proposed by CPS Energy, such as reducing the event setpoint change from 4° to 3°, which would result in changes to the associated event impacts. An analysis is expected to be performed again in FY2014 to quantify these and other impacts. To aid this effort, CPS Energy should continue to collect device-level and residence-level kWh consumption data for the program population.

5.4 COMMERCIAL AND INDUSTRIAL DEMAND RESPONSE PROGRAM

5.4.1 Overview

The Commercial and Industrial Demand Response (C&I DR) Program is a voluntary load curtailment program offered to commercial and industrial customers. Incentives are provided to participating customers for shedding electric load when requested by CPS Energy during high demand periods in the summer. Incentive payments are made based on the amount of load curtailed during called events. In FY2013, CPS Energy enrolled 148 customers in the C&I DR program. This corresponds to a 95% increase in program participation from FY2012. 17 curtailment events were called between June and September, compared to 22 events in FY2012.

5.4.2 Savings Calculations

CPS Energy collected participating facility load data and calculated the kW and kWh savings that were achieved during the FY2013 C&I DR events. The objective of Nexant's analysis was to independently verify the savings based on CPS Energy's baseline calculation methodology and the interval meter data collected for the participating facilities. Nexant's analysis included the following steps:

1. Gain an understanding of the methodology used by CPS Energy to calculate the facility's baseline load and determine the load curtailed during called events.
2. Choose a sample of event days and apply CPS Energy's baseline calculation methodology and event data to independently calculate the load impacts and energy savings. The kW and kWh savings were calculated for the three event days with highest loads in FY2013 – Jun 26, Jun 27, and Aug 10 for all the customers.
3. Divide the Nexant-calculated savings by the CPS Energy-calculated savings to derive program kW and kWh realization rates.
4. Apply these realization rates to the program-calculated kW and kWh savings for all event days in FY2013 to arrive at the total Nexant kW and kWh savings for the program.

To calculate the curtailed load for each event, facility load data for ten (10) eligible days prior to the event day were provided by CPS Energy. The top three out of the 10 days are selected based on the total kWh during the peak period of 3 PM to 7 PM. The kW for the 3 days is then averaged to derive the baseline. In some cases, this average may not be representative of the baseline due to changes in weather and operations on the event day. To adjust the baseline, a baseline shift factor is applied to this average to derive the "true" baseline.

Due to the number of independent variables that can impact the facility's load, the calculation of the baseline shift factor is one of the subjective components of the calculation methodology. Nexant calculated the baseline shift factor as follows, which may vary slightly from CPS Energy's methodology:

1. Graph the event kW and non-adjusted baseline kW to check for unusual trends like a higher than usual event kW before the event compared to the baseline kW. If no unusual trends are noted and the actual load prior to the event matches the calculated based line, no baseline shift factor is required; otherwise, proceed to Step 2.

2. Calculate the sum of standard deviations between each interval pair of event day and baseline kW between 13:00 and 15:00. In other words, calculate:

   Total deviation = Standard deviation (x1, y1) + Standard deviation (x2, y2) + …… Standard deviation (xn, yn)

   Where:

   x = event kW
   y = baseline kW
   1, 2,….n represent 15 minute intervals from 13:00 through 15:00 which is the 3-hour interval before the event.

3. Look for outlier standard deviations (especially close to the event time) and eliminate them from the total deviation calculation.

4. Solve for the baseline shift factor that minimizes this total deviation.

If the above methodology still fails to match the load profile of the baseline with the event day, the following adjustments are made sequentially till a good fit is achieved:

1. Expand the time window in Step 2 from 13:00 to 15:00 to 12:00 to 15:00 and continue with the iteration as outlined above.

2. Examine the graph of demand versus time for each of the top 3 days, and eliminate any day among that does not match the other two days and the event day. Include the next highest demand day to calculate the unadjusted baseline average.

One of the 10 eligible days with a load shape similar to the event day load shape is used as a proxy to the baseline. The baseline shift factor is then applied to this proxy day to adjust the baseline closer to the event day load profile. The baseline shift factor is calculated as detailed above. At a minimum, the sum of the standard deviations as calculated in Step 2 should be lower than the above two adjustments.

5.4.3 Findings and Recommendations

The gross energy and demand savings calculated for the C&I DR program are listed in the following table:

Table 5-6: Demand Response Gross Energy and Demand Savings

Energy Savings (kWh)	Peak Demand Savings (average event kW)	Non-coinc. Demand Savings (average event kW)
2,795,334	63,969	63,969

The following are program findings and recommendations that CPS Energy may consider for the program in the future:

- The realization rate or the ratio of Nexant calculated savings and CPS Energy calculated savings is 0.987, which means there is only a 1.3% difference between the two calculations.
- The R-Square regression factor between Nexant calculated savings and CPS Energy calculated savings for three event days (Jun 26, Jun 27, and Aug 10) exceeded 0.99, which signifies a good correlation between the two savings calculations.
- Nexant recommends CPS Energy continue with current calculation methodology

6 TOTAL IMPACTS AND COST-EFFECTIVENESS SUMMARY

6.1 NET PROGRAM IMPACTS

Net-to-gross (NTG) ratios from other programs' experience and evaluations were used to calculate net impacts shown in Table 6-1.

Table 6-1: FY2013 Program Gross and Net Impacts

Program	Gross Savings			NTG Ratio	Net Impacts			B/C Ratio
	Energy Savings (kWh)	Peak Demand Savings (kW)	Non-Coinc. Demand Savings (kW)		Energy Savings (kWh)	Peak Demand Savings (kW)	Non-Coinc. Demand Savings (kW)	
Energy Efficiency Programs								
Home Efficiency	2,005,255	266	602	0.93	1,864,887	247	560	0.86
Weatherization	3,057,320	1,023	1,522	0.93	2,843,308	951	1,415	0.31
Air Flow Performance	438,193	270	270	0.90	394,374	243	243	0.39
Residential HVAC	8,999,327	2,692	3,365	0.95	8,549,361	2,557	3,197	2.09
Residential Solar	3,393,361	1,760	1,760	1.00	3,393,361	1,760	1,760	0.55
New Homes Construction	9,872,843	1,924	1,924	1.00	9,872,843	1,924	1,924	2.75
Refrigerator Recycling	1,689,345	155	194	0.63	1,064,287	98	122	1.85
Residential Subtotal	**29,455,644**	**8,090**	**9,637**		**27,982,420**	**7,781**	**9,221**	**1.02**
Lighting	67,684,545	11,585	13,055	0.85	57,531,863	9,847	11,097	1.87
Commercial HVAC	7,135,122	4,542	6,259	0.96	6,849,717	4,360	6,009	1.90
Commercial Solar	3,520,372	2,011	2,011	1.00	3,520,372	2,011	2,011	0.76
Cool Roof	68,821	9	10	0.90	61,939	8	9	0.62
New Construction	3,420,560	643	643	1.00	3,420,560	643	643	2.36
LED Street Lights	3,386,878	0	796	0.90	3,048,190	0	716	0.40
Custom	6,396,076	660	660	0.96	6,140,233	634	634	3.67
Commercial Subtotal	**91,612,374**	**19,450**	**23,434**		**80,572,874**	**17,503**	**21,118**	**1.54**
Energy Efficiency Total	**121,068,018**	**27,540**	**33,071**		**108,555,295**	**25,284**	**30,340**	**1.33**
Demand Response/Load Control Programs								
Smart Thermostat	995,279	30,836	30,836	1.00	995,279	30,836	30,836	5.49
Home Manager	89,365	14,461	14,461	1.00	89,365	14,461	14,461	0.97
C&I Demand Response	2,795,334	63,969	63,969	1.00	2,795,334	63,969	63,969	0.94
Demand Response Total	**3,879,978**	**109,266**	**109,266**		**3,879,978**	**109,266**	**109,266**	**1.92**
Grand Total	**124,947,996**	**136,806**	**142,337**		**112,435,273**	**134,550**	**139,606**	**1.53**

Figure 6-1 and Figure 6-2 present a breakdown of the contribution by each program to the overall net program impacts:

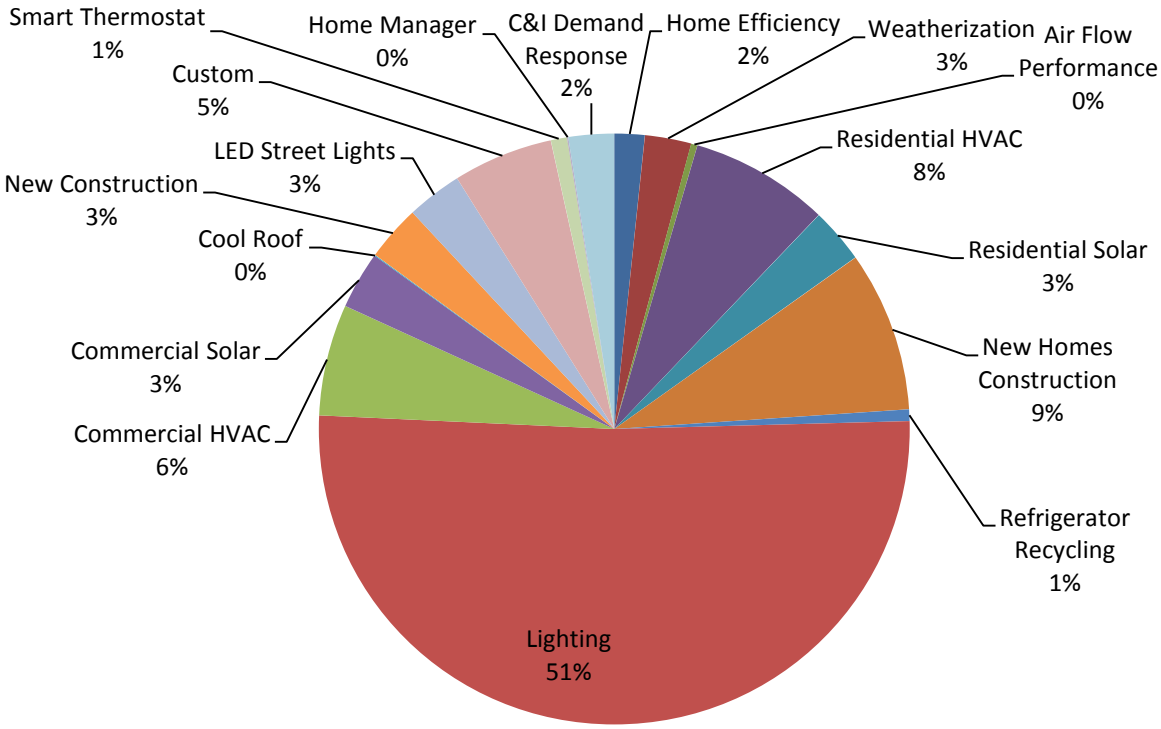


Figure 6-1: FY2013 Energy (kWh) Savings by Program

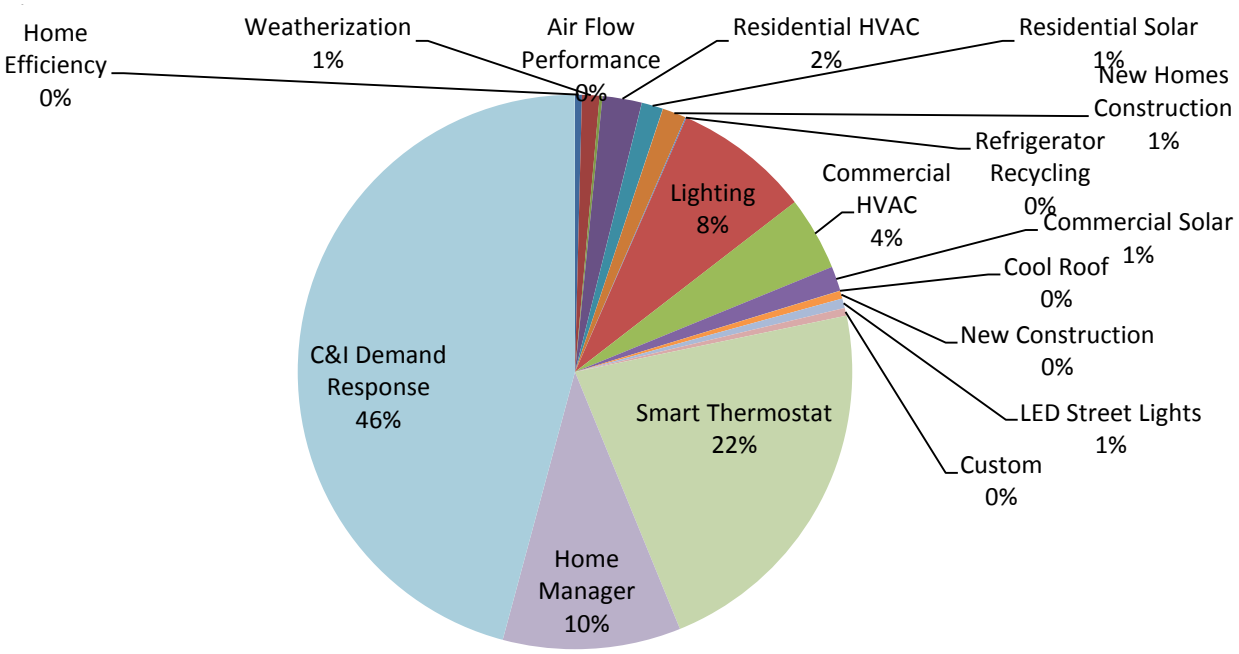


Figure 6-2: FY2013 Non Coincident Demand (kW) Savings by Program

Figure 6-3 presents a comparison of the non-coincident demand savings achieved by the FY2013 program offerings compared with program results from prior years:

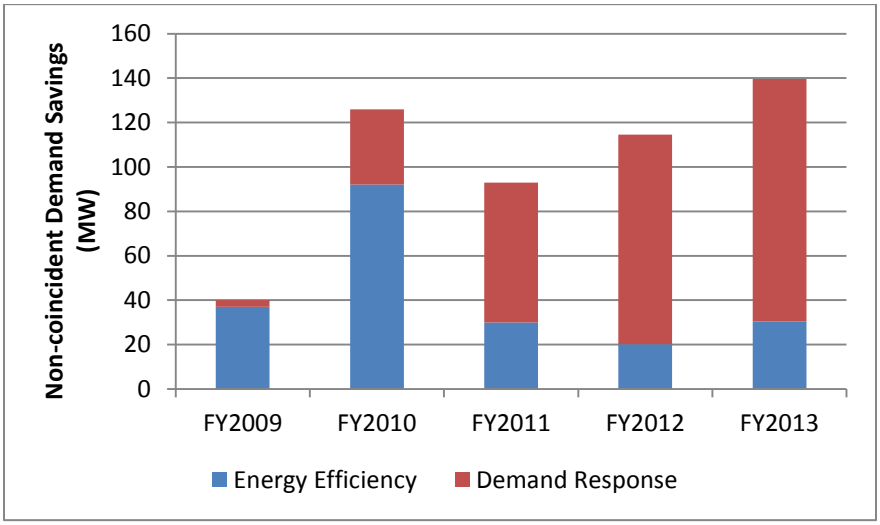


Figure 6-3: Comparison of Annual Non-Coincident Demand (kW) Savings

6.2 ECONOMIC ANALYSIS

The economic evaluation of CPS Energy's DSM program offerings included collection of all program-related costs such as incentives paid directly to customers, marketing outreach to customers and contractors, internal labor costs and incentives provided to CPS Energy staff, and consultant fees (Table 6-2). The economic impacts of the portfolio are shown below.

- Cost of Saved Energy {excludes DR} ($/kWh): $0.037
- Reduction in Revenue Requirements: $31,327,079
- Benefit Cost Ratio: 1.53

Table 6-2: FY2013 Program Expenditures

Category	Amount
Program Management and Marketing	$7,039,701
Rebates and Incentives Paid	$52,078,782
Total Program Expenditures	$59,118,483

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