

Energy Efficiency
Engineering

Carbon
Management
Solutions

Evaluation, Measurement and Verification (EM&V) Study

Azusa Light & Water



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Prepared for:
Paul Reid
Azusa Light & Water

Prepared by:
Lincus Inc.

LINCUS, INC.
Tempe, AZ
Monrovia and
Huntington Beach, CA

P | (877) 525-8898
F | (877) 205-8010

lincusenergy.com

Prepared for:

Paul Reid
Azusa Light & Water
729 N. Azusa Ave.
Azusa, CA 91702

Prepared by:

Branden Morhous, Energy Engineer
Jorj Nofal, P.E., Principal
Guru Navaneetham, IPMVP, Energy Engineer

Lincus Inc.
8727 S Priest Dr., Suite 103
Tempe, AZ 85284

222 Huntington Blvd., Suite 110
Monrovia, CA 91016

Ph: (480) 598-8431
Fax: (480) 598-8485

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1 Utility Overview

Azusa Light & Water (Azusa) offers a number of energy efficiency and renewable energy programs to its customers throughout the City of Azusa. This report describes these Azusa energy efficiency incentive programs and the Evaluation, Measurement, and Verification (EM&V) Plans to be implemented for said programs.

On September 29, 2005, the Governor of California signed Senate Bill 1037 (SB1037) into law. SB 1037 requires that Publicly Owned Utilities put energy efficiency and demand reduction as a top priority and produce an annual report stating expected energy savings, actual energy savings, and descriptions of the programs producing these savings.

One year later, on September 29, 2006, Assembly Bill 2021 (AB2021) was signed into law. This Bill reiterates and adds upon Senate Bill 1037. The additions AB2021 made to SB1037 include an expansion of annual report requirements. These requirements include:

- An independent evaluation measuring and verifying the energy and demand savings produced by the utility's energy efficiency programs
- A tri-annual report highlighting annual targets and potential savings of energy efficiency and demand reduction for ten years

The goals of this EM&V study fulfill this first requirement by providing unbiased, independent evaluations of Azusa's programs. As a part of this study, Lincus will provide Azusa with:

- Program feedback and recommendations for improvement.
- Evaluation of energy efficiency program success.
- Evaluation of program data caliber.
- Increased confidence levels of energy efficiency program results.

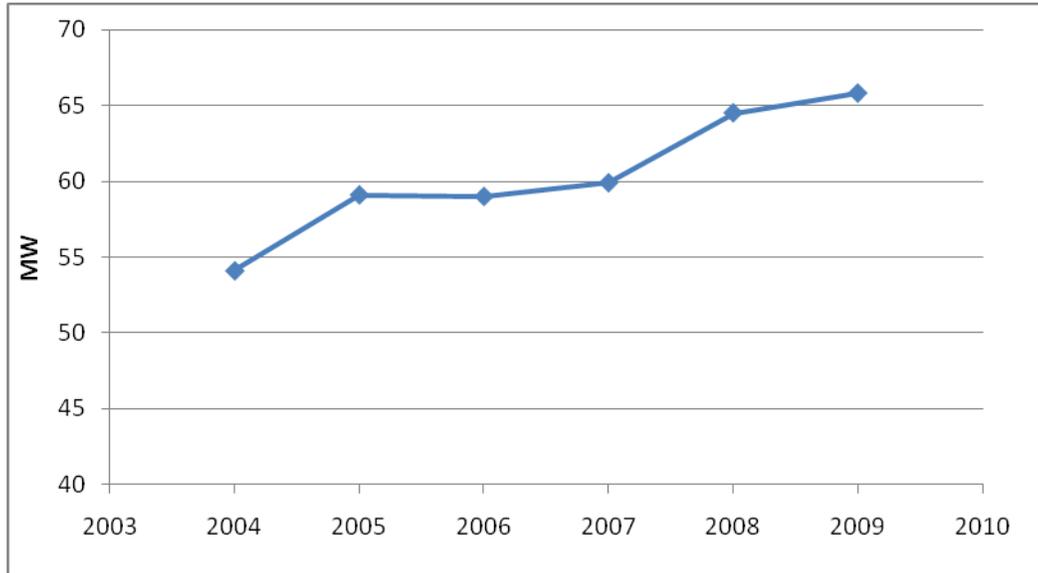
This EM&V study will consider the impacts of Azusa's energy efficiency programs for FY2008/2009 (July 1, 2008 through June 30, 2009). This report is based upon information provided directly by Azusa staff and its website.

1.1 General Utility Background Information

The City of Azusa owns and operates the electric system serving more than 15,650 metered accounts in Azusa, California. Azusa is contracted with Southern California Public Power Authority ("SCPPA"), which provides a majority of Azusa's 66 MW summer peak power requirements from coal, wind, nuclear, and hydro generating plants.

In the 2008-2009 fiscal year, Azusa Light & Water served Azusa, California with 65.8 MW and 264,957 MWh. Figure 1-1 below shows the actual yearly peak demand for Azusa Electric Utility over the last five years.

Figure 1-1: Azusa’s Actual 2005-2009 Peak Demand



Figures 1-2 and 1-3 below compare the baseline demand and energy forecast in AB2021 to the actual demand and energy over the last three years.

Figure 1-2: Azusa’s AB2021 Submitted Baseline vs. Actual MW Demand

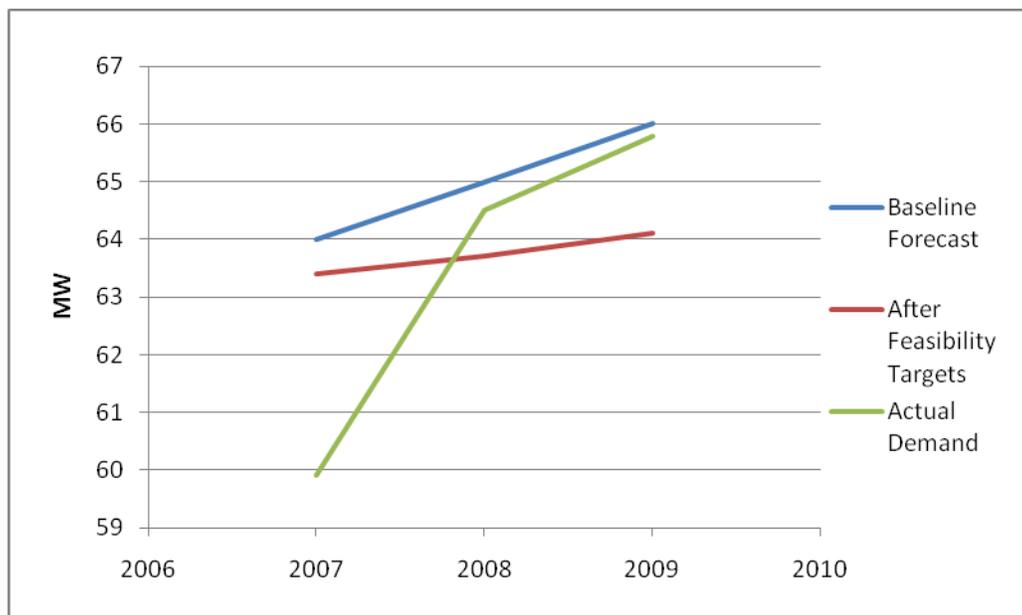
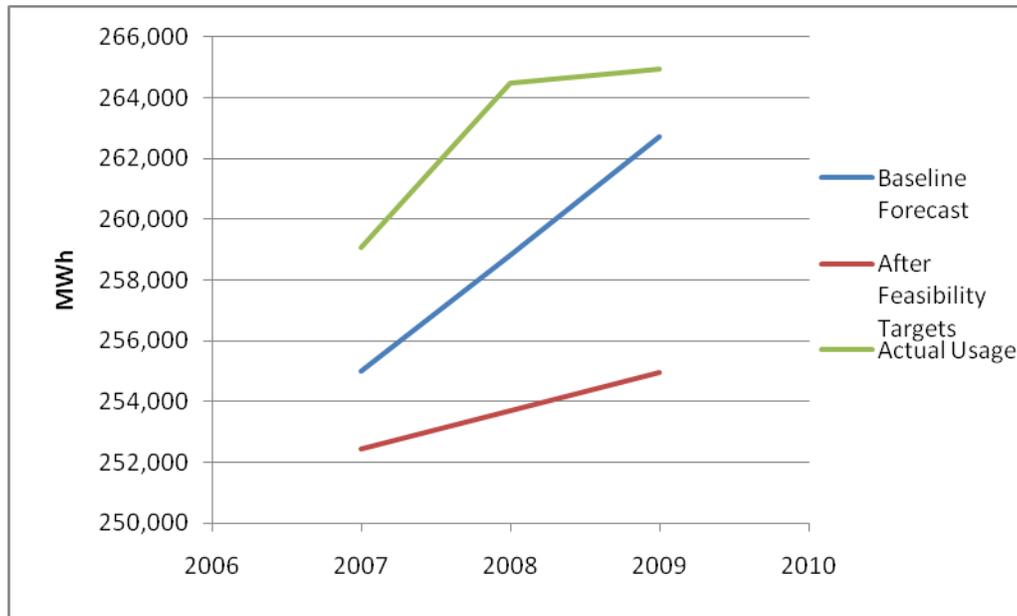


Figure 1-3: Azusa’s AB2021 Submitted Baseline vs. Actual MWh Usage



1.2 Key Customer Markets

Azusa offers energy efficiency programs to 15,650 metered residential and business customers alike. The estimated population of Azusa is about 46,000. Azusa has roughly three dozen Time-Of-Use (>200 kW) Commercial customers, which represent a large portion of the demand requirement.

2 Energy Efficiency Programs

In the 2008-2009 program year, Azusa offered eight energy efficiency programs to residential and business customers. Through this program year, there was a Total Utility Cost of \$490,273 which resulted in a net electrical savings of 2,083,615 kWh and 324.0 coincident peak kW. Below is a list of energy efficiency programs available to Azusa customers, as described on Azusa's website and by its staff.

2.1 2008-2009 Program Offerings



Online Energy Audit – Azusa residential customers are given the ability to help find simple, practical ways to reduce utility bills with an online energy audit. Customer billing history is analyzed in conjunction with answers to the online survey regarding home energy systems and practices.



Refrigerator Rebate – This Program provides incentives for purchasing Energy Star qualified refrigerators, which use less energy than older units of comparable size. Residential customers are given \$100 for units greater than 14.3 cubic feet.

Replacement AC Rebate – This Program offers rebates to residential customers who replace Central AC and Room AC units with Energy Star qualified units. The incentive is \$75 per ton.



Home Weatherization Rebate – Azusa offers incentives to customers for improving their building envelope. Measures such as attic fan, attic and wall insulation, duct sealing, programmable thermostats, solar attic fan, window replacement, and whole house fans are included in this Program. All incentives are prescriptive and based off a dollar amount per unit.



CFL Giveaway – Customers who have an address within Azusa city limits are able to pick up four free CFLs from their local library and/or Light & Water Department office. These CFLs were distributed through the library not only to help customers save energy, but to help the libraries gate counts.

LivingWise Educational Program - LivingWise is a residential savings and education program for Azusa 6th grade students. LivingWise combines classroom learning, a home audit, and minor retrofits completed by students and parents. With their parents, students track the installation of the various energy-saving items, and submit a report to their science teacher.

Business Energy Partnership Program – Business customers who choose to implement energy efficiency measures can apply for an incentive through Azusa. This incentive Azusa offers through this program is 50% of the measure cost, up to \$10,000, per metered account.

Small Business Audit/Direct Install – Azusa provides small businesses with free energy audits. During the energy audit, the facility is inspected for energy efficiency opportunities. When the audit is completed, the customer receives a list of recommended energy efficiency measures they can implement to savings energy. Azusa also provides and installs CFLs and HVAC Tune-Ups on units less than and equal to 5 tons for free when they are recommended. If the customer decides to implement recommended measures, Azusa will pay for 50% of the direct install cost, up to \$10,000, per metered account.

3 Summary of FY 2008-2009 Estimated Savings

Azusa has an energy efficiency program tracking database that consists mostly of Excel files. An E3 calculator sheet was sent to Lincus containing the program energy and demand reduction and incentive totals from this energy efficiency program database. The Tables and Graphs below represent this data provided by Azusa.

3.1 Residential Program Savings

Table 3-1 shows information provided from Azusa's energy efficiency program database of residential measures. This table provides the number of projects, estimated energy and peak demand reductions, net-to-gross ratios, and the incentives provided.

Table 3-1: Estimated Residential Energy and Demand Savings for FY 2008/2009

Program	# of Units	Gross Energy Reduction (kWh) ¹	Summer Peak Reduction (kW) ²	kWh % of Total	kW % of Total	NTG ³	Total Utility Cost ⁴	Cost % of Total
CFL Giveaway	8,224	485,216	90.4	38.9%	62.8%	0.80	\$33,841	21.8%
Online Energy Audit	970	386,060	0.0	31.0%	0.0%	0.80	\$9,111	5.9%
LivingWise	721	263,886	2.9	21.2%	2.0%	0.80	\$33,814	21.8%
Home Weatherization Rebates	237	53,019	39.1	4.3%	27.2%	0.80	\$61,351	39.5%
Replacement AC Rebate	70	38,568	8.2	3.1%	5.7%	0.80	\$9,640	6.2%
Refrigerator Rebates	61	19,276	3.3	1.5%	2.3%	0.80	\$7,557	4.9%
Totals	10,283	1,246,025	143.9	100%	100%		\$155,313	100.0%

According to Azusa's E3 Final Report, the highest energy saving Program is the CFL Giveaway Program at 38.9%, however it is not a reoccurring Program, so Lincus did not evaluate this Program. The remaining Programs were considered in this study and are discussed more in Section 5.1.

The data shown in Table 3-1 is also presented in Figures 3-1 through 3-3. Figure 3-1 shows estimated energy reductions, Figure 3-2 shows estimated summer peak reduction, and Figure 3-3 shows the program costs.

¹ Gross Energy Reduction numbers taken from 'EE Reporting Tool 2008 V1, with IB30 measure 1-20-10'

² Peak Demand Reduction numbers taken from 'EE Reporting Tool 2008 V1, with IB30 measure 1-20-10'

³ NTG numbers taken from 'EE Reporting Tool 2008 V1, with IB30 measure 1-20-10' which references CPUC for ratios

⁴ Total Utility Costs taken from 'EE Reporting Tool 2008 V1, with IB30 measure 1-20-10' as Total Utility Cost

Figure 3-1: Residential kWh Savings for FY 2008/2009

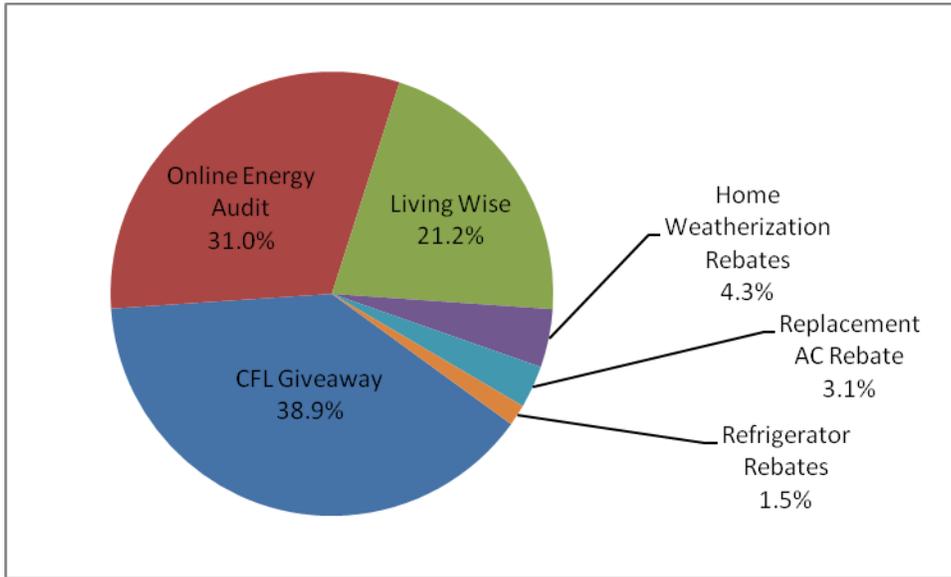


Figure 3-2: Residential Summer Peak kW Reduction for FY 2008/2009

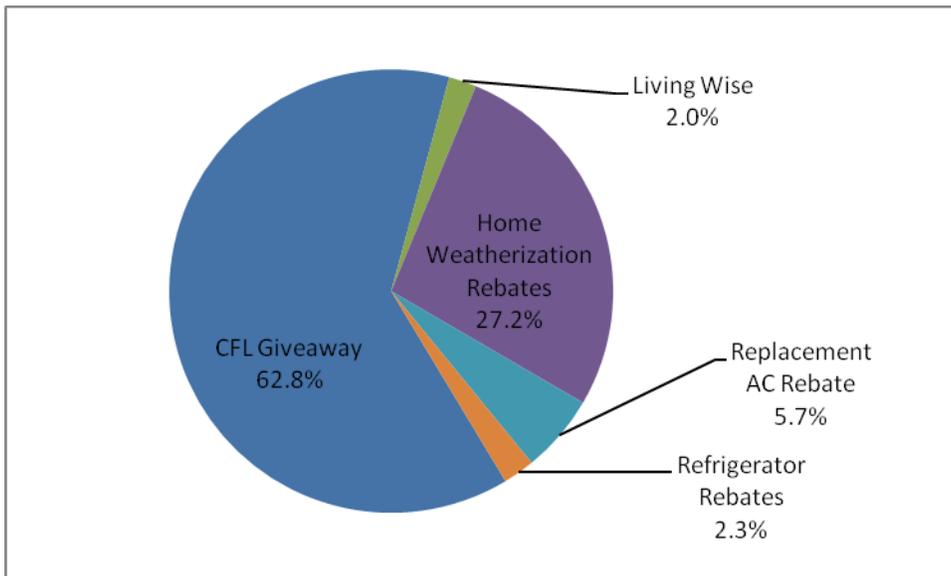
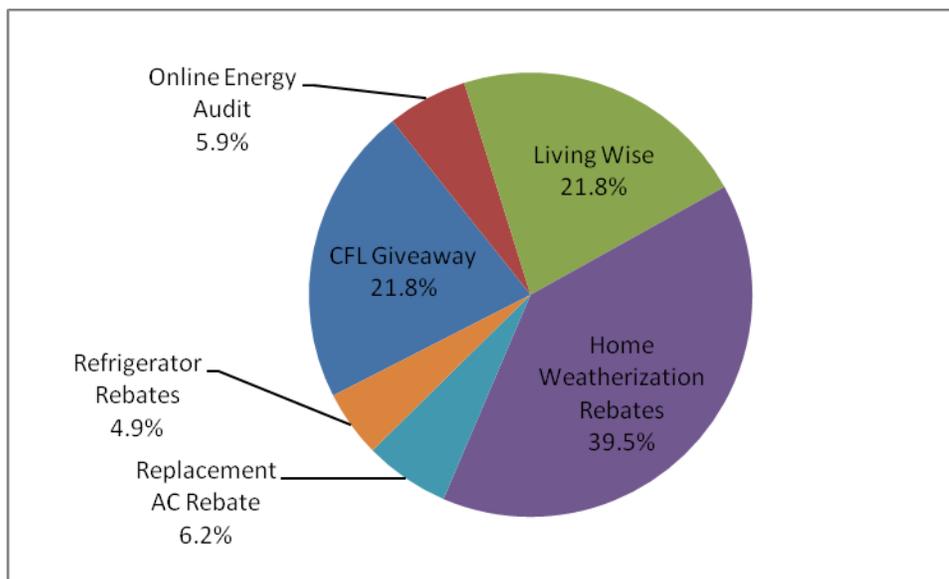


Figure 3-3: Residential Program Costs for FY 2008/2009



3.2 Non-Residential Program Savings

Table 3-4 shows information provided from Azusa’s energy efficiency program database of non-residential measures. The non-residential measures provide much greater levels of energy savings due to the higher kW demand and operating hours. This table provides the number of projects, estimated energy and peak demand reductions, net-to-gross ratios, and the incentives provided.

Table 3-4: Estimated Energy and Demand Impacts for FY 2008/2009 for the Non-Residential Sector

Program	# of Units	Gross Energy Reduction (kWh) ⁵	Summer Peak Reduction (kW) ⁶	kWh % of Total	kW % of Total	NTG ⁷	Program Costs ⁸	Cost % of Total
Business Energy Partnership Program	43	808,432	166.0	74.8%	82.8%	1.00	\$204,994	70.4%
Small Business/ Direct Install	316	272,192	34.6	25.2%	17.2%	1.00	\$86,129	29.6%
Totals	359	1,080,624	200.6	100%	100%		\$291,122	100.0%

According to Azusa’s E3 Final Report, the largest energy saving Program is the Business Energy Partnership Program at 74.8%. The Small Business/ Direct Install Program is the next highest

⁵ Gross Energy Reduction numbers taken from ‘EE Reporting Tool 2008 V1, with IB30 measure 1-20-10’

⁶ Peak Demand Reduction numbers taken from ‘EE Reporting Tool 2008 V1, with IB30 measure 1-20-10’

⁷ NTG numbers taken from ‘EE Reporting Tool 2008 V1, with IB30 measure 1-20-10’ which references CPUC for ratios

⁸ Total Utility Costs taken from ‘EE Reporting Tool 2008 V1, with IB30 measure 1-20-10’ as Total Utility Cost

Program and represents 25.2% of the total savings. Both these Programs were considered in this study and are discussed more in Section 5.2.

The data shown in Table 3-4 is also presented in Figures 3-4 through 3-6. Figure 3-4 shows estimated energy reductions, Figure 4-5 shows estimated summer peak reduction, and Figure 3-6 shows the program costs.

Figure 3-4: Non-Residential kWh Savings for FY 2008/2009

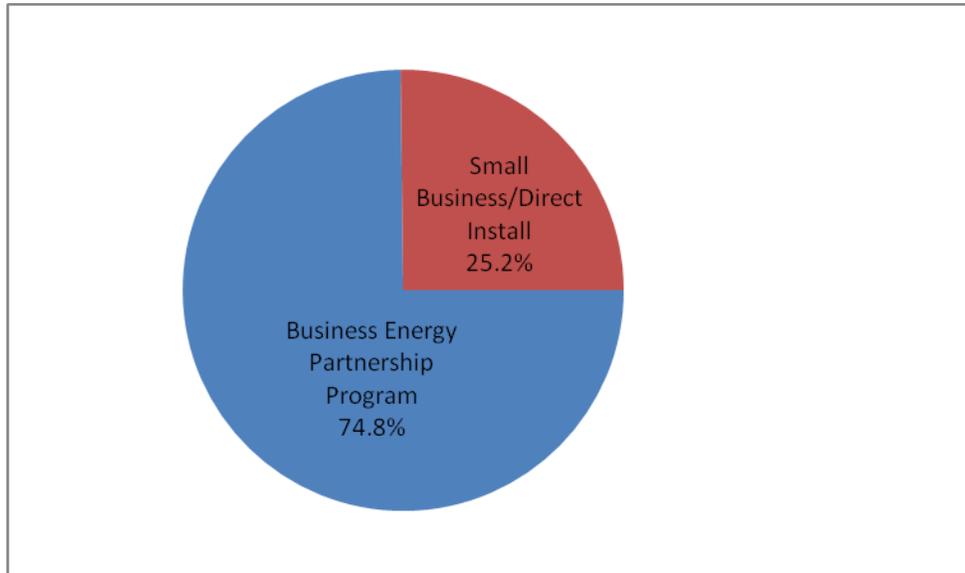


Figure 3-5: Non-Residential Summer Peak kW Reduction for FY 2008/2009

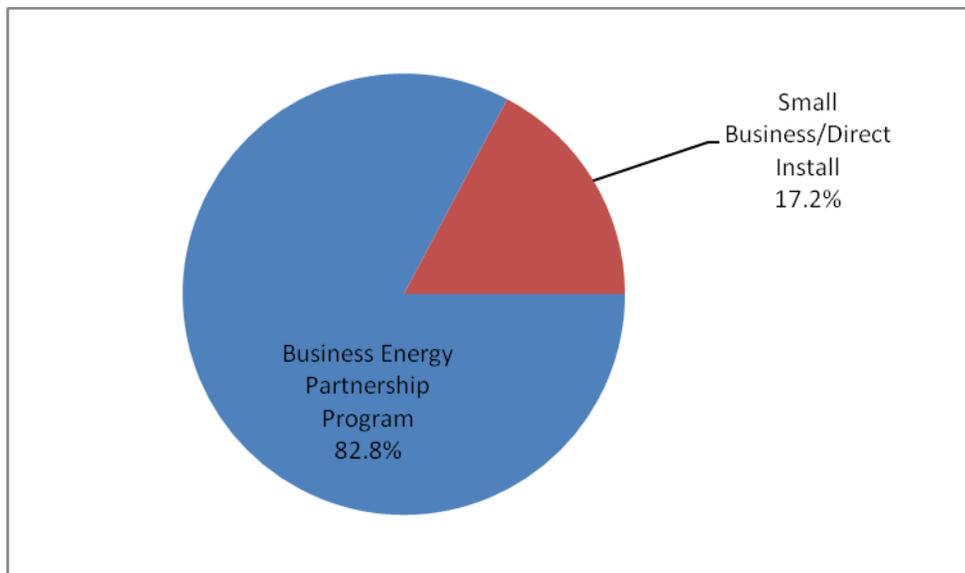
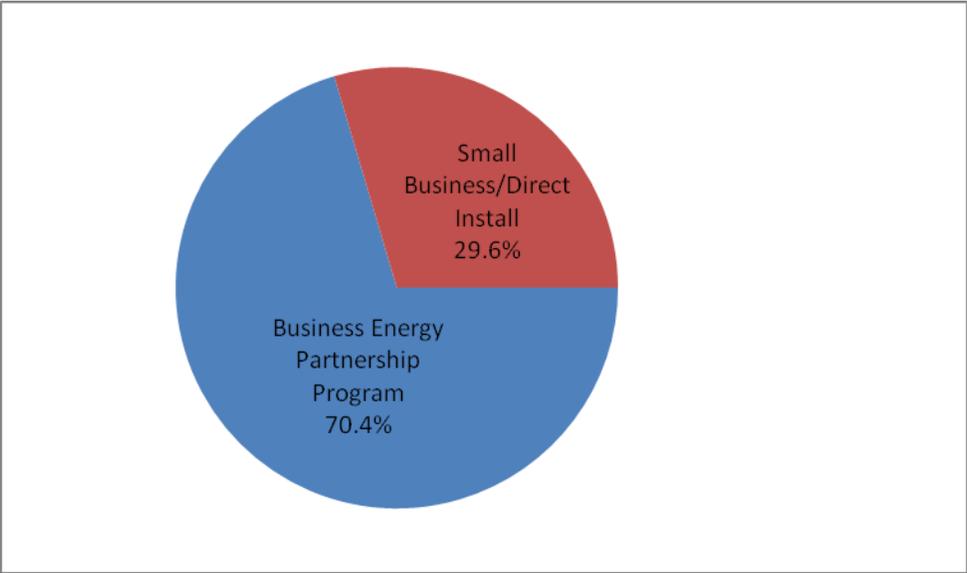


Figure 3-6: Non-Residential Program Costs for FY 2008/2009



4 Program Process Evaluation Plan

4.1 Background and Objectives

Based on Lincus' extensive program development, management, and evaluation experience, as well as the company's own internal EM&V process, Lincus has developed a standardized and streamlined EM&V process to assist Azusa in maximizing program performance, while reducing EM&V costs. The tasks involved are:

- Define Program Goals and Review Tracking System
- Design Data Acquisition Plan
- Collect and Process Data
- Analyze Results
- Provide Results and Recommendations

5 Program Impact Evaluation Plan

5.1 Impact Evaluation Methods

International Performance Measurement and Verification Protocol (IPMVP) is a great resource for considering the range of efficiency measures offered by Azusa. Table 5-1, below, shows a list of IPMVP Measurement & Verification Options. The table provides a list of the different types of M&V options, how the savings are calculated for each option, and which M&V option may typically apply to the measures promoted. Lincus' approach to selecting M&V strategies will follow these guidelines.

Table 5-1: Overview of M&V Options

2007 IPMVP M&V Options	How Savings Are Calculated	Typical Applications
<p>Option A. Retrofit Isolation: Key Parameter Measurement Savings are determined by field measurement of the key performance parameter(s) which define the energy use of the efficiency measures' affected system(s). Parameters not selected for field measurement are estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required.</p>	<p>Engineering models of baseline and reporting period energy from short-term or continuous measurements of key operating parameter(s); estimated values.</p>	<p>A lighting retrofit where power draw is the key performance parameter that is measured periodically. Estimate operating hours of the lights based on building schedules, occupant behavior, and/or prior studies.</p>
<p>Option B. Retrofit Isolation: All Parameter Measurement Savings are determined by field measurement of the energy use of the affected system. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period.</p>	<p>Short-term or continuous measurements of baseline and reporting-period energy, and/or engineering models using measurements of proxies of energy use.</p>	<p>Application of a variable-speed drive and controls to a motor to adjust pump flow. Measure electric power with a meter installed on the electrical supply to the motor, which reads the power every minute. In the baseline period this meter is in place for a week to verify constant loading. The meter is in place throughout the reporting period to track variations in power use.</p>
<p>Option C. Whole Facility Savings are determined by measuring energy use at the whole-facility or sub-facility level. Continuous measurements of the entire facility's energy use are taken throughout the reporting period.</p>	<p>Analysis of whole-facility baseline and reporting period (utility) meter data. Routine adjustments as required, using techniques such as simple comparison or regression analysis.</p>	<p>Multifaceted energy management program affecting many systems in a facility. Measure energy use with the gas and electric utility meters for a 12-month baseline period and throughout the reporting period.</p>
<p>Option D. Calibrated Simulation Savings are determined through simulation of the energy use of the facility. Simulation must demonstrate that it can adequately model actual energy performance measured in the facility.</p>	<p>Energy use simulation calibrated with hourly or monthly utility billing data.</p>	<p>Multi-faceted, new construction, energy management program affecting many systems in a facility - where no meter existed in the baseline period. Simulations are calibrated after installations of utility metering. Baseline energy use is compared to a simulation of reporting period energy use.</p>

5.1.1 M&V Program Options

Table 5-2 below, displays Azusa’s initial M&V option selections by energy efficiency program. Most programs will use either Option A or B under the IPMVP protocols. Option A requires limited measurement and can be the quickest to verify energy savings. M&V Option B usually requires a seven day measurement period to generate trending data and usually takes longer to verify savings. Having all programs under Option A would be ideal for quick and easy, yet still precise. However, the savings for many measures depend on multiple variables that cannot be measured instantly, or even within a week. For these measures Option C and D will be required, a longer measurement period is needed to generate an accurate verification of savings for these Options. More description of the programs to undergo M&V will be done in Sections 5.2 and 5.3.

Table 5-2: Selection of M&V Program Options

Program	M&V Option	Duration of M&V	Measurements
Online Energy Audit	A/B/C/D	Varies	Depends on Measures
LivingWise	A	Instant	Varies on measures
Home Weatherization Rebates	-	-	-
Attic Fan	B	7 Days	Power, Flow, and Air temperature
Duct Sealing	B	7 Days	Air temperature and HVAC consumption
Ceiling Insulation	D	Varies	Utility Bills modeling
Programmable Thermostats	B	7 Days	Air temperature and HVAC consumption
Solar Attic Fan	B	7 Days	Power, Flow, and Air temperature
Whole House Fan	C/D	Varies	Utility Bill analysis/modeling
Windows	B	7 Days	Air temperature and HVAC consumption
Replacement AC Rebate	-	-	-
Central AC	B	7 Days	Air temperature and HVAC consumption
Room AC	B	7 Days	Air temperature and HVAC consumption
Refrigerator Rebates	A	Instant	Power excluding interactive effects
Business Energy Partnership Program	A/B/C/D	Varies	Depends on Measures
Small Business/ Direct Install	-	-	-
Audit	A	Instant	Varies on measures
Fluorescent Lighting	A	Instant	Power and hours of operation
CFLs	A	Instant	Power and hours of operation
Exit Signs	A	Instant	Power and hours of operation
HVAC Tune-up	A	7 Days	Air temperature and HVAC consumption
Window Film	C/D	Varies	Utility Bill analysis/modeling

5.1.2 Program Sample Sizing

Based on the statistical formulas below, the overall sample sizes required to meet EM&V goals were calculated. Equation 5-1 represents the initial sample size to obtain 90% confidence level with 10% precision. Equation 5-2 is the “Finite Population Adjustment” to be used on populations less than 20 times greater than the initial sample size. Equation 5-2 also shows an example using the Refrigerator Rebates population. In this case, the required sample size would be 10 units, since the final number should be rounded up to the nearest whole number.

Equation 5-1: Initial Sample Size Calculation

$$n_o = \frac{z^2 cv^2}{e^2} = \frac{(1.64)^2 (.2)^2}{(.1)^2} = 10.76$$

Equation 5-2: “Finite Population Adjustment” Sample Size Calculation

$$n = \frac{n_o N}{n_o + N} = \frac{(10.76)(61)}{(10.76 + 61)} = 9.15 = 10$$

where:

- n_o is the initial estimate of the required sample size.
- n is the finite population adjusted sample size required.
- N is the finite population of applications.
- cv is the coefficient of variance, defined as the standard deviation of the readings divided by the mean. Until the actual mean and standard deviation of the population can be estimated from actual samples, 0.5 is often accepted as an initial estimate. However, for more homogenous populations, 0.1 is commonly used.
- e is the desired level of precision. For example, e is 0.1 for 10% precision.
- z is the standard normal distribution value for the desired confidence level. For example, z is 1.96 for 95%, 1.64 for 90%, 1.28 for 80%, and 0.67 for 50% confidence.

Table 5-3 below shows the calculated program sample sizes required, using the equations described above. More description of the sample sizes of the programs to undergo M&V will be done below.

Table 5-3: Azusa Program Sample Sizing

Program	# of Units	Sample Size
Online Energy Audit	970	25
LivingWise	721	11
Home Weatherization Rebates	-	-
Attic Fan	1	1
Duct Sealing	1	1
Ceiling Insulation	8	7
Programmable Thermostats	7	6
Solar Attic Fan	2	2
Whole House Fan	2	2
Windows	28	13
Replacement AC Rebate	-	-
Central AC	19	11
Room AC	7	6
Refrigerator Rebates	61	10
Business Energy Partnership Program	43	9
Small Business/ Direct Install	-	-
Fluorescent Lighting	90	10
CFLs	416	7
Exit Signs	1	1
HVAC Tune-up	112	10
Window Film	119	21

5.2 Residential Program Impact Evaluation

Azusa's program database shows seven residential programs being tracked. Table 5-4 shows information provided from Azusa's energy efficiency program database of residential measures. This table is the same as Table 3-1, except the CFL Giveaway Program has been removed, due to it not being considered in this EM&V study.

Table 5-4: Estimated Energy and Demand Impacts for FY 2008/2009 for the Residential Sector

Program	# of Units	Annual Reduction (kWh)	Summer Peak Reduction (kW)	kWh % of Total	kW % of Total	NTG	Program Costs
Online Energy Audit	970	386,060	0.0	50.7%	0.0%	0.80	\$9,111
LivingWise	721	263,886	2.9	34.7%	5.4%	0.80	\$33,814
Home Weatherization Rebates	237	53,019	39.1	7.0%	73.1%	0.80	\$61,351
Replacement AC Rebate	70	38,568	8.2	5.1%	15.3%	0.80	\$9,640
Refrigerator Rebates	61	19,276	3.3	2.5%	6.2%	0.80	\$7,557
Totals	2,059	760,809	53.5	100%	100%		\$121,472

Lincus would normally, due to time restraints, review only those programs that contribute to more 80% of the total energy savings; Online Energy Audit and LivingWise. Due to the low number of participants in the remaining Programs, Lincus performed impact evaluations on all Programs listed in Table 5-4. Below are the impact evaluation plans for each Program.

5.2.1 Online Energy Audit

As discussed in Section 2, Azusa residential customers are given the ability to help find simple, practical ways to reduce utility bills with an online energy audit. With 6,247 surveys performed, a gross energy savings of 386,060 kWh and demand reduction of 0.0 peak kW resulted.

Standard EM&V protocols require at least a confidence level of 90% with a confidence interval of +/- 10% while doing these impact evaluations. In order to meet a statistical confidence of 90% +/- 10%, Lincus reviewed 25 audits.

As seen in Table 5-2, the Online Energy Audit M&V IPMVP Option varies depending on the measure. However, since the savings for the audits come from the 2005 Measure Quantification Methodology Report⁹, Lincus evaluated the 2005 Measure Quantification Methodology Report and the report Azusa received from WebTrends every month. This plan minimized customer inconveniencing, while still providing adequate confidence in the savings numbers.

5.2.2 LivingWise

As discussed in Section 2, LivingWise is a cooperative program within the Azusa Unified School District. This program is aimed at the 6th grade science level and seeks to educate the students in areas of energy and water conservation through hands on program and in-home installation of conservation equipment. Providing students with energy saving knowhow and equipment resulted in a net energy savings of 263,886 kWh and demand reduction of 2.9 kW.

Azusa helped 721 students through this program in the 2008/2009 fiscal year. Standard EM&V protocols require at least a confidence level of 90% with a confidence interval of +/- 10% while performing these impact evaluations. To meet a statistical confidence of 90% +/- 10%, Lincus reviewed 11 audit participants.

As seen in Table 5-2, the LivingWise Program CFLs and Audits M&V IPMVP Option varies depending on the measure. However, since the savings for the audits come from the 2005 Measure Quantification Methodology Report, Lincus evaluated the 2005 Measure Quantification Methodology Report.

⁹ Measure Quantification Methodology Statewide Savings and Cost Final Report prepared for Northern California Power Agency (NCPA), NCPA Members, Southern California Public Power Authority (SCPPA), and SCPPA Members by KEMA Inc. on August 15, 2006

5.2.3 Home Weatherization Rebates

As discussed in Section 2, Azusa offers incentives to customers for improving their building envelope. Measures such as attic fan, attic and wall insulation, duct sealing, programmable thermostats, solar attic fan, window replacement, and whole house fans are included in this Program. With 237 participants, a gross energy savings of 53,019 kWh and demand reduction of 39.1 peak kW resulted.

Azusa processed and paid 237 total participants for this program in the 2008/2009 fiscal year. Standard EM&V protocols require at least a confidence level of 90% with a confidence interval of +/- 10% while performing these impact evaluations. In order to meet a statistical confidence of 90% +/- 10%, Lincus reviewed one attic fan, one duct sealing, seven ceiling insulation, five programmable thermostats, one solar attic fan, five whole house fans, and 22 windows.

As seen in Table 5-2, the Home Weatherization Rebates Program M&V IPMVP Option varies depending on the measure. However, since all of the measures of the Program are included in DEER database, Lincus used DEER savings numbers and verify the installation of the measures. A phone survey of randomly selected customers was conducted to verify installations. This plan minimized customer inconveniencing, while still providing adequate confidence in the savings numbers.

5.2.4 Replacement AC Rebates

As discussed in Section 2, Azusa offers rebates to residential customers who replace Central AC and Room AC units with Energy Star qualified units. With 70 rebates provided, a gross energy savings of 38,568 kWh and demand reduction of 8.2 peak kW resulted.

Azusa processed and paid 70 total participants for this program in the 2008/2009 fiscal year. Standard EM&V protocols require at least a confidence level of 90% with a confidence interval of +/- 10% while performing these impact evaluations. In order to meet a statistical confidence of 90% +/- 10%, Lincus reviewed 18 Central ACs and 7 Room ACs.

As seen in Table 5-2, the Replacement AC Rebates Program should be monitored and verified under IPMVP Option A. However, since both of the measures of the Program are included in DEER database, Lincus used DEER savings numbers and verify the installation of the measures. A phone survey of randomly selected customers was conducted to verify installations. This plan minimized customer inconveniencing, while still providing adequate confidence in the savings numbers.

5.2.3 Refrigerator Rebates

As discussed in Section 2, Azusa provides incentives for purchasing Energy Star qualified refrigerators, which use less energy than older units of comparable size. With 61 refrigerators purchased, a gross energy savings of 19,276 kWh and demand reduction of 3.3 peak kW resulted.

Azusa processed and paid 61 total participants for this program in the 2008/2009 fiscal year. Standard EM&V protocols require at least a confidence level of 90% with a confidence interval of

+/- 10% while performing these impact evaluations. In order to meet a statistical confidence of 90% +/- 10%, Lincus reviewed 10 refrigerators.

As seen in Table 5-2, the Refrigerator Rebates Program should be monitored and verified under IPMVP Option A. However, since this measure is included in DEER database, Lincus used DEER savings numbers and verify the installation of the measures. A phone survey of randomly selected customers was conducted to verify installations. This plan minimized customer inconveniencing, while still providing adequate confidence in the savings numbers.

5.3 Non-Residential Program Impact Evaluation Plans

Azusa’s program database shows two non-residential programs being tracked. Table 5-5 shows information provided from Azusa’s energy efficiency program database of non-residential measures.

Table 5-5: Estimated Energy and Demand Impacts for FY 2008/2009 for the Non-Residential Sector

Program	# of Units	Annual Reduction (kWh)	Summer Peak Reduction (kW)	kWh % of Total	kW % of Total	NTG	Program Costs
Business Energy Partnership Program	43	808,432	166.1	74.8%	82.8%	1.00	\$204,994
Small Business/ Direct Install	316	272,192	34.6	25.2%	17.2%	0.90	\$86,129
Totals	359	1,080,624	200.7	100%	100%		\$291,122

Lincus would normally, due to time restraints, review only those programs that contribute to more 80% of the total energy savings. In this case, both Non-Residential Programs are needed to reach 80% of the total energy savings. Both energy efficiency programs received impact evaluations. Below are the impact evaluation plans for each Program.

5.3.1 Business Energy Partnership Program

As discussed in Section 2, Azusa offers rebates to non-residential customers who choose to implement energy efficiency measures. Azusa approved 43 applications which resulted in a gross energy savings of 808,432 kWh and demand reduction of 166.0 kW.

Azusa processed and paid 43 total participants for this program in the 2008/2009 fiscal year. Standard EM&V protocols require at least a confidence level of 90% with a confidence interval of +/- 10% while doing these impact evaluations. To meet a statistical confidence of 90% +/- 10%, Lincus reviewed nine applications.

As seen in Table 5-2, the Business Energy Partnership Program M&V could fall under any of the IPMVP Options depending on the Measure. Lighting and VFD Measures would be IPMVP Option A. Lincus verified the Lighting savings by using equipment specification sheets and operating hours. Lincus verified the VFD savings by using AirMaster.

5.3.2 Small Business/Direct Install

As discussed in Section 2, Azusa provides small businesses with free energy audits to provide customers with information on energy efficiency opportunities. When the audit is completed, the customer receives a list of recommended energy efficiency measures they can implement to save energy. Azusa also provides and installs CFLs and HVAC Tune-Ups for free when they are recommended. If the customer decides to implement recommended measures, Azusa will pay for 50% of the direct install cost, up to \$10,000, per metered account. Providing small business customers with these services resulted in a gross energy savings of 272,192 kWh and demand reduction of 34.6 kW.

Azusa processed and paid 316 total participants for this program in the 2008/2009 fiscal year. Standard EM&V protocols require at least a confidence level of 90% with a confidence interval of +/- 10% while doing these impact evaluations. To meet a statistical confidence of 90% +/- 10%, Lincus reviewed 23 audits, ten fluorescent lighting, seven CFL, one exit sign, ten HVAC tune-up, and 21 window film applications.

As seen in Table 5-2, the Small Business/Direct Install Program M&V could fall under any of the IPMVP Options depending on the Measure. The Lighting and HVAC Tune-Up Measures would fall under IPMVP Option A and the Window Film would be Options C or D. Lincus verified the Lighting savings by using equipment specification sheets and operating hours. Since the HVAC Tune-Up and Window Measures are considered in DEER database, Lincus used DEER savings numbers and verified the installation of the measures.

6 Process Evaluation Results

The Residential Process Evaluation includes the Online Energy Audit, LivingWise, Home Weatherization Rebates, Replacement AC Rebate, and Refrigerator Rebates Programs. The Non-Residential Process Evaluation includes the Business Energy Partnership Program and Small Business/Direct Install Program.

The results of the Program Process Evaluation include the following areas:

1. Program application processing
2. Utility tracking system
3. Net-to-Gross Ratios

6.1 Program Application Processing

Azusa uses an E3 calculator to calculate savings and other Program factors. This E3 calculator often references DEER as the savings number source for many measures. Many measures within DEER and the E3 have a per unit savings number based on a 1,000 square feet of home unit. This means, for every 1,000 square feet of home, there will be the stated amount of savings per unit installed. However, according to the California Statewide Residential Appliance Saturation Study¹⁰ (RASS), the average square footage of a home is 1,500 sqft. Using this data, Azusa could claim 50% more savings for measures that have a per unit savings number based on 1,000 square feet of home.

Within the E3 and the savings source for the Replacement AC Program, Lincus suggests that Azusa use Line 3484 of the “Select Measures” tab rather than Line 4892 for the Central AC savings. Upon further review, the 2005 Measure Quantification Methodology Report references DEER and RASS for a simplified savings calculation method, which provides a kWh savings per AC unit and a kW savings per ton of cooling. So, when either the total number of AC units or the tons of cooling is entered into the E3, the kW or kWh savings are being either underestimated or overestimated, respectively. Using the suggested line item will take care of this mix up.

Upon reviewing the applications for the Business Energy Partnership Program, Lincus has created a list of recommendations that could increase the quality of accepted applications. These recommendations will help Azusa justify the savings customers obtain by performing retrofit projects.

Lincus recommends that Azusa require specification sheets of the new units (ballasts, lamps, air-conditioners, motors, etc.) be attached to the application when sent in by the customer or contractor for review. This will allow for smoother and more accurate processing of the application. It is also advised that air-conditioners require AHRI certification. AHRI certification provides confidence in the efficiencies and cooling capacities provided. It also makes it easier to

¹⁰ California Statewide Residential Appliance Saturation Study by KEMA-XENERGY, Itron, and RoperASW on June 2004

obtain the efficiencies and cooling capacities if they are not provided when the application is sent for review, as they can be found online at www.ahridirectory.org.

Although in this fiscal year it wasn't true, applications can often include multiple measures that interact with each other within a single system. Currently, due to the lack of manpower and resources, applications including multiple measures that interact with each other often go through a method of calculation that does not take into account interactive effects. It is recommended, going forward, that energy modeling be required to more accurately calculate the savings. With more manpower and finance resources for the Programs, Azusa can either bring in an outside energy efficiency firm to provide this work, or hire additional staff to improve application processing. Although energy modeling provides more reliable and accurate results, Azusa with its current resources, is using simpler spreadsheet calculations that do not include interactive effects.

It is also recommended that applications over 100,000 kWh savings go through a process of Quality Control. This process could range anywhere from having a second or third internal engineer verify the calculations to having an outside consultant verify the calculations. This process can minimize mistakes in calculations and bring upon new methods of calculating savings. Another recommendation that will verify savings is to request trending data for applications over 100,000 kWh savings and require M&V for applications over 250,000 kWh savings. Many facilities that are able to saving 100,000 kWh from a retrofit have Energy Management Systems (EMS) and can provide trending data from the EMS upon request. This data will provide more accurate savings estimates as the trending and M&V provide actual data from the retrofit systems.

A number of applications included VFDs among their measures. VFDs need to be commissioned to meet their full savings capacity. VFDs that are not properly commissioned could result in negative energy savings. It is recommended that Azusa verify proper commissioning is performed when VFDs are being incentivized.

Regarding the selection of baseline conditions, Lincus recommends that Azusa use generally accepted baseline calculation methodologies such as the four baselines below:

1. Current Title-24 Standards – This baseline should be used at all times, unless current T-24 standards are not available for the specific retrofit or the retrofit qualifies for Early Retirement. Current industry standards are used if current T-24 standards are not available for the specific retrofit.
2. Title-24 Standards for Early Retirement – Early Retirement is considered for units that are being retrofit five years prior to the end of their Estimated Useful Life (EUL). Typically, only motors, chillers, and packaged air conditioners savings are calculated using this baseline. T-24 standards at the time the existing unit was installed would be used as the baseline in these cases.
3. Current Industry Standards – This baseline is used only if T-24 standards are not available for the specific retrofit. An example of this is air-compressors. There currently are not T-24 standards for these units, so industry standards, at the time the existing was installed, could be used as the baseline.
4. Current Operating Conditions – If T-24 and Industry standards are not available, the current operating conditions can be used as the baseline for customized application calculations.

6.2 Utility Tracking System

While obtaining information for the Customized Energy Rebates Program, it was discovered that all applications and information attached are stored in a filing cabinet and some application information is available on their server. Azusa has a tracking system that includes general information about the application, but does not contain all information that may be useful. Lincus recommends that Azusa implements a tracking system that saves all information about the application and makes it easily accessible when needed. Appendix A describes a tracking system that meets and exceeds these recommendations. This tracking system is available to Azusa from Lincus if they would like to use it.

Lincus recommends this tracking system be applied to the Residential and Non-Residential Programs alike. This tracking system will also have the capability to keep track of the information recommended within this study.

Implementing a new tracking system will:

- Bring down costs by providing all information in one location available to everyone and easy maintenance & revisions to the Programs, which ensures less down time
- Increase kWh savings by providing weekly updates to give Program Managers an idea when more customer outreach is necessary and allowing the ability to adapt and revamp new energy efficiency Programs faster and reach more participants in a short time

6.3 Net-to-Gross Ratios

Net-to-Gross analysis was taken out of Lincus' scope in developing this EM&V study. Currently, Azusa is using NTG ratios that were agreed upon to at the SCPPA PBC Committee meeting.

7 Impact Evaluation Results

The Program Impact Evaluation is a process of EM&V that determines the achieved energy savings of a Program. This savings is determined by comparing the energy use and demand after the Program has been implemented to what would have been used if the Program was not implemented.

7.1 Residential Program Impact Evaluation

As stated in Section 5, the Residential Impact Evaluation includes five Programs: Online Energy Audit, LivingWise, Home Weatherization Rebates, Replacement AC Rebate, and Refrigerator Rebates.

7.1.1 Online Energy Audit

This program includes one Measure in the E3: educating the customer with the online audit. Table 7-1 shows Azusa's claimed kWh and peak kW per unit savings sourced from the Methodology Report.

Table 7-1: Online Energy Audit claimed savings per unit

Final Report for the Evaluation of the California 2002 Home Energy Efficiency Survey Program	
Per Audit	
kWh	kW
398	0.000

Upon reviewing the 2002 Program Evaluation for the Statewide Home Energy Efficiency Survey Program, it was found that Azusa has been conservative in its kWh savings claim for this education savings measure. Lincus recommends that Azusa use 438 kWh savings per survey instead of the current 398 kWh.

The E3 Energy Savings Calculation tool used by Azusa includes a line item for estimating energy savings from energy education. The associated energy savings is based on the 2008 Measure Quantification Methodology Addendum¹¹. Page 111 of the report states:

¹¹ Measure Quantification Methodology Statewide Savings and Cost 2008 Supplement Addendum 2008-1 prepared for Northern California Power Agency (NCPA), NCPA Members, Southern California Public Power Authority (SCPPA), and SCPPA Members by KEMA Inc. on February 8, 2008

The California Investor Owned Utilities (IOU) actively participate in both residential and nonresidential energy education programs. Among the activities included in these programs are residential energy audits, community outreach through the IOU energy centers, and educational mailings. The IOU's do not claim energy savings associated with their educational activities instead they limit reporting of energy savings associated with energy efficiency to their rebate programs. A methodology for quantifying the energy savings associated with home audit programs was developed as part of the 2002 Program Evaluation for the Statewide Home Energy Efficiency Survey Program. The savings are based on the RECAP program savings software analysis and on self-reported adoption rates of various measures. The associated savings are rolled up for all types of audits (in-home, mail, telephone and internet) with an average of 438 kWh per audit (Southern California Gas participants are not in the average). These audits are educationally focused; they did not include measure installations.

Although the 2008 Measure Quantification Methodology Report states that IOU's do not claim energy savings from energy education, Azusa does for its Online Energy Audit Program. Table 7-2 shows the verified kWh and peak kW savings obtained from the 2002 Program Evaluation for the Statewide Home Energy Efficiency Survey Program for the educational portion of the audit performed.

Table 7-2: Online Energy Audit verified savings per unit

Final Report for the Evaluation of the California 2002 Home Energy Efficiency Survey Program	
Per Audit	
kWh	kW
438	0.000

Table 7-3 shows Azusa's claimed (ex-ante) savings and Lincus' verified (ex-post) savings for the Online Energy Audit Program.

Table 7-3: Online Energy Audit Program savings

Audits performed	Claimed kWh	Claimed peak kW	Verified kWh	Verified peak kW
970	386,060	0.0	424,860	0.0

7.1.2 LivingWise

The LivingWise Program includes two Measures in the E3: installation of CFLs given to students, and educating the students about energy efficiency. However, Azusa only claimed the average household savings provided in the LivingWise report. This report is provided to Azusa by the

LivingWise Program. It includes estimated savings based on the energy and water saving items provided to the students. Azusa claims these savings as a customized “Education Programs - In class” line item. Table 7-4 shows Azusa’s claimed kWh and peak kW per unit savings.

Table 7-4: LivingWise claimed savings per unit

LivingWise Report	
per student	
kWh	kW
366	0.004

Lincus verified that 13W CFLs were provided to the students, and the corresponding savings was applied. Table 7-5 shows Lincus’ verified savings per unit.

Table 7-5: LivingWise verified savings per unit

DEER - Single Family All CZ		2005 Measure Qualification Methodology Report	
<=15W CFL		per student	
kWh	kW	kWh	kW
32	0.006	438	0.0

Table 7-6 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the LivingWise Program. The increase in savings comes from using the Methodology Report educational savings and adding the CFLs as well.

Table 7-6: LivingWise Program savings

Total CFLs and students	Claimed kWh	Claimed peak kW	Verified kWh	Verified peak kW
721	263,886	2.9	338,870	4.3

In the future, if chosen to, Azusa could manually enter the savings numbers for the CFLs into E3. Table 7-7 shows the verified kWh and peak kW savings obtained from DEER 2005 for the CFLs provided to the students.

Table 7-7: LivingWise DEER 2005 savings per CFL

DEER 2005 - Single Family CZ 09	
13W CFL	
kWh	kW
36	0.003

7.1.3 Home Weatherization Rebates

The Home Weatherization Rebates Program has seven Measures: Attic Fans, Duct Sealing, Ceiling Insulation, Programmable Thermostats, Solar Attic Fans, Whole House Fans, and Windows. An Excel spreadsheet was given to Lincus with every application paid during the 2008-2009 FY. This spreadsheet had customer information, such as name, address, and daytime phone number, Measure information, such as which Measure was implemented, make and model numbers, and other unit information, and rebate given. Using the spreadsheet sent by Azusa, the sample size was randomly selected based on the zip codes and time of the year as evenly as possible. The randomly selected customers were then contacted and asked the corresponding questions from the phone surveys in Appendix B. Once the sample size of successful phone surveys completed was met, DEER 2005, RASS, and Energy Star were used to verify the savings.

7.1.3.1 Attic Fans

The Attic Fan Measure had a sample size of one customer and one successful phone survey was completed. As stated in the Measure Qualification Methodology document used by Azusa to obtain savings, “There are no documented savings within DEER or the PG&E work papers.” This document also states “Attic fan energy savings are calculated based on RASS data for utility energy consumption by end use.” Since RASS data is used to determine the savings, the 32 kWh savings per unit stated in the Measure Qualification Methodology document is a reasonable number. It is Lincus’ recommendation that further analysis be done to justify the current savings of this Measure.

Table 7-7 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Attic Fan Measure.

Table 7-7: Home Weatherization Rebates’ Attic Fan Measure savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
32	0.1	32	0.1

7.1.3.2 Duct Sealing

The Duct Sealing Measure had a sample size of one customer and one successful phone surveys was completed. Table 7-8 shows Azusa’s claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report.

Table 7-8: Home Weatherization Rebates’ Duct Sealing Measure claimed savings per unit

2005 Measure Qualification Methodology Report	
Per 1,000 sqft	
kWh	kW
123	0.118

Lincus verified the savings numbers within 2005 Measure Qualification Methodology Report. All savings numbers in Table 7-9 are per 1,000 square feet of window.

Table 7-9: Home Weatherization Rebates’ Duct Sealing Measure verified savings per unit

2005 Measure Qualification Methodology Report	
Per 1,000 sqft	
kWh	kWh
123	0.118

The total number of participants was obtained from the application spreadsheet given by Azusa. Table 7-10 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Duct Sealing Measure.

Table 7-10: Home Weatherization Rebates’ Duct Sealing Measure savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
123	0.2	123	0.2

In the future, if chosen to, Azusa could manually enter the savings numbers for the duct sealing into E3. As it can be seen in Table 7-11, DEER 2005 for a Single Family in Climate Zone 9 was used to obtain the savings. All savings numbers in Table 7-11 are per 1,000 sqft of home.

Table 7-11: Home Weatherization Rebates’ Duct Sealing Measure DEER 2005 savings per unit

DEER 2005 - Single Family CZ 09	
Per 1,000 sqft	
kWh	kWh
77	0.075

7.1.3.3 Ceiling Insulation

The Ceiling Insulation Measure had a sample size of seven customers and four successful phone surveys were completed. The discrepancy in customers surveyed comes from customers respectfully declining to participate in the survey. Two of the four customers surveyed had Ceiling insulation prior to installing the new insulation. Table 7-12 shows Azusa’s claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report, which references DEER, for a Single Family home in Climate Zone 09.

Table 7-12: Home Weatherization Rebates’ Ceiling Insulation Measure claimed savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family, CZ 09	
R-0 to R-30 (per 1000 sqft)	
kWh	kW
542	0.264

Lincus verified the above measure to be the best result available within the E3 for R-0 to R-30. However, R-Vintage to R-30 was also found to be an applicable measure from the surveys. As it can be seen in Table 7-13, the savings numbers for R-0 to R-30 were unchanged from the E3 model and R-Vintage to R-30 was added. All savings numbers in Table 7-13 are per 1,000 square feet of insulation.

Table 7-13: Home Weatherization Rebates’ Ceiling Insulation Measure verified savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family, CZ 09			
R-0 to R-30 (per 1000 sqft)		R-Vintage to R-30 (per 1000 sqft)	
kWh	kW	kWh	kW
542	0.264	169	0.096

The total amount of insulation was obtained from the application spreadsheet given by Azusa. Table 7-14 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Ceiling Insulation Measure.

Table 7-14: Home Weatherization Rebates’ Ceiling Insulation Measure savings

Total sqft Ceiling Insulation	Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
9,000	4,878	2.4	3,200	1.6

In the future, if chosen to, Azusa could manually enter the savings numbers for the Ceiling Insulation into E3. As it can be seen in Table 7-14, two savings numbers will need to input from DEER 2005. The first is for those customers that did not have Ceiling insulation prior to new insulation (R-0 to R-30) and the second is for those customers that did have insulation prior to the new insulation (R-Vintage to R-30). All savings numbers in Table 7-14 are per 1,000 square feet of insulation.

Table 7-14: Home Weatherization Rebates’ Ceiling Insulation Measure DEER 2005 savings per unit

DEER 2005 - Single Family, CZ 09, Vintage before 1978			
R-0 to R-30 (per 1000 sqft)		R-Vintage to R-30 (per 1000 sqft)	
kWh	kW	kWh	kW
591	0.236	205	0.108

7.1.3.4 Programmable Thermostats

The Programmable Thermostat Measure had a sample size of 6 customers and zero successful phone surveys were completed. The discrepancy in customers surveyed comes from customers respectfully declining to participate in the survey. Table 7-15 shows what Azusa’s claimed kWh and peak kW per unit savings. The savings are sourced from the 2005 Measure Qualification Methodology Report, which references DEER, for a Single Family home in Climate Zone 09.

Table 7-15: Home Weatherization Rebates’ Programmable Thermostat Measure claimed savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single-Family	
(per 1000 sqft)	
kWh	kW
-171	0.00

Lincus verified the savings with the 2005 Measure Qualification Methodology Report. Table 7-16 shows Lincus’ verified savings per unit. There is no change in savings per unit here.

Table 7-16: Home Weatherization Rebates’ Programmable Thermostat Measure verified savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single-Family	
(per 1000 sqft)	
kWh	kW
-171	0.00

The total number of thermostats was obtained from the application spreadsheet given by Azusa. Table 7-17 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Programmable Thermostat Measure. It is recommended that Azusa not incentivize this measure, as it results in negative savings, or incorporate this measure into the Central AC Measure.

Table 7-17: Home Weatherization Rebates’ Programmable Thermostat Measure savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
-855	0.0	-855	0.0

In the future, if chosen to, Azusa could manually enter the savings numbers for the Programmable Thermostats into E3. DEER 2005 was used to obtain the savings for a Single Family home in Climate Zone 9. All savings numbers in Table 7-18 are per 1,000 square feet of home.

Table 7-18: Home Weatherization Rebates’ Programmable Thermostat Measure DEER 2005 savings per unit

DEER 2005 - Single Family, CZ 08, Vintage before 1978	
(per 1000 sqft)	
kWh	kW
-176	0.000

7.1.3.5 Solar Attic Fans

The Solar Attic Fan Measure had a sample size of two customers and zero successful phone surveys were completed. The discrepancy in customers surveyed comes from customers respectfully declining to participate in the survey. As stated in the Measure Qualification Methodology document used by Azusa to obtain savings, “There are no savings for solar attic fans in the DEER database or in PG&E workpapers.” This was confirmed by Lincus and further studies were searched for. A case study by Parker & Sherwin¹², states that 460 kWh was saved by installing one solar attic fan on a house in Florida. Taking the climate and building envelope and HVAC efficiency standards differences into account, the 176 kWh savings per unit stated in the Measure Qualification Methodology document is reasonable number. It is Lincus’ recommendation that further analysis be done to justify the current savings of this Measure.

¹² Parker, D. S., & Sherwin, J. R. (2000). Performance Assessment of Photovoltaic Attic Ventilation Fans. *Florida Solar Energy Center*, May 15-17.

7.1.3.6 Whole House Fans

The Whole House Fan Measure had a sample size of two customers and one successful phone survey was completed. The discrepancy in customers surveyed comes from customers respectfully declining to participate in the survey. The one customer surveyed said there was no other form of night ventilation previously. Table 7-19 shows Azusa’s claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report, which references DEER, for a Single Family home in Climate Zone 9.

Table 7-19: Home Weatherization Rebates’ Whole House Fan Measure claimed savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family CZ 09	
per 1000 sqft of home	
kWh	kW
15	0.003

Lincus verified the savings numbers within 2005 Measure Qualification Methodology Report. All savings numbers in Table 7-20 are per 1000 square feet of home.

Table 7-20: Home Weatherization Rebates’ Whole House Fan Measure verified savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family CZ 09	
per 1000 sqft of home	
kWh	kWh
15	0.003

The square footages of the homes that applied were assumed to be an average of 1,000 sqft per home. Table 7-21 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Whole House Fan Measure.

Table 7-21: Home Weatherization Rebates’ Whole House Fan Measure savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
75	0.0	75	0.0

In the future, if chosen to, Azusa could manually enter the savings numbers for the whole house fans into E3. As it can be seen in Table 7-22, DEER 2005 was used to obtain the savings for a Single Family home in Climate Zone 8 and a vintage before 1978. All savings numbers in Table 7-22 are per 1,000 square feet of home. Based on findings in RASS, the average square footage of homes is about 1,500 sqft. Using this data, Azusa can set the UVM to 1.5 and report 50% more savings.

Table 7-22: Home Weatherization Rebates’ Whole House Fan Measure DEER 2005 savings per unit

DEER 2005 - Single Family, CZ 09, Vintage before 1978	
Whole House Fan per 1,000 sqft	
kWh	kW
17	0.002

7.1.3.7 Windows

The Windows Measure had a sample size of 13 customers and four successful phone surveys were completed. The discrepancy in customers surveyed comes from customers respectfully declining to participate in the survey. Table 7-23 shows Azusa’s claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report, which references DEER, for an Above Vintage Single Family home in Climate Zone 9. The per unit savings below assume that the retrofit windows are clear.

Table 7-23: Home Weatherization Rebates’ Low-e Windows Measure claimed savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family CZ 09 Above Vintage	
Clear Window (per 100 sqft)	
kWh	kW
226	0.17

Lincus verified the savings numbers within 2005 Measure Qualification Methodology Report. All savings numbers in Table 7-24 are per 100 square feet of window.

Table 7-24: Home Weatherization Rebates’ Low-e Windows Measure verified savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family CZ 09 Above Vintage	
Tinted Window (per 100 sqft)	
kWh	kW
395	0.28

The total sqft of glass was obtained from the application spreadsheet given by Azusa. Table 7-25 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Windows Measure.

Table 7-25: Home Weatherization Rebates’ Low-e Windows Measure savings

Total sqft Glass	Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
21,500	48,590	36.6	48,590	36.6

In the future, if chosen to, Azusa could manually enter the savings numbers for the windows into E3. As it can be seen in Table 7-26, DEER 2005 for a Single Family and Multi-Family homes in Climate Zone 9 and Vintage before 1978 was used to obtain the savings. A U-Factor of .35 and

SHGC of 0.32 was selected since that is the minimum requirement for Energy Star qualification. There were two categories needed to calculate the savings for this Measure. The first is for those customers that replaced windows in a single family home and the second is for those customers that replaced windows in a multi-family home. All savings numbers in Table 7-26 are per 100 sqft of glass.

Table 7-26: Home Weatherization Rebates' Low-e Windows Measure DEER 2005 savings per unit

DEER 2005 - Single Family, CZ 09, Vintage before 1978		DEER 2005 - Multi-Family, CZ 09, Vintage before 1978	
U-Factor 0.35 & SHGC 0.32 per 100 sqft glass			
kWh	kW	kWh	kW
425	0.250	157	0.202

7.1.4 Replacement AC Rebate

The Replacement AC Rebate Program has two Measures: Central AC and Room AC. An Excel spreadsheet was given to Lincus with every application paid during the 2008-2009 FY. This spreadsheet had customer information, such as name, address, and daytime phone number, Measure information, such as which Measure was implemented, make and model numbers, and other unit information, and rebate given. Using the spreadsheet sent by Azusa, the sample size was randomly selected based on the zip codes and time of the year as evenly as possible. The randomly selected customers were then contacted and asked the corresponding questions from the phone surveys in Appendix B. Once the sample size of successful phone surveys completed was met, DEER 2005, RASS, and Energy Star were used to verify the savings.

7.1.4.1 Central AC

The Central AC Measure had a sample size of 11 customers and three successful phone surveys were completed. The discrepancy in customers surveyed comes from customers respectfully declining to participate in the survey. Table 7-27 shows Azusa's claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report, which references DEER and RASS in a simplified savings calculation method, for SEER 14 above vintage at a Single Family home in Climate Zone 09. The simplified calculation method uses RASS EUCs as a base and notes that the kWh savings is per household, where the kW savings is per ton of cooling. The kWh savings assumes an average tonnage per household. These numbers are used in the E3 model Azusa uses to claim savings, which ultimately miscalculates the savings, since the savings unit to be entered into the E3 is tons of cooling. When inputting the total tons of cooling, the kWh savings is over estimated. If the total number of units is entered, the kW savings are under estimated. These savings numbers were used for all units regardless of the SEER value, i.e. SEER 15+ units would claim the savings of a SEER 14 unit.

Table 7-27: Replacement AC Rebates Program’s Central AC Measure claimed savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family, CZ 09	
per household	per ton
kWh	kW
607	0.110

As stated in Section 6.1, Lincus suggests that Azusa use a different line item within the E3 for reporting Central AC savings. This new line item is also noted within the 2005 Measure Qualification Methodology Report and provides per ton of cooling savings numbers for both kWh and kW. Table 7-28 shows Lincus’ verified savings per unit.

Table 7-28: Replacement AC Rebates Program’s Central AC Measure verified savings per unit

2005 Measure Qualification Methodology Report (DEER) - Single Family, CZ 09	
per ton	
kWh	kW
256	0.344

The total tonnage was obtained from the application spreadsheet given by Azusa. Table 7-29 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Central AC Measure.

Table 7-29: Replacement AC Rebates Program’s Central AC Measure savings

Total Tons	Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
62	37,643	6.8	15,872	21.3

In the future, if chosen to, Azusa could manually enter the savings numbers for the Central AC into E3. As it can be seen in Table 7-30, DEER 2005 for a Single Family home in Climate Zone 9 was used to obtain the per unit savings by SEER rating. Since Azusa only requires an Energy Star rating for units to qualify, the lowest SEER rating that qualifies for Energy Star (14 SEER) was used to calculate the savings. All savings numbers in Table 7-30 are per cooling ton.

Table 7-30: Replacement AC Rebates Program’s Central AC Measure DEER 2005 savings per unit

DEER 2005 - Single Family, CZ 09	
Central AC to Central AC per ton	
kWh	kW
286	0.364

7.1.4.2 Room AC

The Room AC Measure had a sample size of six customers and two successful phone surveys were completed. The discrepancy in customers surveyed comes from customers respectfully declining to participate in the survey. One of the two customers surveyed said they replaced an old Room AC. The other said they added a new Room AC without replacing anything. The tonnage of the units surveyed averaged one ton. Table 7-31 shows Azusa’s claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report, which references Energy Star.

Table 7-31: Replacement AC Rebates Program’s Room AC Measure claimed savings per unit

2005 Measure Qualification Methodology Report (Energy Star) - Above Vintage	
Average per ton	
kWh	kW
116	0.169

Energy Star’s Room AC Savings Calculator was used to verify the savings for this Measure. The location used was Los Angeles to obtain the typical hours of cooling. All savings numbers in Table 7-32 are per Room AC unit (one ton average) installed.

Table 7-32: Replacement AC Rebates Program’s Room AC Measure verified savings per unit

2005 Measure Qualification Methodology Report (Energy Star) - Above Vintage	
Average per ton	
kWh	kW
116	0.169

Table 7-33 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Room AC Measure.

Table 7-33: Replacement AC Rebates Program’s Room AC Measure savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
924	1.4	924	1.4

7.1.5 Refrigerator Rebates

The Refrigerator Rebates Program has one Measure: Energy Star Refrigerators. An Excel spreadsheet was given to Lincus with every application paid during the 2008-2009 FY. This spreadsheet had customer information, such as name, address, and daytime phone number, Measure information, such as which Measure was implemented, make and model numbers, and other unit information, and rebate given. Using the spreadsheet sent by Azusa, the sample size was randomly selected based on the zip codes and time of the year as evenly as possible. The randomly selected customers were then contacted and asked the corresponding questions from the phone surveys in Appendix B. Once the sample size of successful phone surveys completed was met, DEER 2005, RASS, and Energy Star were used to verify the savings.

7.1.5.1 Refrigerators

The Refrigerator Measure had a sample size of 10 customers and 10 successful phone surveys were completed. Table 7-34 shows Azusa’s claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report, which references Energy Star. These savings number are a weighted average across various retrofit options.

Table 7-34: Refrigerator Rebates Program’s Refrigerator Measure claimed savings per unit

2005 Measure Qualification Methodology Report (Energy Star) – Weighted Average	
Average per Refrigerator	
kWh	kW
316	0.054

Lincus verified the savings with the 2005 Measure Qualification Methodology Report. Table 7-35 shows Lincus’ verified savings per unit. There is no change in savings per unit here.

Table 7-35: Refrigerator Rebates Program’s Refrigerator Measure verified savings per unit

2005 Measure Qualification Methodology Report (Energy Star) – Weighted Average	
Average per Refrigerator	
kWh	kW
316	0.054

Table 7-36 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Refrigerator Measure.

Table 7-36: Refrigerator Rebates Program’s Refrigerator Measure savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
19,276	3.3	19,276	3.3

In the future, if chosen to, Azusa could manually enter the savings numbers for the Refrigerators into E3. DEER 2005 also has refrigerator retrofit savings numbers for Single Family homes in Climate Zone 9. There are four door types for refrigerator (bottom mount freezer, side mount freezer with through-the-door dispenser, side mount freezer without through-the-door dispenser, and top mount freezer) considered in DEER 2005. RASS contains a breakdown of refrigerators by door type. The savings numbers in Table 7-37 are based off a weighted average using the door type ratio from RASS and the savings numbers from DEER 2005. All savings numbers in Table 7-37 are per Refrigerator installed.

Table 7-37: Refrigerator Rebates Program’s Refrigerator Measure DEER 2005 savings per unit

DEER 2005 - Single Family, All CZs Average per Refrigerator from those surveyed	
kWh	kW
62	0.011

7.2 Non-Residential Program Impact Evaluation

As stated in Section 5, the Non-Residential Impact Evaluation includes two Programs: Business Energy Partnership Program and Small Business/Direct Install Program.

7.2.1 Business Energy Partnership Program

For the Business Energy Partnership Program, all the applications were reviewed and randomly selected based on the kWh savings and technology of the retrofit. Installation of the retrofit fixtures was verified with a site visit. As stated in Table 5-3, the sample size for this Program is nine applications. Six of the nine selected applications were lighting retrofits, two were window film treatments, and the last was an air compressor retrofit.

7.2.1.1 Lighting

The six lighting applications contained savings calculations broken down by fixture and invoices. The energy savings calculations were accurate, in terms of referencing the correct numbers within the calculations. The proposed/recommended retrofit fixtures consistently represent industry standards in reference to the existing fixtures. Installation of the retrofit fixtures was verified with a site visit. Using IPMVP Protocols and engineering practices, the hours of operation of fixtures were obtained by monitoring with a light logger in 15 minute intervals. This logger measures the lumens per square foot at the point of the sensor. Using the lumens/sqft data collected, the hours of operation can be obtained using a simple calculation. Lighting loggers were not placed in all areas retrofit. The areas containing the largest savings and areas with non-typical fixtures and proposed hours were focused on. Some applications included the implementation of occupancy sensors. Using the lighting logger also takes into consideration the savings from the occupancy sensors, as the logger measures when the lights turn on and off. The hours of operation varied slightly from the calculation sheets for most fixtures monitored. The specification sheets of the fixtures were obtained online and the input wattages were used as the fixture wattages. It is recommended that lamp and ballast specifications sheets (pre and post) be required for processing applications.

When occupancy sensors are installed within an application, the calculations typically assume a decrease in fixture operating hours based on facility operation, personal experience with such sensors, or even a blind guess. DEER 2005 has an occupancy savings of 40% for all building types and areas. This is based on actual case studies and as DEER is a reputable source, it is recommended that DEER be used when calculating occupancy sensor savings. DEER 2008 has updated occupancy sensor savings. These savings numbers are percentages broken down by building type and area. Using these savings numbers for future program years is highly recommended.

A factor in the difference of savings numbers is HVAC interactive effect savings and coincident diversity factor were not considered. Lighting fixtures generate heat when they are in operation. This generated heat increases the temperature of the room, which increases the load the air-conditioners needs to cool. When a lighting retrofit is done, the wattage of the fixture decreases and the heat generated also decreases. This will result in savings from the air-conditioners since the heat load is less. HVAC interactive effects increase the kWh savings by 4-18% and the kW savings by 8-26%, depending on the building type. Coincident diversity factors are ratios that are used to calculate peak kW savings from kW savings. It is described as the probability of a

particular piece of equipment coming on during a facility’s peak load. This ratio can vary between 0.42 and 0.99, depending on the building type. It is also recommended that Azusa use these factors, obtained from DEER, in their future analysis, along with the requirement of spec sheets.

Table 7-38 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Lighting portion of the Business Energy Partnership Program.

Table 7-38: Business Energy Partnership Program Lighting savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
591,580	84.9	650,852	78.6

7.2.1.2 Window Film Treatment

The two window film treatment applications were at the same location. Table 7-39 shows Azusa’s claimed kWh and peak kW per unit savings sourced from the 2005 Measure Qualification Methodology Report, which references PG&E Workpapers, for non-residential buildings in Climate Zone 9.

Table 7-39: Business Energy Partnership Program Window Film claimed savings

2005 Measure Qualification Methodology Report (PG&E Workpapers) - CZ 09	
per sqft of window	
kWh	kW
13	0.0015

Lincus verified the savings numbers within the 2005 Measure Qualification Methodology Report and researched other Workpapers. Southern California Edison Workpaper WPSCNRHC0002-1 has savings numbers for window film retrofits at many building types and vintages in many climate zones. Lincus recommends using this Workpaper for window film treatment applications. All savings numbers in Table 7-40 are per square foot of window.

Table 7-40: Business Energy Partnership Program Window Film verified savings

Southern California Edison Workpaper WPSCNRHC0002-1, applicable building type and vintage, CZ 09	
per sqft of window	
kWh	kW
13	0.0061

The total sqft of glass was obtained from the applications provided by Azusa. Table 7-41 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Window Film Treatment applications.

Table 7-25: Business Energy Partnership Program Window Film savings

Total sqft Glass	Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
4,216	54,808	8.4	54,808	25.7

7.2.1.3 Air Compressor

The VFD on Air Compressor application replaced an inefficient 100 HP reciprocating air compressor with a 150 HP rotary air compressor at an industrial manufacturing facility. Through discussions with facility staff, it was discovered that the air compressor line pressure is 642 psi during facility operating hours (6am-6pm Monday-Friday) and 321 psi during the nights and weekends. An inspection of the site was performed to verify the installation and operation of the air compressor. The increase in air compressor is due to an increased demand of production. Due to this, the savings will be based on 150 HP air compressors in the existing and post cases. The facility does not currently have a SCADA system, but has plans to implement one or an EMS in the future.

Azusa originally used a manufacturer savings percentage of 10% to calculate the savings. Lincus used AIRMaster software to perform the savings calculations using the information obtained from facility staff and the application. AIRMaster is a freeware provided by the Department of Energy and commonly used in industry. Table 7-26 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Air Compressor application. The decrease in kW savings comes from using 150 HP air compressors in the existing and post cases. Realistically, increasing the HP would also increase the kW consumption, which would result in a negative savings.

Table 7-26: Business Energy Partnership Program Window Film savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
29,568	11.2	78,839	0.0

For an overall view of the Business Energy Partnership Program, a ratio of claimed and verified savings is applied to the total claimed savings. Table 7-27 shows the overall program claimed and verified savings.

Table 7-27: Business Energy Partnership Program savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
808,432	166.1	938,248	165.9

7.2.2 Small Business/Direct Install

The Small Business/Direct Install Program was comprised of five measures: an audit, T8 retrofits, CFL retrofits, exit sign retrofits, and HVAC tune-ups. Site inspections were performed to verify the installation of the energy efficient equipment. For the lighting measures, the retrofit fixtures and hours of operation were verified. For the HVAC measures, the performance of the HVAC tune-up was verified.

Table 7-28 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Small Business/Direct Install measures.

Table 7-28: Small Business/Direct Install verified measure savings

Measure	Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
Audit	122,584	0.0	134,904	0.0
T8	11,325	2.4	12,941	2.4
HVAC Tune-up	84,968	19.4	55,498	39.4
Exit Sign	245	0.0	351	0.0
CFL	55,044	19.2	205,565	52.1

The increase in lighting kWh savings comes from an increase in hours of operation. The hours the businesses are open were used in the savings calculations. Typically, employees turn lights on

earlier to get a store ready or because they came in early. The same goes for afterhours. Employees stay late to close up shop or they work late. A slight increase of hours was included in the verified hours of operation. The lighting kW savings decreased due to adding coincident diversity factors to the savings. It is also recommended that Azusa use these factors, obtained from DEER, in their future analysis, along with including spec sheets for the fixtures installed.

The increase in the exit sign savings comes from using DEER 2005 savings numbers for an LED exit sign. The unit savings are 351.3 kWh and .0423 kW per exit sign. This measure applies to all commercial customers in all climate zones. Lincus recommends using the latest DEER version for exit sign savings.

The decrease in kWh savings and increase in kW savings for the HVAC tune-up comes from using DEER 2008 for a small package AC increased refrigerant charge from typical under-charge to factory specified level. The unit savings are 76.5 kWh and .0570 kW per ton of cooling. This measure applies to small retail in climate zone 9. Lincus recommends using the latest DEER version for HVAC tune-up measures, or require pre and post kW measurements and applying typical cooling hours for climate zone 9.

The increase in the audit savings comes from using the updated 2005 Methodology Report savings numbers, as stated in sections 7.1.1 and 7.1.2, for educational programs. The unit savings are 438 kWh and 0.0 kW per audit.

Table 7-29 shows Azusa’s claimed (ex-ante) savings and Lincus’ verified (ex-post) savings for the Small Business/Direct Install Program.

Table 7-29: Small Business/Direct Install Program savings

Claimed Gross kWh Savings	Claimed Gross peak kW Savings	Verified Gross kWh Savings	Verified Gross peak kW Savings
272,192	34.6	272,379	79.3

8 Program Realization Rates

A Realization Rate is a ratio that compares the previously calculated savings to the current verified savings. If a Realization Rate is greater than 100%, that means the previous savings were underestimated. If the Realization Rate is less than 100%, the previous savings have been overestimated. Using the verified kWh savings in Section 7, a Realization Rate can be calculated for each Program by dividing it by the claimed savings. Table 8-1 below shows the claimed and verified savings and the calculated kWh Realization Rate for each Program that underwent the M&V process. The italicized items are measures within the noted Program above them and add up to the program totals.

Table 8-1: Program kWh Realization Rates

Program	Claimed Gross kWh Savings	Verified Gross kWh Savings	kWh Realization Rate
Online Energy Audit	386,060	424,860	110.1%
LivingWise	263,886	338,870	128.4%
<i>Audit</i>	263,886	315,798	119.7%
<i>CFLs</i>	0	23,072	N/A
Home Weatherization Rebates	53,019	51,341	96.8%
<i>Attic Fan</i>	32	32	100.0%
<i>Duct Sealing</i>	123	123	100.0%
<i>Ceiling Insulation</i>	4,878	3,200	65.6%
<i>Programmable Thermostats</i>	-855	-855	100.0%
<i>Solar Attic Fan</i>	176	176	100.0%
<i>Whole House Fan</i>	75	75	100.0%
<i>Windows</i>	48,590	48,590	100.0%
Replacement AC Rebate	38,568	16,796	43.5%
<i>Central AC</i>	37,643	15,872	42.2%
<i>Room AC</i>	924	924	100.0%
Refrigerator Rebates	19,276	19,276	100.0%
Business Energy Partnership Program	808,432	938,147	116.0%
Small Business/ Direct Install	272,192	272,379	100.1%
Totals	1,841,433	2,061,669	112.0%

Table 8-2 below shows the claimed and verified savings and the calculated kW Realization Rate for each Program that underwent the M&V process.

Table 8-2: Program kW Realization Rates

Program	Claimed Gross Peak kW Savings	Verified Gross Peak kW Savings	kW Realization Rate
Online Energy Audit	0.0	0.0	N/A
LivingWise	2.9	4.3	149.2%
<i>Audit</i>	2.9	0.0	0.0%
<i>CFLs</i>	0.0	4.3	N/A
Home Weatherization Rebates	39.1	38.4	98.1%
<i>Attic Fan</i>	0.1	0.1	100.0%
<i>Duct Sealing</i>	0.1	0.1	100.0%
<i>Ceiling Insulation</i>	2.4	1.6	68.2%
<i>Programmable Thermostats</i>	0.0	0.0	N/A
<i>Solar Attic Fan</i>	0.0	0.0	N/A
<i>Whole House Fan</i>	0.0	0.0	100.0%
<i>Windows</i>	36.6	36.6	100.0%
Replacement AC Rebate	8.2	22.7	276.6%
<i>Central AC</i>	6.8	21.3	312.2%
<i>Room AC</i>	1.4	1.4	100.0%
Refrigerator Rebates	3.3	3.3	100.0%
Business Energy Partnership Program	166.1	165.9	99.9%
Small Business/ Direct Install	34.6	79.3	229.2%
Totals	254.2	313.8	123.5%

9 Conclusion and Recommendations

Overall, Azusa's Programs are well run and provide Customers with much needed incentives for implementing energy efficiency into their lives. However, upon review, the energy savings and peak power reduction claimed by the Programs, as a whole, are slightly over-calculated and some areas could use some changes to better the processing of applications and provide more accurate savings calculations.

Azusa currently uses default NTG ratio values from the CPUC Energy Efficiency Policy Manual Version 2, as requested by SCPPA. Net-to-Gross (NTG) analysis was taken out of Lincus' scope in developing this EM&V study.

Recommendations for the Online Energy Audit Program

- 1. Use the revised 2005 Methodology Report savings numbers**

The Online Energy Online Program's kWh and kW savings slightly increased. It is recommended that Azusa use the revised 2005 Methodology Report educational savings numbers of 438 kWh savings per audit instead of the 398 kWh savings currently used.

Recommendations for the LivingWise Program

- 1. Use current DEER savings for CFL wattages installed**
- 2. Use the revised 2005 Methodology Report savings numbers**

The LivingWise Program's kWh and kW savings slightly changed. This is due to also claiming the CFLs provided to the students, instead of only the educational portion of the Program. It is recommended that Azusa use the revised 2005 Methodology Report educational savings numbers of 438 kWh savings per audit instead of the 398 kWh savings currently used.

Recommendations for the Home Weatherization Rebates Program

- 1. Use current DEER savings for each measure**
- 2. Implement a new Energy Efficiency Program Integration Platform**

The Home Weatherization Rebates Program's kWh decreased by about 3% and kW savings also decreased by about 2%, overall. There are seven Measures in this Program. Most of the Measures have a verified savings relatively close to the claimed savings. The measure that has a relatively large change in savings is Ceiling Insulation. This change was due to customers having insulation prior to installing the new insulation. It is recommended that Azusa use savings numbers obtained from the latest DEER, in the future. It is also recommended that Azusa implement a new Energy Efficiency Program Integration Platform that can store all applications, provide easy access to all application information when needed, and perform E3 calculations, such as TRC, PAC, and Levelized Costs, for reports and Program Management knowledge.

Recommendations for the Replacement AC Rebates Program

1. Use current DEER savings for each measure

The Replacement AC Program's kWh decreased by 56.5% and kW savings increased by 176.6%, overall. There are two Measures in this Program. The difference between the savings is due to using different line items within the E3 provided by SCPPA. The measure that has a relatively large change in savings is Central AC. This change was due to using a line item with varying unit savings. It is recommended that Azusa use savings numbers obtained from the latest DEER, in the future.

Recommendations for the Refrigerator Rebates Program

1. Use current DEER savings for each measure

The Refrigerator Rebates Program's savings had no change overall. This is due to Azusa using the correct line item with the E3 provided by SCPPA. It is recommended that Azusa use savings numbers obtained from the latest DEER, in the future.

Recommendations for the Business Energy Partnership Program

- 1. Additional technical resources or additional budgeting to hire an outside firm to assist with the Program are needed**
- 2. Require specification sheets to verify fixture wattages**
- 3. Claim, but do not incentivize, HVAC interactive effects**
- 4. Verify proper commissioning of VFDs**
- 5. Develop a robust savings analysis method for projects that implement multiple measures in a system and save over 100,000 kWh**
- 6. Perform quality control for applications with over 100,000 kWh savings**
- 7. Request trending data for applications with over 100,000 kWh savings and require M&V for applications with over 250,000 kWh savings**
- 8. Establish proper energy consumption baselines to evaluate measure savings**
- 9. Include past billing data in applications**

The Business Energy Partnership Program's savings has slightly increased overall. The increase is mostly due to the change in hours of operation for lighting fixtures do to the data logger measurements, the addition of HVAC interactive effects, and the air compressor application. Light loggers were used to determine the hours of operation of lights throughout facilities. DEER standards for occupancy sensors could be used for hour of operation reductions. By decreasing the load of the lighting, the cooling load decreases as well, which is where the HVAC interactive effects come in. It is recommended that Azusa require spec sheets for each fixture retrofit and use the fixture input wattage from the spec sheets, claim, but not incentivize, HVAC interactive effects, and include the coincident diversity factors in savings calculations for Lighting Measures. It is recommended that Azusa verify proper commissioning is being done on retrofit equipment. Improper commissioning has a tendency to result in negative savings. It is recommended that Azusa develop an energy model for applications that implement multiple measures in a system. This will guarantee a more accurate savings calculation. Performing quality control on applications over 100,000 kWh will also provide more accurate savings calculations. This can either be done internally or through an outside consultant. Also, request trending data for applications over 100,000 kWh savings and require M&V for applications over 250,000 kWh

savings. This data will provide more accurate savings estimates as the trending and M&V provide actual data from the retrofit systems. Azusa should follow California’s generally used utilities procedures manual when determining a baseline, as stated in Section 6.1.

Recommendations for the Small Business/Direct Install Program

- 1. Use current DEER version in obtaining savings for each measure**
- 2. Follow DEER methodology to include coincident diversity factors**

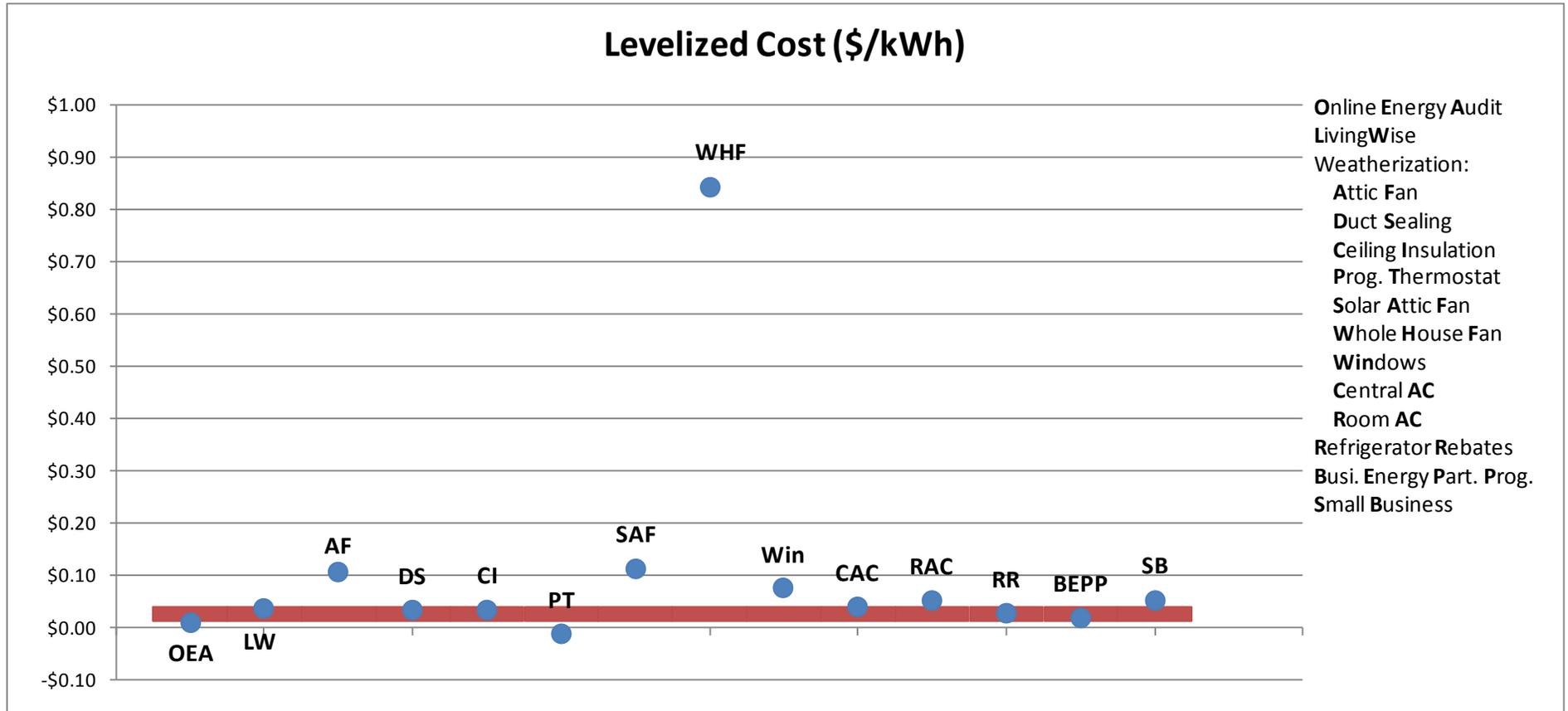
The Small Business/Direct Install Program’s kWh savings slightly increased overall. The increase in the savings is due to using DEER and the hours of operation measurement. The hours of operation slightly increased in some applications, which increases savings. It is recommended that the latest DEER version be used to obtain savings numbers. The CFL, exit sign, and HVAC tune-up savings can all be obtained from DEER. It is also recommended that coincident diversity factors be applied to demand savings. These factors will convert average demand savings to peak demand savings.

Table 9-1: Levelized Cost of Energy Savings by program

Program	Verified Gross kWh Savings	Claimed NTG	Program Cost	Lifetime Levelized Cost (\$/kWh)
Online Energy Audit	424,860	80%	\$9,111.24	\$0.009
LivingWise	338,870	80%	\$33,813.86	\$0.037
Home Weatherization Rebates	51,341	80%	\$61,350.72	\$0.074
<i>Attic Fan</i>	32	80%	\$41.27	\$0.107
<i>Duct Sealing</i>	123	80%	\$60.39	\$0.034
<i>Ceiling Insulation</i>	3,200	80%	\$1,818.95	\$0.036
<i>Programmable Thermostats</i>	-855	80%	\$90.84	-\$0.012
<i>Solar Attic Fan</i>	176	80%	\$160.83	\$0.114
<i>Whole House Fan</i>	75	80%	\$757.26	\$0.841
<i>Windows</i>	48,590	80%	\$58,421.20	\$0.075
Replacement AC Rebate	16,796	80%	\$9,640.02	\$0.041
<i>Central AC</i>	15,872	80%	\$9,170.61	\$0.040
<i>Room AC</i>	924	80%	\$469.41	\$0.053
Refrigerator Rebates	19,276	80%	\$7,556.59	\$0.027
Business Energy Partnership Program	938,147	100%	\$204,993.69	\$0.019
Small Business/ Direct Install	272,379	90%	\$86,128.65	\$0.053
Totals	2,061,669	90.4%	\$412,594.77	\$0.027

Figure 9-1 shows Life Levelized Costs of each Measure compared to the average of the nine Programs verified, about \$0.027 per net life kWh. This gives an idea of how much each Measure costs to incentivize relative to the savings Azusa obtains.

Figure 9-2: Graph of the Levelized Cost of each Measure compared to the average



Recommendation: Lower Home Weatherization Rebates Whole House Fan utility cost

As it can be seen, the Home Weatherization Rebates Whole House Fan Measure has the highest highest levelized cost. This is also due to it having higher cost and a lower savings. The only suggestion for lowering the Levelized Cost is to lower the utility cost. This could be done by lowering the incentive.

Recommendation: Lower Home Weatherization Rebates Attic Fan utility cost

The Attic Fan rebate has the second highest levelized cost. This is due to it having a high utility cost and low energy savings. The only suggestion for lowering the Levelized Cost is to lower the utility cost. This could be done by lowering the incentive.

Recommendation: Reduce Solar Attic Fan incentive

The third highest Levelized Cost is the Solar Attic Fan Measure. Upon review of other California Utilities, it was discovered that Azusa has a competitive incentive amount offered for Solar Attic Fans. To achieve a lower Levelized Cost, it is recommended that Azusa lower the incentive amount to between \$75 and \$100. Doing so will still provide a competitive incentive amongst neighboring Utilities and also lower the levelized cost.

Recommendation: Remove Programmable Thermostat Measure from Home Weatherization Rebates Program

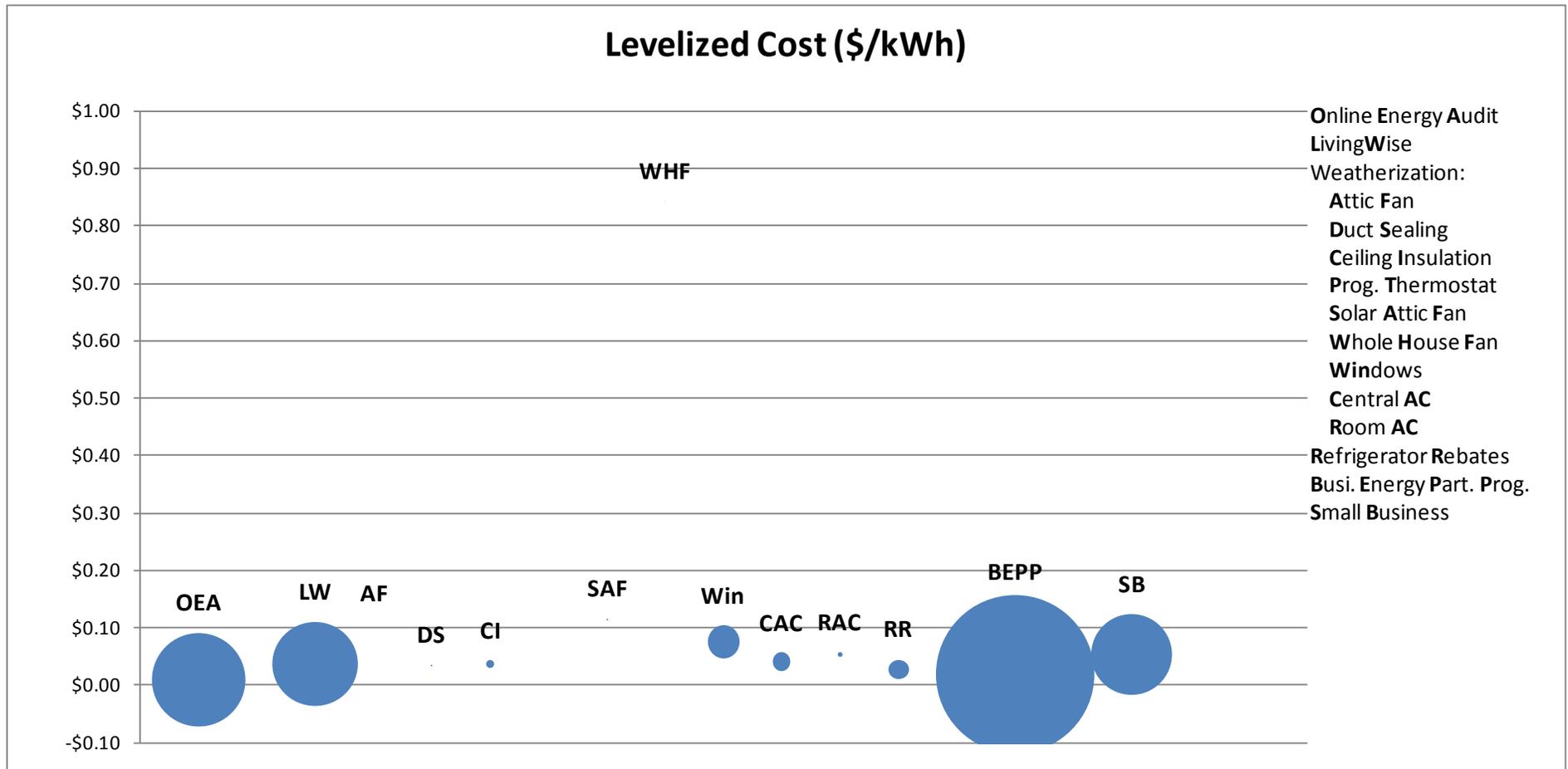
It should be noted that the Home Weatherization Rebates Programmable Thermostat has a negative levelized cost. This means that Azusa is incentivizing a measure that provides negative savings. It is highly recommended that Azusa remove this measure from the Program, or include it within the Central AC Measure.

Recommendation: Market Programs with levelized costs under the average

The Business Energy Partnership Program is the higher saving Program and is under the average levelized cost. It is recommended that Azusa push to get more savings from Programs with levelized costs under the average.

Figure 9-2 is a bubble graph that shows the same data from Figure 9-1, but also shows how much energy savings each Measure offers by the size of the bubble. This figure gives an idea of which Programs contribute the most to the average levelized cost.

Figure 9-2: Bubble graph of the Levelized Cost of each Measure based on verified kWh savings



Appendix A –Energy Efficiency Program Integration Platform

Lincus recommends a program management software platform that can offer a robust functionality by combining many of the separate and independent excel worksheets, program data, application forms, accounting and billing notices as well as savings the data in one central location. The purpose of this energy efficiency program management platform is to promote, track, and evaluate energy efficiency installations made by your utility. This type of program management platform will allow Azusa to configure & release new energy efficiency programs in a short span of time for different customer classes, keep track of program results and compare various programs or measures within a single business tool. In addition, this type of program management tool can provide detailed business critical reports for program administrators, customer service representatives, and inspection and EM&V consultants to review program performance. The benefits of this type of program management software include:

1. Simplifying Administrative Tasks

The tool should provide intuitive user interface for utility companies to execute their daily task with productivity.

- Should be easy to manage the task assignment / re-assignment and track status changes
- Should notify program managers on their pending tasks for prioritization
- Needs to validate most of the program check list, eliminating manual intervention
- Provide quick access to any energy efficiency programs information
- Easy to accommodate program changes to the existing programs without delays
- Be able to track, assess, and audit the program performance through dashboard and reports

2. Common Platform for Managing EE Programs

The tool provides a seamless view across programs and gets real-time information which will aid in both their strategic and tactical decisions:

- Bring down costs / complexity of hosting the application
- Adapt and revamp new energy efficiency Programs faster and reach more participants in a short time

3. Flexibility / Scalability

Lincus recommends that such tool is flexible and scalable and allows Azusa to design more energy efficiency programs within a short time and reach to the market.

- a. Flexible to accommodate program changes
- b. Extensible application to handle new energy program requirements
- c. Needs to meet configurable requirements for future energy efficiency programs
- d. Be able to handle growth in Program users

Appendix B – Customer Surveys

I. Home Weatherization Rebates Program

INTRO: Hello, my name is _____ and I'm calling on behalf of Azusa Light and Water. How are you today? We are performing a quick survey of your household's participation in Azusa's Home Weatherization Rebates Program. I assure you this is not a sales attempt. Azusa is trying to ensure that the Home Weatherization Rebates Program is successful and meeting the needs of its customers. According to our records, your household has purchased and received a rebate from Azusa for an Attic Fan. Is this correct?

Did you participate in the decision to purchase this item or did someone else in the household do so?

If they did: (Continue below)

If someone else: May I speak with that person please? (Repeat INTRO and continue below)

May I ask for a couple minutes of your time to answer [*FOUR TO SIX*] quick survey questions?

If yes: Thank you! (Continue with questions)

If no: Thank you for your time. (Call next person on list)

QUESTIONS BY MEASURE:

Attic Fan:

1. Did the attic fan replace an old attic fan?
 - a. Yes
 - b. No
2. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
3. Are you satisfied with this Program?
 - a. Yes
 - b. No
4. Do they have any suggestions on how to improve the program?

Ceiling Insulation:

1. Was there insulation in the attic previously?
 - a. Yes
 - b. No
2. What was the R-Value of the previous insulation?
 - a. Yes
 - b. No
3. If not sure, what is the vintage of the house?
4. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
5. Are you satisfied with this Program?
 - a. Yes
 - b. No
6. Do they have any suggestions on how to improve the program?

Programmable Thermostat:

1. Prior to installing the programmable thermostat, did you perform any temperature setbacks at night?
 - a. Yes
 - b. No
2. What is the vintage of the house?
3. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
4. Are you satisfied with this Program?
 - a. Yes
 - b. No
5. Do they have any suggestions on how to improve the program?

Solar Attic Fan:

1. Did the solar attic fan replace an old attic fan?
 - a. Yes
 - b. No
2. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
3. Are you satisfied with this Program?
 - a. Yes
 - b. No
4. Do they have any suggestions on how to improve the program?

Whole House Fan:

1. Was there night ventilation or an economizer before?
 - a. Yes
 - b. No
2. What is the vintage of the house?
3. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
4. Are you satisfied with this Program?
 - a. Yes
 - b. No
5. Do they have any suggestions on how to improve the program?

Windows:

1. Did these windows replace old windows?
 - a. Yes
 - b. No
2. If yes, were the old windows single paned or double paned?
 - a. Single
 - b. Double
3. If yes, did the old windows have tinting?
 - a. Yes
 - b. No
4. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
5. Are you satisfied with this Program?
 - a. Yes
 - b. No
6. Do they have any suggestions on how to improve the program?

Exodus: That concludes our survey. I would like to thank you for your time and I hope you continue to participate in Azusa Light and Water's Residential Energy Efficiency Programs.

II. Replacement AC Program

INTRO: Hello, my name is _____ and I'm calling on behalf of Azusa Light and Water. How are you today? We are performing a quick survey of your household's participation in Azusa's AC Replacement Program. I assure you this is not a sales attempt. Azusa is trying to ensure that the AC Replacement Program is successful and meeting the needs of its customers. According to our records, your household has purchased and received a rebate from Azusa for Room Air Conditioners. Is this correct?

Did you participate in the decision to purchase this item or did someone else in the household do so?

If they did: (Continue below)

If someone else: May I speak with that person please? (Repeat INTRO and continue below)

May I ask for a couple minutes of your time to answer [SEVEN TO EIGHT] quick survey questions?

If yes: Thank you! (Continue with questions)

If no: Thank you for your time. (Call next person on list)

QUESTIONS BY MEASURE:

Central Air Conditioners:

1. How old was the replaced unit?
2. Was the replaced unit the same size (tonnage) as the new unit?
 - a. Yes
 - b. No
3. If not, how big was the replaced unit?
4. Do you also have Room Air Conditioners?
 - a. Yes
 - b. No
5. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
6. Are you satisfied with this Program?
 - a. Yes
 - b. No
7. Do they have any suggestions on how to improve the program?

Room Air Conditioners:

1. Did the new unit replace an old unit?
 - a. Yes
 - b. No
2. How old was the replaced unit?
3. Was the replaced unit the same size (tonnage) as the new unit?
 - a. Yes
 - b. No
4. If not, how big was the replaced unit?
5. Do you also have a Central AC system?
 - a. Yes
 - b. No
6. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
7. Are you satisfied with this Program?
 - a. Yes
 - b. No
8. Do they have any suggestions on how to improve the program?

Exodus: That concludes our survey. I would like to thank you for your time and I hope you continue to participate in Azusa Light and Water's Residential Energy Efficiency Programs.

III. Refrigerator Rebates Program

INTRO: Hello, my name is _____ and I'm calling on behalf of Azusa Light and Water. How are you today? We are performing a quick survey of your household's participation in Azusa's Refrigerator Rebates Program. I assure you this is not a sales attempt. Azusa is trying to ensure that the Refrigerator Rebates Program is successful and meeting the needs of its customers. According to our records, your household has purchased and received a rebate from Azusa for a Refrigerator. Is this correct?

Did you participate in the decision to purchase this item or did someone else in the household do so?

If they did: (Continue below)

If someone else: May I speak with that person please? (Repeat INTRO and continue below)

May I ask for a couple minutes of your time to answer six quick survey questions?

If yes: Thank you! (Continue with questions)

If no: Thank you for your time. (Call next person on list)

1. Is the freezer on the new unit above, below, or to the side?
 - a. Above
 - b. Below
 - c. Side
2. If side, is there a through-the-door ice dispenser?
 - a. Yes
 - b. No
3. What size (cubic feet) was the new refrigerator?
4. Would you have made this purchase if Azusa wasn't supplying a rebate?
 - a. Yes
 - b. No
5. Are you satisfied with this Program?
 - a. Yes
 - b. No
6. Do they have any suggestions on how to improve the program?

Exodus: That concludes our survey. I would like to thank you for your time and I hope you continue to participate in Azusa Light and Water's Residential Energy Efficiency Programs.

Appendix C – Customer Survey Results

I. Home Weatherization Rebates Program

Attic Fan:

	Yes	No
1. Did the attic fan replace an old attic fan?	0	1
2. Would you have made this purchase if Azusa wasn't supplying a rebate?	1	0
3. Are you satisfied with this Program?	1	0
4. Do they have any suggestions on how to improve the program?	<ul style="list-style-type: none"> newsletter and information in bill was helpful and informative 	

Ceiling Insulation:

	Yes	No
1. Was there insulation in the attic previously?	2	2
2. What was the R-Value of the previous insulation?	R7	
3. If not sure, what is the vintage of the house?	1980	
4. Would you have made this purchase if Azusa wasn't supplying a rebate?	4	0
5. Are you satisfied with this Program?	3	1
6. If not, may I ask why you are not satisfied?	<ul style="list-style-type: none"> incentive helped make decision to install insulation 	

Solar Attic Fans:

	Yes	No
1. Was there night ventilation or an economizer before?	0	1
2. What is the vintage of the house?	7 years	
3. Would you have made this purchase if Azusa wasn't supplying a rebate?	1	0
4. Are you satisfied with this Program?	1	0
5. Do they have any suggestions on how to improve the program?	<ul style="list-style-type: none"> • make people more aware of the program 	

Windows:

	Yes	No
1. Did these windows replace old windows?	4	0
2. If yes, were the old windows single pane or double pane?	(4) single	
3. If yes, did the old windows have tinting?	0	4
4. Would you have made this purchase if Azusa wasn't supplying a rebate?	4	0
5. Are you satisfied with this Program?	4	0
6. If not, may I ask why you are not satisfied?	<ul style="list-style-type: none"> • incentive really helped make her decision; • publicize more, did not know about incentive until contractor told her about it; • incentive helped her make purchase 	

II. Replacement AC Rebates

Central Air Conditioners:

	Yes	No
1. How old was the replaced unit?	10-30 years	
2. Was the replaced unit the same size (tonnage) as the new unit?	0	3
3. If not, how big was the replaced unit?	3-5 tons	
4. Do you also have Room Air Conditioners?	0	3
5. Would you have made this purchase if Azusa wasn't supplying a rebate?	3	0
6. Are you satisfied with this Program?	3	0
7. Do they have any suggestions on how to improve the program?	<ul style="list-style-type: none"> • need more information about the rebate, found out about the incentive through her neighbor; • need more publicity about the incentive, found out about the rebate incidently; • did not know about the incentive - AC contractor told her to apply for it. 	

Room Air Conditioners:

	Yes	No
1. Did the new unit replace an old unit?	1	1
2. How old was the replaced unit?	No Answer	
3. Was the replaced unit the same size (tonnage) as the new unit?	No Answer	No Answer
4. If not, how big was the replaced unit?	No Answer	
5. Do you also have a Central AC system?	0	2
6. Would you have made this purchase if Azusa wasn't supplying a rebate?	2	0
7. Are you satisfied with this Program?	2	0
8. Do they have any suggestions on how to improve the program?	<ul style="list-style-type: none"> • None 	

Appendix D – Verified Savings Using DEER 2008

During the 2008-2009 FY, DEER 2005 was the most recent version of DEER that Azusa could use to claim savings. Currently, DEER 2008 is the most recent version. The latest version of DEER is recommended to use in future fiscal years.

Between DEER 2005 and DEER 2008, only a few Measures offered by Azusa have been updated. Those Measures are: LivingWise CFLs, Home Weatherization Rebates Duct Sealing, Replacement AC Rebates Central AC unit, and Refrigerator Rebates Energy Star Refrigerator.

Tables D-1 through D-8 show the savings numbers taken from DEER 2008. The odd numbered tables show the DEER 2008 savings for each Measure and the odd numbered tables show the DEER 2005 savings for the same Measure. This is done to compare the changes in unit savings. In future fiscal years, it is recommended that Azusa use these savings numbers.

Table D-1: LivingWise CFLs DEER 2008 verified savings per unit

DEER 2008	
13W CFL	
kWh	kW
29	0.005

Table D-2: LivingWise CFLs DEER 2005 verified savings per unit

DEER 2005	
13W CFL	
kWh	kW
36	0.003

Table D-3: Home Weatherization Rebates Duct Sealing DEER 2008 verified savings per unit

DEER 2008 - Single Family Residential, CZ 09, Vintage before 1978	
per 1,000 sqft	
kWh	kW
94	0.127

Table D-4: Home Weatherization Rebates Duct Sealing DEER 2005 verified savings per unit

DEER 2005 - Single Family Residential, CZ 09, Vintage before 1978	
per 1,000 sqft	
kWh	kW
77	0.075

Table D-5: Replacement AC Rebates Central AC unit DEER 2008 verified savings per unit

DEER 2008 - Single Family, CZ 09	
Central AC to Central AC per ton	
kWh	kW
143	0.191

Table D-6: Replacement AC Rebates Central AC unit DEER 2005 verified savings per unit

DEER 2005 - Single Family, CZ 09	
Central AC to Central AC per ton	
kWh	kW
286	0.364

Table D-7: Refrigerator Rebates Energy Star Refrigerator DEER 2008 verified savings per unit

DEER 2008 - Single Family CZ 09	
Weighted Average per Refrigerator	
kWh	kW
192	0.038

Table D-8: Refrigerator Rebates Energy Star Refrigerator DEER 2005 verified savings per unit

DEER 2005 - Single Family CZ 09	
Weighted Average per Refrigerator	
kWh	kW
62	0.011

Table D-9 shows the kWh and kW GRRs for the four Measures updated in DEER 2008. Using the savings numbers above, and the methodologies stated in Section 7, the following Program savings and GRRs were produced.

Table D-9: Program kWh and kW Realization Rates using DEER 2008 savings numbers

Program	Claimed Gross kWh Savings	Verified Gross kWh Savings	kWh Gross Realization Rate	kW Gross Realization Rate
LivingWise	263,886	337,031	127.7%	127.5%
<i>CFLs</i>	0	21,233	N/A	N/A
Home Weatherization Rebates	53,019	16,037	30.2%	26.8%
<i>Duct Sealing</i>	123	94	76.6%	107.4%
Replacement AC Rebate	38,568	9,808	25.4%	150.3%
<i>Central AC</i>	37,643	8,859	23.5%	173.8%
Refrigerator Rebates	19,276	11,728	60.8%	71.1%
Totals	1,841,433	2,143,297	116.4%	107.8%

In comparison, Table D-10 shows the kWh and kW GRRs for the four Measures using DEER 2005 savings numbers.

Table D-10: Program kWh and kW Realization Rates using DEER 2005 savings numbers

Program	Claimed Gross kWh Savings	Verified Gross kWh Savings	kWh Gross Realization Rate	kW Gross Realization Rate
LivingWise	263,886	341,847	129.5%	85.2%
<i>CFLs</i>	0	26,049	N/A	N/A
Home Weatherization Rebates	53,019	16,020	30.2%	26.7%
<i>Duct Sealing</i>	123	77	62.5%	63.9%
Replacement AC Rebate	38,568	18,684	48.4%	280.9%
<i>Central AC</i>	37,643	17,735	47.1%	330.5%
Refrigerator Rebates	19,276	3,804	19.7%	19.6%
Totals	1,841,433	2,149,047	116.7%	110.8%

Also in comparison, Table D-11 shows the kWh and kW GRRs for the four Measures using Azusa’s E3 calculator savings numbers. This table is a condensed version of Table 8-1.

Table D-11: Program kWh and kW Realization Rates using E3 calculator savings numbers

Program	Claimed Gross kWh Savings	Verified Gross kWh Savings	kWh Gross Realization Rate	kW Gross Realization Rate
LivingWise	263,886	338,870	128.4%	149.2%
<i>CFLs</i>	0	23,072	N/A	N/A
Home Weatherization Rebates	53,019	51,341	96.8%	98.1%
<i>Duct Sealing</i>	123	123	100.0%	100.0%
Replacement AC Rebate	38,568	16,796	43.5%	276.6%
<i>Central AC</i>	37,643	15,872	42.2%	312.2%
Refrigerator Rebates	19,276	19,276	100.0%	100.0%
Totals	1,841,433	2,061,669	112.0%	123.5%

As it can be seen, if DEER 2005 savings numbers were used during the 2008/2009 FY, the total kWh savings would increase by 4.7% and the kW savings would decrease by 12.7%. Theoretically, if DEER 2008 savings numbers were used during the 2008/2009 FY, the total kWh savings would decrease by 4.4% and the kW savings would decrease by 15.7%