Final Report

An Evaluation of the Low-Income Weatherization Program

Results of an Impact Evaluation

Prepared for
Empire District Electric Co.

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Executive Summary

About This Report

This report presents the results of an impact evaluation of Empire Electric's Low-Income Weatherization Program. This program's primary goal is to provide home weatherization services to the low-income community within Empire Electric's territory. The services provided are expected to lower participant's utility bills and improve their payment performance. This evaluation focuses on 100 participants that received weatherization services between October 2006 and September 2008 and had billing data that fit the reliability criteria for the study (please see methodology for details).

Summary of Findings

1. The net savings from the weatherization services is an average of 2,052 annual kWhs, or a 13.4% decrease in consumption. The electric savings for the participant group is estimated at a 1,819 kWhs annually, equal to an 11.8% reduction in electricity consumed. The comparison group increased their annual consumption by 233 kWhs.

2. Seventy-four out of the 100 participants (74%) studied decreased their consumption of electricity by an average of 3,141 kWhs (adjusted for comparison group) after their homes were weatherized. This is an approximate monthly savings of 262 kWhs. The other 26% increased their energy consumption by an average of 3,128 kWhs.

3. The evaluation found no significant correlation between blower door test results and program-level whole house energy savings, the costs of weatherization, or the number of weatherization measures installed. This indicates that while blower door test may help identify measures to be installed, the installation of those measures in themselves do not provide enough total savings to greatly influence the total amount of savings achieved. Likewise, installing higher number of measures does not necessarily results in lower infiltration. This is most likely due to the overall condition of the homes before weatherization and the ways in which the home is used by the occupants (number of occupants, high-use medical equipment, etc.).

4. The highest energy savings are realized by those homes receiving lighting upgrades (CFLs). However, there were a small number of homes getting CFLs, so this finding is not significant due to a low sample size.

Recommendations

TecMarket Works has the following recommendations for the low-income weatherization program:

1. The weatherization program in the Empire territory should include CFLs into the mix when possible, as lighting improvements will likely result in greater energy savings for the customer and Empire, and lower utility bills for their low-income customers.

Introduction

This report presents the results of an impact evaluation of the Low-Income Weatherization Program. The evaluation examined 100 participants that received weatherization services between October 2006 and September 2008 and had billing data that fit the reliability criteria for the study (please see methodology for details).

Program Description

Qualifying low income customers receive help in managing their energy use and bills through Empire's Low Income Weatherization and High Efficiency Program. The program works directly with local CAP agencies that already provide weatherization services to low income customers through the DOE and other state agencies. Empire provides supplemental funds to the CAP agencies to cover the cost of weatherization measures. This program is administered by the CAP agencies and follows the protocol under current federal and state guidelines. CAP agencies expect to spend an average of $1,200 (escalated by $50 per year) of Empire funds to supplement their DOE funds. Empire funds focus on measures that reduce electricity usage such as electric heat, air conditioning, refrigeration, lighting, etc. CAP agencies have discretion to use the funds as they wish for weatherization and heating equipment. In addition, they may also spend up to $200 towards the purchase of an ENERGY STAR® rated refrigerator and $100 towards the purchase of ENERGY STAR® rated CFLs and lighting fixtures.

There were three CAP agencies represented in this study, they are: Economic Security Corporation (ESC), West Central Missouri Community Action Agency (WCMCAA), and The Ozarks Area Community Action Corporation (OACAC).

Anticipated annual participation is 125 customers. Empire is currently in its third contract year of participation in this program. The 2005-2006 contract-year had 103 participants, with 148 participants in the following contract year. The current contract year has benefited 80 customers through May 2008.

This program is based on the Department of Energy weatherization program. As such, it will require an impact evaluation only.

Evaluation Methodology

The study methodology consisted of three parts. These are:

1. A weather normalized energy usage analysis in which TecMarket Works examined participant's electricity consumption before and after weatherization to determine if the program had an effect on energy consumption.
2. Comparison of billing analysis results to Blower Door Test results.
3. Comparison of billing analysis results between measure groups.

Energy Savings Analysis

Energy savings for Program participants were determined by looking at the change in energy usage of the participants from before weatherization to after weatherization compared to a simulated comparison group established by using the monthly pre-program consumption of participants over the analysis period. Empire selected this approach because selecting a comparison group of non-participating low-income customers would have been too time-consuming and costly for this evaluation. Instead, the comparison group was developed from the participant group by using only pre-weatherization meter data and randomly assigning a date to break all pre-weatherization data into pre and post data. In effect, the participants become their own comparison group. This procedure is a standard approach within the evaluation field when the study cannot include a comparison group of non-participants.

The data that was used for this analysis was provided from Empire's monthly-metered account database. The data was provided in kWh per month per customer for up to twenty-seven months before the program and twenty-seven months after the program.

After the data was cleaned, average participant usage per year was calculated. Energy savings were calculated using PRISM.

PRISM™ Analysis

Program impacts were examined using PRISM™ Advanced Version 1.0 software for Windows developed at Princeton University's Center for Energy and Environmental Studies.

PRISM™ is a commercially available analysis software package designed to estimate energy savings for heating and/or cooling loads in residential and small commercial buildings. The current Advanced Version permits users to enter and edit data from a variety of sources, to carry out sophisticated reliability checks, to eliminate cases that do not meet standards, and to display results in graphical and textual forms.

PRISM™ allows the user to estimate the change in energy consumption per heating or cooling degree-day for the periods before and after measures are installed in homes by combining energy consumption and weather data. By subtracting the estimate of energy use per degree-day after the measures are installed from the value before the measures are installed and multiplying by an appropriate annual degree-day value, total annual normalized energy savings can be estimated.

Degree-days vary from year to year, which potentially presents a problem for deciding on a value for annual degree-days. This is especially problematic if one is trying to determine paybacks. For example, one could normalize the savings to the period preceding the installation of measures or the period after. If one selects a warm period, then savings may be too low and paybacks too long. If one selects a cool period for normalization, then the estimate of paybacks may be too high.

PRISM™ mitigates this problem by effectively averaging temperatures over a twelve-year period and providing an estimate of degree-days that is typical for the region of the study, although not one that necessarily matches the specific weather conditions in any

given year. The advantage of normalizing to the PRISM™ recommended period is that the results will be consistent from study to study over a period of time. The same end can be achieved by consistently using the same user selected time frame. For this study we chose the period from January 1, 1992 through December 31, 2002, recommended by PRISM™ support.

A major feature of PRISM™ is the ability to evaluate cases against reliability criteria. The first criterion is the R^2 value (explained variance), a measure of the fit of the degree-day and energy consumption data, or in statistical lingo, the amount of variance in energy consumption explained by changes in degree-days. Energy consumption is assumed to be a linear function of degree-day. R^2 varies from 0 to 1. If R^2 is close to zero, it means that factors other than outdoor temperature are driving energy consumption. If the R^2 is close to 1 it means that outdoor temperature is almost entirely responsible for energy consumption. Outdoor temperature is usually the overriding factor in both heating and air conditioning fuel use and the goal of the weatherization program is to improve the thermal characteristics of the building shell and the fuel use rate of the heating and air conditioning systems to reduce fuel use related to outdoor temperature. The PRISM™ default for R^2 is at .7. This means that at least seventy percent of energy use is temperature dependant. If less than 70 percent of the energy used in a building is temperature related, then it becomes difficult to understand the effects of the weatherization measures and the case is dropped from the analysis. We used .7 in this study although most of the R^2 values in this study were .85 or higher. In other words, 85 percent or more of heating and cooling electricity use in this study is temperature driven. PRISM™ has a second measure of reliability which is the coefficient of variation for the normalized annual consumption (CV(NAC)). Normalized annual consumption is the amount of fuel consumed by a unit for a typical weather year. When estimating normalized annual consumption some estimates may have a very tight error band while others may have a band that is quite wide. In estimating the average consumption we want estimates of unit consumption that are very close to the actual and we want to eliminate values that may not be very close because they may cause the estimates of the average consumption for all units to vary significantly from the actual. Because the variation in the estimates of normalized annual consumption generally will be higher in homes with higher consumption, the estimate of the variation in normalized annual consumption is divided by the estimate of normalized consumption to obtain CV(NAC). This provides a standardized measure of the variability of the normalized consumption that is comparable across homes. The PRISM™ default for CV(NAC) is 7 percent and that is the value used in this study.

Comparison to Blower Door Test Results

The blower door tests that were performed on participating homes were done by the weatherizing agency, and the results of these tests were provided to TecMarket Works for each of the participants.

The results of the blower door tests were provided as CFM (cubic feet per minute) reduction values and in percent change in CFM for each home. These values are then regressed with the PRISM results for each home.

Comparison Between Measure Groups

The services provided to the participants were varied and in many cases went beyond weatherization services. Table 1 below presents the measures recorded by the agencies and how they were categorized by TMW and Empire for analysis. Some measures, such as "health and safety repairs" were eliminated from the list of measures as they have no significant effect on energy consumption. All others were categorized into the following groups:

- Insulation
- Infiltration
- Hot Water Heater
- Doors and Windows
- HVAC
- Lighting

Table 1. Measures Installed During Weatherization

Measure as Listed in Data from Agencies	Frequency	Percent	Group for Analysis
2 doors	1	0.05	Doors and Windows
A/C coil cleaned & recharged	1	0.05	HVAC
AC foam	23	1.23	Infiltration
Attic & floor insulation	8	0.43	Insulation
Attic insulation	152	8.11	Insulation
Backer Rod	8	0.43	Infiltration
batten strip on interior walls on paneling seam	1	0.05	Infiltration
C&T	3	0.16	HVAC
Caulking	148	7.90	Infiltration
Ceiling and Floor Insulation	1	0.05	Insulation
Ceiling Insulation	3	0.16	Insulation
Cement Patch	90	4.80	
CFLs	22	1.17	Lighting
Change Furnace Filters	1	0.05	HVAC
Chimney liner	1	0.05	Infiltration
Claze	7	0.37	Doors and Windows
Clean & tune furnace	52	2.77	HVAC
Cover Plate	12	0.64	Infiltration
Door	25	1.33	Doors and Windows
Door Replacement	5	0.27	Doors and Windows
Door Sweep	80	4.27	Infiltration
Door: Misc. Material	3	0.16	Doors and Windows
Door: Misc. Repair	20	1.07	Doors and Windows
Door: Storm Door Replacement	1	0.05	Doors and Windows
DR	1	0.05	Doors and Windows
Drw & Wdws	1	0.05	Doors and Windows

Dryer Vent	2	0.11	Infiltration
Duct Insulation	6	0.32	Infiltration
Duct Repairs & Insulation	2	0.11	Infiltration
Expanding Foam	2	0.11	Infiltration
Exterior Door	56	2.99	Doors and Windows
Faced bat on knee wall	1	0.05	Insulation
Fan limit	1	0.05	HVAC
Flashing	40	2.13	Infiltration
Floor Insulation	23	1.23	Insulation
Floor Repair	3	0.16	
Floor Vents	1	0.05	Infiltration
Foam Sealant	100	5.34	Infiltration
Foundation Vent	3	0.16	Infiltration
Glass	57	3.04	Doors and Windows
Glass Replacement	3	0.16	Doors and Windows
Glaze	51	2.72	Doors and Windows
Grill & Pipe	1	0.05	Hot Water Heater
Hatch Replaced	1	0.05	Infiltration
Health & Safety Repair	90	4.80	
Health & Safety Repair/Replacement	30	1.60	
Heating System Repair	4	0.21	HVAC
Heating System Replacement	3	0.16	HVAC
Hole in Ceiling Repaired	1	0.05	Infiltration
Hot Water Heater Jacket	68	3.63	Hot Water Heater
Infiltration	85	4.54	Infiltration
Install return duct and attach to r/a duct	1	0.05	Infiltration
Insulation	5	0.27	Insulation
Insulation: Rim Joist	2	0.11	Insulation
Joints Sealed	1	0.05	Infiltration
Mill Plastic	1	0.05	
Mortar Patch	2	0.11	
Outlet Gaskets	120	6.40	Infiltration
Outlet Insulators	23	1.23	Infiltration
Patch Holes in Floor	1	0.05	
Pipe Wrap	53	2.83	Hot Water Heater
Plastic	1	0.05	Infiltration
Primary Windows	26	1.39	Doors and Windows
Pully Covers	20	1.07	Infiltration
Reconn seal	1	0.05	Infiltration
Repair Ceiling and Wall Holes	3	0.16	Infiltration
Repair Gas Leak	1	0.05	

Replace furnace vent	1	0.05	
Replace Hatch	3	0.16	Infiltration
Replace water heater vent	1	0.05	Hot Water Heater
Replaced outlet and switch covers where missing	1	0.05	Infiltration
Roof Vent	2	0.11	Infiltration
Sash Locks	29	1.55	
Screen	1	0.05	
Scuttle Door	6	0.32	Infiltration
Seal around wall furnace	1	0.05	
Seal Lines	4	0.21	
Seal Lines Under Sinks	1	0.05	
Sheet Rock	1	0.05	Infiltration
Sidewall Plugs	30	1.60	Infiltration
Skirting	2	0.11	Infiltration
Space Heater	1	0.05	
Storm Door	1	0.05	Doors and Windows
Storm Windows	11	0.59	Doors and Windows
Stroms Interior	1	0.05	Doors and Windows
Thermostat	1	0.05	HVAC
Threshold	1	0.05	Infiltration
Vapor Barrier	6	0.32	
Vent Skirting	1	0.05	Infiltration
Vented Water Heater	1	0.05	Hot Water Heater
Vents	8	0.43	Infiltration
W-Stat	1	0.05	HVAC
Wall	1	0.05	Insulation
Wall & Attic Insulation	4	0.21	Insulation
Wall Insulation	56	2.99	Insulation
Water Heater	2	0.11	Hot Water Heater
Water Heater Replacement	1	0.05	Hot Water Heater
Weatherstrip	106	5.66	Infiltration
WHdr	1	0.05	Hot Water Heater
Window Repair	1	0.05	Doors and Windows
Window Replacement	2	0.11	Doors and Windows
Windows	16	0.85	Doors and Windows
Windows and Doors	3	0.16	Doors and Windows

Placing the measures into the six measure groups allows us to assign that group to each home, as applicable. Some homes have one group assignment, others have all six. These groups and the impact results, dollars spent, and blower door test results are examined in the report.

Evaluation Findings

Sample Size

The results presented in this section are based on 100 participants that were customers long enough to have an account history and who have stayed with Empire long enough to look at trends in usage after the program. The comparison group of pre-program participants consists of 107 customers.[1]

Because of this participant sample size, the sample's precision level and the confidence interval are rigorous enough to draw program impact conclusions. The sample available for this analysis represents a 90% level of precision with a plus or minus 10% confidence interval. This means that if this study were repeated 100 times we would expect that 90% of the studies would have findings that would be the same as the findings in this study plus or minus 10 percent. This confidence interval is considered strong enough for developing conclusions and provides evidence of program effects. The primary findings from these activities are reported below.

Energy Savings Analysis: Changes in Electricity Consumption of Participants

Seventy-Four of the 100 participants studied used significantly less energy after weatherization than they did before they were weatherized. The data from the 100 participants was analyzed using PRISM as described in the methodology.

It's interesting to note the annual kWh consumption of the participants before they were weatherized. Table 2 below summarizes their consumption:

Table 2. Annual Usage of Customers Before Being Weatherized

	Increased Consumption After Weatherization	Decreased Consumption After Weatherization
Annual Usage Before Weatherization	11,622	16,688

As can be seen in Table 2, those that decreased their consumption after weatherization started out with a higher level of consumption before they were weatherized than those that increased their consumption. This could be because of multiple reasons:

1. The homes with the higher energy consumption were in greater need of being weatherized.
2. These homes were provided with methods of reducing energy consumption that resulted in changed behavior. For example, the weatherization agency may have noticed that all the bulbs were incandescent and suggested they be replaced with CFLs to reduce energy consumption further.

[1] The comparison group is larger than the participant group because the random split of the pre-weatherization data resulted in an additional 7 customers having results that passed the reliability criteria.

3. Those that increased their consumption had homes that were not in as great a need for the weatherization services, so the measures provided less savings.

On average, those that decreased their consumption did so by 2,908 kWhs annually. However, the consumption stream for non-participants over the same period increased, widening the gap between participants and the comparison group. After adjusting for the comparison group, savings increased, on average, to 3,141 kWhs annually. However, a number of participants (26%) increased their consumption after weatherization. This is normal in any given population; however, it is significant that one in four of the participants increased their consumption after they were weatherized. Those that increased their consumption did so by an average of 3,128 kWhs annually after adjusting for the comparison group. Overall, of the 100 participants analyzed, the mean savings per weatherized home is 2,052 kWhs annually.

Table 3. Annual Energy Savings

	Increased Consumption	Decreased Consumption	All Participants
Number of Participants	26 (26%)	74 (74%)	100
Number of Comparison Homes	56 (52%)	51 (48%)	107
Mean Change in Annual kWh Consumption of Participants	+3,361	-2,908	-1,819
Mean Percent Change in Annual kWh Consumption of Participants	+28.9%	-17.4%	-11.8%
Mean Change in Annual kWh Consumption of Comparison Group	+2,118	-1,802	+233
Mean Percent Change in Annual kWh Consumption of Comparison Group	+14.7%	-11.8%	+1.6%
Mean Change in Annual kWh Consumption of Participants Adjusted for Comparison Group	+3,128	-3,141	-2,052
Mean Percent Change in Annual kWh Consumption of Participants Adjusted for Comparison Group	+26.9%	-18.8%	-13.4%

As noted above, increases in consumption are normal and appear in every study of this type. After weatherization, some participants feel that they can adjust the temperature in their homes to a more comfortable level without an increase in their utility bill. Others may have had changes occur in their homes that are not related to heating or cooling, such as additional occupants in the home, or the addition of medical equipment or appliances such as televisions or computers.

Comparison to Blower Door Test Results

Results for the blower door tests conducted before and after weatherization were provided to TecMarket Works for 235 participants. In this section of the report we examine the blower door test results, and compare that data to the energy impact evaluation results.

Table 4 below presents the summary of findings of the blower door tests and the PRISM results among the participants. For those 100 participants that had reliable results from the PRISM analysis, the CFM results dropped an average of 30.8% after weatherization, and their energy consumption dropped an average of 13.4%. If we look at only those PRISM participants that had energy savings, the energy savings is an average of 18.8%, and the change in CFM increases slightly – and insignificantly – from 30.8% to 31.4%.

Table 4. Blower Door Test Results

Group	n	% change in CFM	% change in annual kWh consumption
All Participants	235	-33.3%	-
PRISM participants	100	-30.8%	-13.4%
PRISM participants with energy savings	74	-31.4%	-18.8%

Correlations

Surprisingly, there is no significant correlation to be found between blower door test results and energy savings in either of the PRISM groups listed in Table 4. For the PRISM participants, the correlation factor of energy savings and CFM the percent change in CFM is 0.19. For PRISM participants with energy savings, the correlation factor of energy savings and CFM the percent change in CFM is 0.20. Correlation factors for CFM reduction to costs of weatherization or number of measures installed are even lower at 0.02 for both. This analysis, from this limited population, indicates that there are only limited benefits in conducting blower door tests in order to achieve weatherization induced energy savings.

Correlation with Participants That Only Received Infiltration and/or Door Measures

There were two participants that received only infiltration measures and that also had reliable PRISM results. This sample was too low for a regression analysis, however an examination of these two participants indicate that as infiltration is reduced, savings increase. Table 5 presents the results of the infiltration reduction for the two participants.

Table 5. Savings of Participants Receiving Only Infiltration Measures

	Reduction in CFM	Normalized Annual Savings
Participant A	10.4%	426 kWh = 1.9%
Participant B	5.2%	262 kWh = 1.42%

When we expand the analysis to include participants receiving both infiltration and door measures (11 participants) the correlation between the blower door test results and the electric energy savings increases to .30, indicating a somewhat positive relationship. This low correlation is because 3 of these participants increased their consumption after weatherization while 8 decreased their consumption. Looking at only the 8 participants who decreased their consumption provides a correlation between blower test results and kWh savings of .83, a strong positive relationship. Thus, for energy savers the relationship between the change in blower door test scores and savings is strong and positive, but not all participants who reduce CFM also save energy.

Comparisons Between Measure Groups

As described in methodology, the measures installed were placed into groups for analysis. These groups are listed are: Insulation, Infiltration, Hot Water Heater, Doors and Windows, HVAC, and Lighting and encompass all the measures listed in Table 1. Table 6 below presents the counts of measures installed in the 286 homes for which there was data. Counts are shown in total and by weatherization agency. Percents for each agency and measure group are also presented.

Figure 1 displays the percent of homes weatherized that received measures from each of the measure groups by the weatherization agency. Infiltration measures such as sealing, caulking, and outlet gaskets were the most common measures installed, with 87% of weatherized homes receiving those measures. The Economic Security Corporation (ESC) installed these measures in 98% of the 150 homes they weatherized, and they were also the most likely to provide these infiltration measures or services.

Table 6. Measures Installed

		Infiltration	Insulation	Doors and Windows	HVAC	Hot Water Heater	Lighting	Total
	Number of Homes:	**Counts**						
ESC	150	147	118	108	54	77	0	504
WCMCAA	10	7	6	4	1	0	0	18
OACAC	126	95	77	48	10	16	22	268
Total	286	249	201	160	65	93	22	790
	Percent of Homes:	**Percents**						
ESC	52.4%	98.0%	78.7%	72.0%	36.0%	51.3%	0.0%	
WCMCAA	3.5%	70.0%	60.0%	40.0%	10.0%	0.0%	0.0%	
OACAC	44.1%	75.4%	61.1%	38.1%	7.9%	12.7%	17.5%	
Total	100.0%	87.1%	70.3%	55.9%	22.7%	32.5%	7.7%	

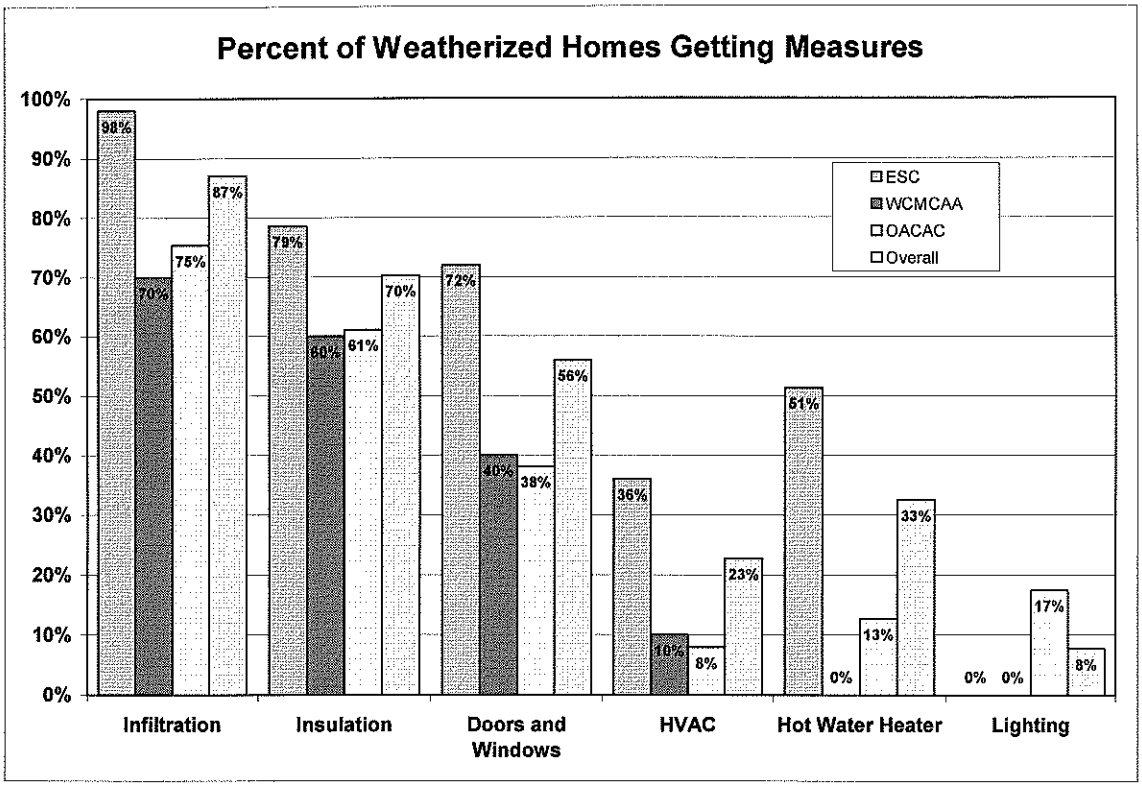

Figure 1. Percent of Weatherization Measures in Weatherized Homes

Costs of Weatherization

The amount of money spent on weatherizing a home ranged from a low of $48 to a high of $3,532. The average amount spent on weatherizing a home was $1,631. The three agencies were very similar in the mean amount spent on weatherizing a home. However, as homes were placed into one or more of the measure categories, differences in the mean cost of weatherization were revealed. As can be seen in Figure 2 below, those homes that received hot water heater services (which includes water heater replacement and hot water heater jackets), on average received a higher value for the total weatherization services received.

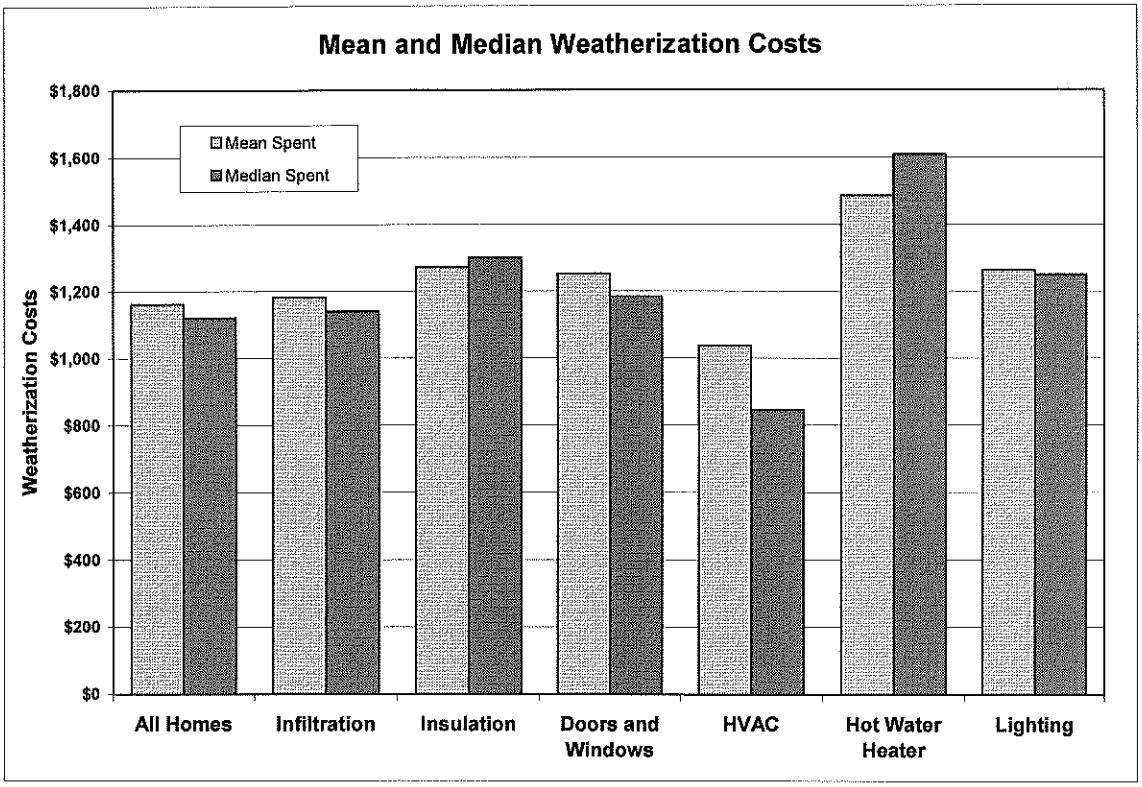

Figure 2. Costs of Weatherization

Energy Savings by Measure Group

Figure 3 below shows the mean annual energy savings by the homes that received the various measures. The 100 homes that had reliable data saved an average of 2,052 kWhs annually. As can be seen in Table 6 above, OACAC was the only weatherization agency to install lighting measures, and they only installed them in 17.5% of the homes they weatherized. The homes that received lighting upgrades had, on average, much higher energy savings. However, since there were a small number of homes receiving CFLs, this finding is not significant and should be viewed as an indicator of potential savings from CFLs.

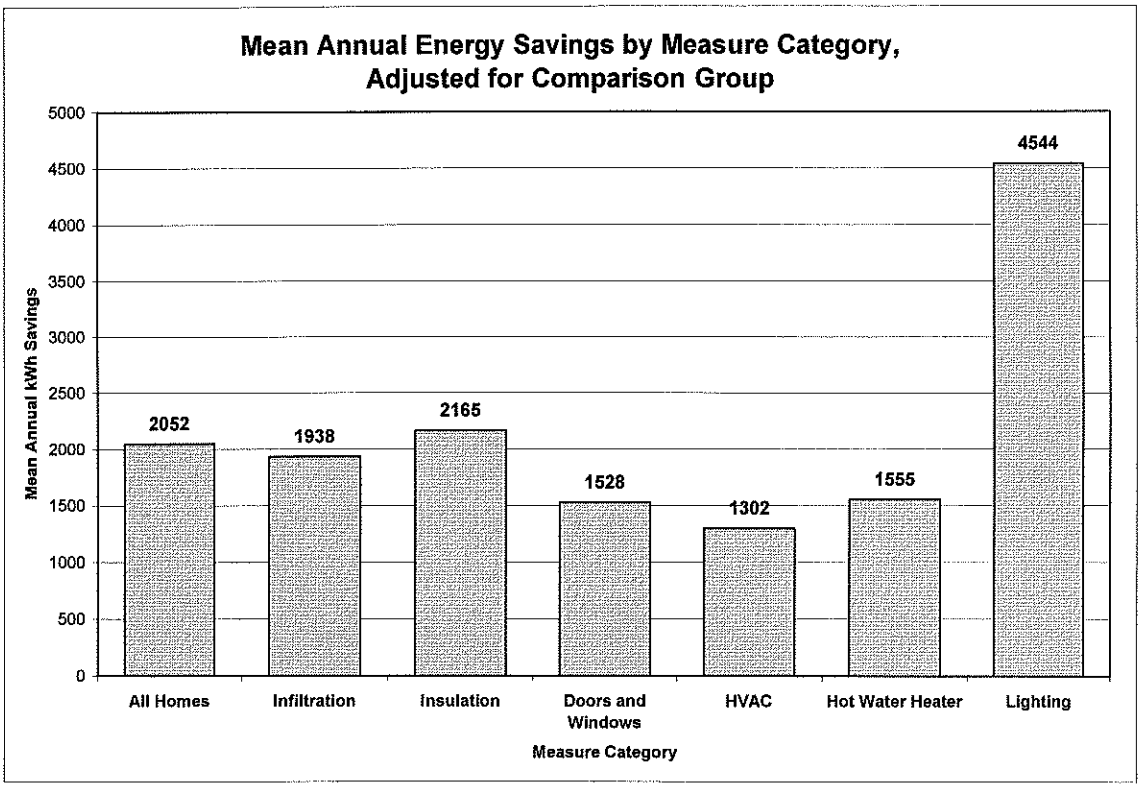

Figure 3. Mean Annual kWh Savings by Measure Group

Benefit Cost Tests

The total resource cost (TRC) test revealed a negative net present value (NPV) for the Low Income Weatherization Program. This indicates that, over a 15 year useful life, the avoided energy and demand savings were insufficient to recuperate the initial program cost of $226,360. Furthermore, a benefit cost ratio of less than one shows that this program is not economical from the combined perspective of the utility and the ratepayers.

The societal test, like the TRC test, produced a negative NPV for the Low Income Weatherization Program. Since the societal test aims to represent the program from the point of view of the society as a whole, it attempts to capture all benefits and costs, including externalities. What this means in this case is that on top of the avoided energy and demand savings incorporated into the TRC test, avoided environmental damage costs were factored in. However, all of these savings combined were not enough to offset the initial cost of $226,360 over the span of a 15 year useful life. Thus the benefit cost ratio remains less than one, and the program is deemed not cost effective from a societal perspective.

Because the Low Income Weatherization Program was a free program and the participant test does not take into account the impacts on the utility, the participant test showed a positive NPV. With the cost to the participant equaling zero, the benefit cost ratio is, by definition, undefined. This means that the benefits to the participant are infinitely greater than the costs. Therefore, this program is cost effective from the perspective of the participant.

Table 7. Benefit Cost Test Results for the Low Income Weatherization Program

Test	Net Present Value	B/C Ratio
Total Resource Cost Test	-$129,593	.43
Societal Test	-$115,957	.49
Participant Test	$211,455	-

Table 8. Parameter Values for Benefit Cost Tests

Parameter	Value
Number of Participants	100
Project Life	15
Project Analysis Year 1	2007
Avg. kWh/Part. Saved	2,052
Utility Project Cost	$226,360
Incentive Cost	$0
Participant Cost	$0
Utility Discount Rate	7.80%
Societal Discount Rate	4.72%
Participant Discount Rate	5.00%
Escalation Rate	2.50%

Final Report

An Evaluation of the Commercial & Industrial Rebate Program

Results of Process and Impact Evaluations

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Executive Summary

About This Report

This report presents the results of process and impact evaluations of Empire Electric's Commercial & Industrial Rebate (C&I Rebate) Program. This program's primary goal is to save energy by providing financial incentives to Empire District Electric's C&I customers through a rebate for high efficiency improvements. These improvements can be either prescriptive or custom in nature. The program is expected to lower the participants' utility bills and also to reduce peak demand. This evaluation focuses on participants that received a rebate between June 2007 and May 2009.

Summary of Findings

1. The incentive rebate is capped at $20,000 per year, per customer. This means that the customer can do the same measure during the second year of their participation, such as completing a lighting project in another part of the plant. However, it also means that participants who have significant savings potentials may be forced to delay their projects, waiting for Empire's rebate period requirements to pass. This restriction can slow savings for customers with large savings potentials unless all of the portfolio's allocated funds are spent each year. This can result in non-acquisition of cost effective energy resources for Empire's customers that must be provided with higher cost conventional supplier. This rule, while helping to stretch resources over the program period, essentially increases costs to the program and to the customer and slows acquisition of cost effective resources.

2. The majority of the customers that were surveyed learned of the program from their contractors or electricians, or from an Empire employee directly. Only 2 out of 39 customers that we surveyed said that they learned of the program through a direct mailing from Empire.

3. Thirty-three of the customers surveyed (85%) indicated that the rebate was the primary or an important reason for the decision to install the energy efficient option.

4. The customers have a high level of satisfaction (9.08 out of 10) for the program overall.

5. The savings from the C&I Incentive Program are summarized in the table below. More details can be found in Impact Analysis Results.

Program Element	Claimed Savings		Realization Rates		Evaluated Savings	
	kWh	kW	kWh	kW	kWh	kW
Custom lighting	3,514,049	493	1.10	0.97	3,848,013	479
Custom other	436,783	14	0.40	0.85	175,880	12
Prescriptive lighting					142,273	39
Prescriptive HVAC					5,545	3
				Total	4,171,711	532

Recommendations

TecMarket Works and Building Metrics have the following recommendations for the C&I Rebate Program:

1. Empire should consider changes to the energy audit rebate structure to increase the benefits of participation for potential large savers. The rebate levels can be calibrated to achieve cost effective energy resources. At the current time, the program provides a 50% rebate on audit costs, but limits per-customer rebates to $300 (or $500 for customers with space over 20,000 square feet). C&I audits are costly. For many of the participants the rebate does not cover a significant part of the audit's cost. When audit costs are more than $600 ($1,000 for larger facilities), the incentive begins to lose its appeal. For many medium and large facilities the incentive can be less than 5% of the cost of a high quality investment-grade energy audit. Currently only about 5% of the participants utilize the audit rebate. Empire should consider a scaled audit rebate structure calibrated to the square feet of the participating facility or other size metric (kW/kWh). However, increasing the rebate for an audit also means increasing the risk that the expenditures for the audit may not be accompanied by a corresponding increase in energy savings. As a result, Empire should consider rebates for medium and large customers over a specific size (square feet of facility or kW or kWh) that must be accompanied by a financial commitment from the participant to take at least some of the recommended actions over a specific period of time to cost effectively recover the added incentive. This must be well calibrated so that the cost of the rebate for the audit and any installed measures that, as a package, must be cost effective. This would mean that as a customer commits to allocating an increasing budget for energy efficiency actions, the rebate structure can be correspondingly increased up to a maximum level that does not allow the projects to not pass a cost effectiveness test. If done well, the package can be expected to increase participation, increase savings and meet cost effectiveness requirements. This approach should only be considered if there is sufficient room between the measure rebates and the expected savings to allow an increase in the audit rebate levels.

2. Add the Large Power rate class to the list of qualified customers. Currently, the largest customers are not eligible to participate. If they are included, potential participation and energy savings from the program will likely dramatically increase.

3. Develop a technical reference manual to guide energy savings calculations submitted by contractors and applicants. The manual should provide standard values for engineering calculations such as lighting fixture watts, heating and cooling full-load hours by building type, and other reference data to assist customers and contractors in preparing their applications.

4. Add LED lighting to the measures covered by the prescriptive program.

5. Some customers that apply for a rebate don't know how to calculate estimates of the savings. This is something that AEG could likely do.

6. Add contact information for an Empire or AEG staff person on the application so that applicants with questions can easily find this information if they have questions about the program or the application.

7. Add a statement on the application that makes it clear that the rebates are only to cover measures that would not be installed without the rebate to offset the installation/measure cost.

Introduction

This report presents the results of a process and impact evaluation of the Commercial & Industrial Rebate (C&I Rebate) Program. The evaluation also surveyed 39 participants that received a rebate for high efficiency improvements at their facilities that were either prescriptive or custom in nature.

Program Description

Empire Commercial & Industrial Rebate Program provides rebates to customers who purchase high-efficiency equipment for their facilities. An audit is not required to participate in these programs, but is a component of the program. Applications must be pre-approved by Empire (through AEG) before equipment is purchased and installed. There are two rebate programs, custom and prescriptive, each one designed to fit the needs of different types of customers and measure applications.

Custom Rebate for Retrofits

The Custom Rebate Retrofit Program provides customers with financial incentives for installing qualifying electric savings measures including HVAC systems, motors, variable speed drives, lighting, building controls, and pumps. Customers may apply for individual or multiple efficiency measures within the same facility.

Small Commercial Building Service (CB) or Small Commercial Total Electric Service (SH) Customers are first evaluated to determine eligibility for the Prescriptive Rebate Program. If eligible, prescriptive rebates will apply.

All custom rebates are individually analyzed to ensure that they pass the Societal Benefit/Cost Test. Any measure that is pre-qualified (evaluated prior to being installed) must produce a Societal Benefit/Cost test result of 1.05 or higher. In addition, the project's incremental payback must be greater than two years.

A customer can submit multiple rebate applications for different measures. Each individual measure is evaluated on its own merits. Similar measures that are proposed in different facilities or buildings will be evaluated separately. Customers are limited to $20,000 in total incentive payments per year.

Custom rebates are calculated as the lesser of the following:

- A buy down to a two year payback
- 50% of the incremental cost
- 50% of lifecycle avoided demand and energy costs

Prescriptive Rebates

Pre-qualified prescriptive rebates are designed for commercial customers served under Empire's Small Commercial Building Service (CB) or Small Commercial Total Electric Service (SH) rates. Rebates are available for a variety of common energy savings technologies for both new construction projects and retrofits. The specific categories, rebate levels and performance levels

are outlined by end use below. Efficiency measures that do not qualify under the Prescriptive Rebate Program may be submitted to the Custom Rebate Program.

Lighting

Whether for new construction projects or major renovations, fluorescent linear lighting dominates the commercial lighting market, particularly in offices, schools, and some retail applications. The four-foot 32-watt T8 lamp combined with an electronic ballast has essentially become standard practice. As a result, rebates are available for specifying lamps and ballasts that exceed the performance levels of the standard T8 lamp system. Additionally, rebates are offered for reducing lighting power density below the maximum thresholds specified by energy codes.

Existing lighting systems can be eligible for rebates by replacing with new fixtures that exceed current standard practice. The existing market for fluorescent lamps is a mixture of T8 lamps and older T12 lamps. The replacement of these older systems can provide energy savings but requires replacement of both lamps and ballasts. The following rebates are available for early replacement of lamps and ballasts in existing systems.

High Performance T8 Fixtures

High Performance T8 (or "Super T8") lighting is an option that can be used to retrofit T12 or standard T8 lighting in existing facilities, or can be used instead of standard T8 lighting in new facilities. High Performance T8 fixtures must meet specifications set by the Consortium for Energy Efficiency [CEE] including, but not limited to, the following:

- Lamps must have 90 lumens per watt [LPW] or greater
- 88 LPW for programmed start ballasts lamps must have high color rendering index [CRI], greater than or equal to 81
- Electronic ballasts must be instant start or programmed start meeting CEE performance

Rebates are as follows:

- $20 for 2- lamp fixtures
- $30 for 3- lamp fixtures

Standard T8 lamps and ballasts

This option is only available for the replacement of existing T12 systems. Both lamps and ballasts must be replaced to be eligible.

Rebates are as follows:

- $2 per lamp
- $10 per ballast

Lighting Power Density

For common building types where the above prescriptive lighting options do not apply, a prescriptive rebate may be available based on Lighting Power Density. The overall lighting

power must be reduced by at least 25% below the requirements of the local energy code or ASHRAE Std. 90.1

Rebates are as follows:

- $1 per watt per square foot reduction

High Intensity Fluorescent
High Intensity Fluorescent lighting is designed to replace high intensity discharge [HID] fixtures in high bay and other applications such as gymnasiums, warehouses, and parking lots. These fixtures must have the following characteristics: use T5 or T5HO lamps with electronic ballasts use at least 4 lamps per fixture the fixture must be at least 75% efficient

Rebates are as follows:

- $50 per fixture

Pulse Start Metal Halide
For HID applications, rebates are available for lamp and ballast replacements in typical 400-watt high bay applications. The lamp must be rated as pulse start with a pulse start ballast. Lamp wattage must be either 320 or 360 watts as a replacement for 400-watt metal halide or high-pressure sodium.

Rebates are as follows:

- $50 per fixture

Lighting Controls
Rebates are available for occupancy sensors; either switch replacements or remote/ceiling mounted that use ultrasonic or passive infrared technology. Dual technology sensors are also eligible. Rebates for switch replacement sensors are limited to small rooms less that 250 ft^2.

Rebates are as follows:

- $20 for switch replacement sensors
- $50 for ceiling/remote mounted sensors

Air Conditioning
Rebates are available for exceeding the minimum performance requirements of local energy codes [or ASHRAE Std. 90.1] for unitary packaged and split system air conditioners typically found in small commercial applications. The performance levels required vary by type and size but are consistent with the high-efficiency standards set forth by CEE.

Type and Size	Minimum Performance	Rebate
Single Phase Unitary or Split Systems < 5.4 tons	14.0 SEER	$92 per ton
Three Phase Unitary or Split Systems < 5.4 tons	13.0 SEER	$92 per ton

Unitary or Split Systems >5.4 tons and <= 11 tons	11.0 EER	$73 per ton
Unitary or Split Systems >11 tons and <= 20 tons	10.8 EER	$79 per ton
Unitary or Split Systems >tons and <= 30 tons	10.0 EER	$79 per ton

Motors
Rebates are available for installing motors that exceed minimum performance requirements of local energy codes [or ASHRAE Std. 90.1] for typical applications of three phase Design A and Design B motors. Rebates are available for both Open Drip Proof [ODP] and Totally Enclosed Fan Cooled [TEFC] motor types. Motor efficiency must meet or exceed that which is classified as NEMA Premium. These performance levels are provided in the table below.

Motor Size (hp)	ODP	TEFC Incentive ($/Motor)	NEMA Nominal Efficiency
1	85.5	85.5	$50
1.5	86.5	86.5	$50
2	86.5	86.5	$60
3	89.5	89.5	$60
5	89.5	89.5	$60
7.5	91.0	91.7	$90
10	91.7	91.7	$100
15	93.0	92.4	$115
20	93.0	93.0	$125
25	93.6	93.6	$130

Rebates are limited to the most common motor speed, 1800 rpm [nominal]. Larger motors or other motor speeds may be eligible under the Custom Rebate Program. Any efficiency measure not contained in this list may be submitted to the Custom Rebate Program.

Evaluation Methodology

The study methodology consisted of three parts. These are:

1. A process evaluation consisting of in-depth interviews with the program management.
2. A facility manager survey.
3. An energy impacts analysis using engineering algorithms.

Process Evaluation Methodology

The process evaluation included a design and operations review. This review consisting of five management interviews to discuss various aspects of the program, such as the level of the rebates and types and models of equipment offered. The interview instrument for the management interview can be found in Appendix A: C&I Rebate Program: Management Interview Instrument.

Participant Survey Methodology

TecMarket Works was provided with the contact information for 48 unique C&I customers that participated in the C&I Rebate program. We attempted contacts with each of the facilities a maximum of 7 times before terminating attempts in order to maximize the survey completion

rate for this study. TecMarket Works was, able to achieve a high completion rate by completing surveys with 39 of the 48 facility managers, for an 81% completion rate.

We spoke with facility managers about a variety of topics, including but not limited to:

- Their intentions in upgrading the equipment and the influence of the program in their decision
- Their satisfaction with various program aspects
- Their ideas for increasing participation

The survey employed can be found in Appendix B: C&I Rebate Program: Facility Manager (Participants) Interview Instrument.

Energy Savings Analysis Methodology
The impact evaluation used an engineering-based approach to estimate program savings. The impact evaluation effort consisted of the following steps:

1. Analysis of program participation tracking system data
2. Development of engineering estimates for lighting measures
3. Development of prototypical building energy simulation models for HVAC measures
4. Simulation of HVAC measure energy savings
5. Calculation of gross program energy and demand savings

An extract from the program tracking database covering paid projects from June 2007 through the end of May 2009 was received from Empire. These data were analyzed to identify the type and numbers of measures installed by participants by program element. These data were used to define the methods used to conduct the impact evaluation.

The analysis was broken down into prescriptive and custom program elements. Within the prescriptive program, lighting and HVAC measures were analyzed[1]. Within the custom element, the projects were segmented into lighting and "other" categories. A sample of lighting and other projects was selected and formed the basis of the analysis.

Prescriptive Lighting. Engineering algorithms were used to estimate the savings for prescriptive lighting measures. The measure description and baseline assumptions were reviewed, and fixture wattage assumptions developed for the base case and measure. Participants were assigned to building types, and standard operating hour assumptions by building type were used to estimate energy savings.

Prescriptive HVAC. Participants were assigned to a standard building type, and building energy simulations using the DOE-2.2 simulation model were used to estimate energy saving according to the equipment efficiency and building type. The unit energy savings from the simulations were applied to the rebated equipment listed in the tracking data.

[1] During the program evaluation period, no applications for motor rebates had been processed.

Custom Lighting. A sample of lighting projects was selected, and the project files and documentation for the projects was received from Empire. Each participant in the sample was contacted by phone to get their lighting system operating hours. The savings for each project in the sample was recalculated using a standard fixture watts table and the revised lighting operating hours from the phone survey.

Custom Other. A sample of remaining custom projects was selected, and project files were obtained from Empire. The selected projects were either HVAC efficiency or HVAC controls measures. Each customer was assigned to a standard building type, and building energy simulations using the DOE-2.2 simulation model were used to develop energy savings estimates for the sampled projects.

Energy savings were added across all of the prescriptive lighting and HVAC measures. For the custom program, the savings estimated for the sampled projects were used to estimate a sample realization rate, defined as the ratio of the evaluated savings to the savings in the tracking database. A separate sample realization rate was estimated for custom lighting and custom other projects. The sample realization rate was applied to the remaining custom projects in the tracking database to estimate the total program saving.

Evaluation Findings

This section of the report presents the detailed evaluation findings for the C&I Rebate Program.

Process Evaluation

This section presents the results from the in-depth management interviews performed with five people who work closely with the program:

1. Sherry McCormack, Energy Efficiency Coordinator, Empire District Electric
2. Kelly Chenoweth, Senior Energy Services Representative, Empire District Electric
3. Ralph Nigro, Vice President, Applied Energy Group
4. Huei Wong, Applied Energy Group – calculates the C&I rebates
5. Carla McMillan, Applied Energy Group – processes C&I applications

Program Objectives

Both of the program managers have a clear vision of the objectives of the C&I Rebate Program. The objectives are to cost effectively provide energy resources by raising awareness of energy efficient opportunities in the C&I sector and to assist Empire's small C&I customers to move to more energy efficient processes or systems so that they can better utilize the energy supplied to them and reduce their operating costs.

Applied Energy Group (AEG) is contracted by Empire to process the applications and calculate the rebates for the program. TMW interviewed three key contacts at AEG about the C&I Rebate Program, and all three of them also have a clear understanding of the program objectives. They indicated that the objective of the C&I Rebate Program is to save energy and move the market towards more energy efficient measures (primarily lighting, HVAC, and motors) and to help Empire's C&I customers reduce the incremental cost between standard and high efficiency equipment. By helping Empire's C&I customers move towards energy efficiency, this helps Empire avoid building capacity and also improves customer relations.

Program Utilization

The most common measure being installed through the program is energy efficient lighting, and managers would like to see more HVAC and motors rebated. In addition, the C&I Rebate program has a facility energy audit component, but most customers are not taking advantage of this service. The C&I Rebate program will rebate 50% of the audit costs if at least one of the recommendations in the audit report is implemented (and the report's recommended actions measures themselves may qualify for rebates as well).

Currently, only about 5% of participating customers are obtaining an audit of their facilities. This may be due to the facility size limits in place for the audit rebate. The C&I Rebate program will rebate 50% of the audit cost up to a cap. The maximum rebate is $300 for facilities under 20,000 square feet in size, and $500 for buildings that are over 20,000 square feet. An audit of a building that has 20,000 square feet would likely cost more than $600. In this case the customer would receive a rebate that is less than50% of the audit cost. For buildings of this size, an audit would cost more than $1,000. While the program managers did not offer suggestions for what the rebated amount should be set at, at least one manager thinks that the audit costs are double

what Empire presumed they are when the rebate amounts were set, and that this under-estimation of audit costs may be a limiting factor to the number of customers that are willing to pay for an audit.

Program Rebates
The managers and key staff all feel that the measure-specific incentives offered are set at the right amount to help move the C&I customers to more energy efficient options. They report that the feedback from the C&I customers regarding the incentives has all been very positive.

The incentive rebate is capped at $20,000 per year, per customer. This means that the customer can do the same measure during the second year of their participation, such as completing a lighting project in another part of the plant. However, it also means that participants who have significant savings potentials may be forced to delay their projects, waiting for Empire's rebate period requirements to pass. This restriction can slow savings for customers with large savings potentials unless all of the portfolio's allocated funds are spent each year. This can result in non-acquisition of cost effective energy resources for Empire's customers that must be provided with higher cost conventional supplier.

In cases where a customer needs to reapply for a second rebate for the same upgrade or project the customer's timeline for their project becomes influenced by the program's rebate rules. While the program's managers do not feel that allowing multiple rebates for the same project or the same technology over subsequent years does not increase freeridership, it can mean that the programs rules are acting to control or influence project timing. If a customer must delay a project, and reapply for the rebates, this means that the program must process another application, increasing program costs and the costs to the customer for the new application. This rule, while helping to stretch resources over the program period, essentially increases costs to the program and to the customer and slows acquisition of cost effective resources.

This condition is experienced because of the low funding levels for the program compared to the savings that can be achieved. Essentially the ability of the program to acquire energy savings is greater than the program budget will allow the savings to be acquired. The incentive budget for the second year of the program was set at $214,000. With this limit on the amount of incentives, the managers need to carefully manage their resources over the budget year. Managers report that there have been times in which the program's operational funds for administration had to be paid to participants who had approved project in excess of the program's incentive budget.

As a result of doing this, the program has been able to request and receive more money for incentives to cover additional allocations. For example, the incentive funds were increased to $264,000 for the third year of program operations.

Even though the funds for the incentives are being exhausted (or surpassed), the number of customers participating is lower than anticipated. Empire had expected more participants leading to a more serious shortfall. However, it may well be the program limits on the audit payments and the cap on incentive payments to individual customers that is limiting participation. It is not unusual for demand for program resources to out-strip the supply of those resources.

Program Technologies

The technologies covered by the C&I Rebate program incorporate a broad-based perspective that allows any energy efficiency improvement that has a payback of over two years to be partially rebated. AEG, who processes the applications and calculates the rebates, has been receptive to analyzing any project that cost effectively saves energy. The most commonly installed technology is lighting. Lighting upgrades are typically easy for the customers to implement, and, likewise, it's easy for them to process the program application. While most energy efficiency programs in the United States focus on lighting measures because they are especially cost effective for the program and the customer, commercial programs are largely dominated by lighting rebates typically covering from 60% to 80% of acquired savings. Moving to measures in addition to lighting will require a substantial push to acquire industrial participants. However, the rebate caps may limit the success of industrial customers who often need to exceed the rebate caps to make energy efficiency projects worth diverting resources from their core business needs to energy saving upgrades.

The prescriptive rebates as they are now structured are well suited for most small C&I customers, while the custom rebates are designed for the larger customers who have projects that do not need large rebates to move forward. The prescriptive portion of the program works well, but there are a few changes that the program managers would like to see. One change is that there is at least one new technology that is being used in the market that should be considered for inclusion in the prescriptive measure lists. That measure is LED lighting. According to the program managers these should be added to the program's prescriptive offerings. At this time, projects that use LEDs are considered custom projects. The second change suggested by the program's managers is that some of the managers would like to see is the eligibility requirements change for larger companies. Currently, the prescriptive portion is only available to two service rates (CB and SH). These are the smaller C&I customers. According to the interviewed managers, extending the prescriptive rebates to all classes would likely increase participation and increase the amount of cost effective energy that could be obtained if there were enough program resources to cover these acquisitions. It is highly possible that the current rebate and participatory rules are limiting the amount of energy savings that can be acquired by Empire's non-residential customers, increasing energy costs for all customers while limiting carbon savings that can be achieved. Because energy efficiency often provides the least-cost energy supplies, program operational rules and funding sources should be matched to the achievable savings that can be acquired within the service territory if customers are to obtain the most cost effective energy supplies.

Program Operations

C&I customers that are interested in receiving a rebate for an energy efficiency upgrade must submit an application before they proceed with the project. This is a reasonable requirement because if they proceed without the rebate, then there is no need for the program's funds to be spent on those projects. The savings are already being acquired. The rebate application and program information can be found on the Empire web site. In addition Empire has a call center whose staff have received training on taking and processing program-related calls regarding energy efficiency. These calls are then transferred to either Sherry McCormack or Kelly Chenoweth who will answer the customer's questions and guide them to the online resources

where they can find the information they need to understand the program and consider participating.

All projects are required to obtain pre-approval from AEG. Most customers understand this requirement and it is well displayed on the application and on the program's web site. However, there have been a few participants who have not understood this requirement and have proceeded on their own. However, Empire does not enforce this rule. All of the applicants that did not receive the required pre-approval were approved by Empire to maintain good customer relations. It is not clear if these customers would have implemented the installed measures if they thought they would not obtain the rebates. However, the fact that these customers took the program recommended actions without getting an assurance of receipt of the rebates suggests that some or most of them would have taken the action without the program, essentially meaning that the program spent resources to acquire savings that were already acquired.

The applications received are sent to AEG for processing. The customers send information to the program administrator detailing what they plan to install, information about their current equipment, and estimated project costs. AEG then assesses the application to see if the project meets the program's participation criteria. If the project is pre-approved, AEG notifies Empire and Sherry McCormack sends the applicant a letter with an estimated rebate amount that is based on the project costs and the estimated savings. If the project plans change, the rebated amount may be adjusted during final calculations by AEG if the participants inform AEG of that change. After project completion, AEG finalizes the process by sending all application materials and rebate calculations to Sherry McCormack, who tracks program participation and expenditures, and requests that a rebate check be sent to the customer.

The rebate application is eight pages long, with most of the text presenting participation terms and conditions. The application is clear and straightforward. However, the paperwork can be daunting for some customers, especially for those running smaller operations. However, the customers can call Empire for assistance with the application process. In some cases participants have their contractors or suppliers complete or help with the application.

Program Participation and Promotion

Empire does the promotion for the program in-house through sending qualifying C&I customers oversized direct-mail post cards (8.5x4") on sturdy stock, and through advertisements in business journals and local newspapers. In addition contactors are also active marketing agents for the program. Contractors and suppliers are also program-marketing agents for the program because they educate customers as well as the installers performing the upgrades about the program, helping to spread program information into the market. The contractors have been very helpful as marketing agents and have helped the program acquire participants.

Empire's program managers also attend trade shows "about four times a year" to talk about the program with a wide range of contactors, customers and other interested parties. Current program staffing levels limit additional market push efforts by the program manager. For print and media promotion, Empire utilizes the services of its communications department and follows their guidelines for promotion. In addition, Empire employs an outside marketing agency for development of corporate communications. While the marketing firm does provide some

recommendations for program marketing efforts, the primary role of the marketing firm is to focus on the company's marketing and customer relations needs. The program is a very small component of the company's operations and at the current size does not merit nor can it afford the concentrated attention of a marketing firm.

Opinions vary about the level of participation compared to the potential participation. AEG's experience is that all programs have ups and downs in participation that depend on interest and economic conditions. There can always be more marketing provided to increase participation, however, AEG considers the marketing efforts of the program manager and the current approaches to be adequate given the program funding levels provided. AEG reports an increase in applications after the program manager holds a marketing event, and AEG does not want to over-subscribe the program and use all of the program's funds up in a few months. As a result, at the current funding level, it is important to throttle the marketing efforts to match the annual budget and operational period so that the demand for the program does not exceed the allocated budget.

According to AEG, "Empire is doing an excellent job of marketing the program". AEG also reports that while additional program marketing can increase participation, that participation will require a program budget to support that participation.

Ideas for Increasing Participation

In order to qualify for the prescriptive C&I program, the customer has to be in a qualifying rate category. The first step in the application review process is for AEG to verify the rate code to confirm eligibility for the prescriptive program component. If the applicant is a large C&I customer, they are automatically placed into the custom measure category even if all measures are prescriptive. AEG feels that the trade allies have gotten used to this and that the program is operating smoothly, however they think it might be best to use prescriptive rebates regardless of the customer's rate code for all lighting projects. Empire program managers agree with this point.

An additional change to the program concerns the rate class for participants. The large power users (classified as "LP") are not currently qualified to participate, limiting energy savings from this important group of customers. Likewise, these large customers have attempted to participate in the program causing Empire to deny their participation. These customers are not happy that their class has been restricted from participating because of a regulatory decision that excludes their participation. Empire's managers would like to see this change. According to regulated stipulations, all Empire programs have to pass the RIM test at a 1.05 level. Large Power users do not pay or participate in Empire's energy efficiency program. This condition was successfully added to the program's operational rules by an intervener representing large power users. However, this condition essentially limits the amount of savings that can be achieved by Empire. Past history in the energy program field indicates that large amounts of very cost effective savings can be achieved by the large customers who participate in energy efficiency programs. To exclude these customers reduces the cost effectiveness of the program and limits the amount of energy that can be saved. This restriction also results in increased carbon emission release by requiring the burning of fossil fuels to provide the power that is not saved.

By not acquiring all cost effective savings all ratepayers are harmed by having to generate additional power supplies or purchase them off the market at market prices.

Freeridership
The level of freeridership for this program is unknown. Discussions with AEG suggest that because the application must be approved before the retrofits are launched, freerider ship is low. However, they have never measured the level of freeridership and there is no participation screening process during the application approval process to weed out freeriders. The evaluation employed engineering approaches for estimating impacts that do not employ a freerider adjustment.

What Works Well
Below are the conditions that the Empire and AEG program managers report working well for the C&I Rebate Program:

- Having the AEG as a third party handling the paperwork and processing the applications works well. They have the technical knowledge and the manpower to process the applications and work with the customers, and they provide a quick application review and approval process. AEG talks to the customers individually in cases to resolve application issues, especially if it looks like the application should be rejected – AEG will call the customer to see if something can be done to the project to capture the energy savings and get the application approved.

- AEG evaluates all applications within two weeks, so there is little delay in energy efficiency upgrades and projects.

- The relationship with the program manager at Empire is really good, with quick responses and good communication.

- The incentive amounts help customers move forward with a project and they are provided with options in the application. They don't need a computer to apply, so "mom & pop" stores can and do apply for rebates.

What Doesn't Work Well
Below are some of the things that the managers report not working well and need to be addressed in the program redesign efforts.

- Some customers are not aware of the pre-approval, even though it is the first thing that they should read when they open the application.

- The rates classes for the program can result in some bad outcomes. There are large power users who want to participate, and their projects could really help to increase the energy savings as a result of the program.

- Almost all of the applications are for lighting. We need to move customers to add more energy efficient HVAC, motors, and other technologies such as VFDs and chillers.

- There have been cases where the volume of information we ask for has discouraged people from pursuing a rebate or possibly even the project. We need to simplify the application process.

- The heft of the paperwork required can be daunting and can be overwhelming for small operations if they are doing it themselves. Some customers don't know how to calculate estimates of the savings. I suggest they go to the vendor for help – they bear some responsibility if they are trying to sell something to that customer.

- Program marketing could be done a little more aggressively – but that depends on internal resources for this program and the marketing efforts at Empire.

- AEG suggests that all lighting measures should be prescriptive, and shouldn't require a custom application and a project assessment process for the larger customers. They believe that the custom projects and incentives should be reserved for things that are unusual. This change would simplify the participatory process for both customers and those processing the applications.

Facility Manager Survey Results

TecMarket Works completed surveys with 39 facility managers for an 81% response rate. The responses and analyses are presented below, and the survey instrument can be found in Appendix B: C&I Rebate Program: Facility Manager (Participants) Interview Instrument.

How C&I Customers Became Aware of the C&I Rebate Program

The majority of the customers that we surveyed learned of the program from their contractors or electricians (n=13), or from an Empire employee directly (n=11). Only 2 customers that we surveyed said that they learned of the program through a direct mailing from Empire. Their comments are below:

- My electrician or contractor told me about the program. (n=13)
  - I heard about it from two sources; Lloyd's Electric and a local electrician.
  - We were informed of the program through Orion Energy Services, contracted by CCE for all of our lighting.
  - I heard about the program from my cousin and son, both of whom are contractors in Joplin.
  - An employee of Ozark Energy Services told us about the program after doing lighting work for us.
  - I had a solar system installed at my home by a contractor, and he told me about the C&I rebate.
  - I learned about the rebate program from both an employee and a local electrician.
  - The gentlemen I work for and his contractors told me about the C&I program.
  - I learned of the program through an agency providing lighting installation.
  - I don't remember exactly how I learned of it, perhaps Ozark Energy?
  - I learned about the rebate through our contractor as well as an energy conference.
  - Ed's Electric told us about the rebates.
  - Allen Electric informed us about the rebates available through Empire's program.
  - We learned about the program through our Grainger sales rep, our maintenance supplier.

- Someone at Empire told me about the program. (n=11)
  - Empire Electric told me about the program
  - I heard about the program from both my utility company and maintenance department.
  - My utility company told me about the C&I Program.
  - An employee of Empire Electric told me about the program.
  - We had Empire conduct and energy audit in 2006. We asked what else could be done and were referred to the program.
  - I contacted empire regarding energy efficiency and was told about the program.
  - I learned of the program through a friend that works for Empire; he led me to a local contractor.
  - We learned about the C&I Program from our electric company.

  - We learned about the C&I Program from Sherry McCormack, Empire's coordinator in Joplin.
  - We learned about the program through an Empire employee that is one of our customers.
  - Our lighting company told us about the rebate program.

- An employee of mine told me about the program. (n=3)
  - I heard about the program from both my utility company and maintenance department.
  - I don't remember exactly how it came to my attention, but I believe one of my employees told me about it.
  - I learned about the rebate program from both an employee and a local electrician.

- I received information in the mail. (n=2)
  - I received a notice in the mail informing me of the C&I rebate program.
  - We heard about the program when we put on an addition and used energy management software. We received a card in the mail about the C&I program.

- I found the information online. (n=2)
  - I learned of the rebate program through the internet.
  - I learned of the rebate program through the internet, either a state department or other government website.

- Other sources (n=8)
  - I heard about the C&I program through our rebate company.
  - I learned about the rebate program from a co-worker.
  - Carl, our representative, made us aware of Empire's C&I program.
  - True Value of Joplin participated in the program and referred their contractor to us.
  - I learned about the rebate program from a consulting firm that searches for incentives and rebates.
  - Extos informed us about the rebate.
  - The owner of the hotel came across the program and suggested it to us.
  - We had participated in the program before and decided to do it again.

When they first heard of the program, 22 out of the 39 surveyed did not have enough information about the program, though this is to be expected when so many of them heard about the program from sources other than Empire. However, after they called Empire or looked on Empire's website, all of them were able to learn what they needed to know about the program and participated.

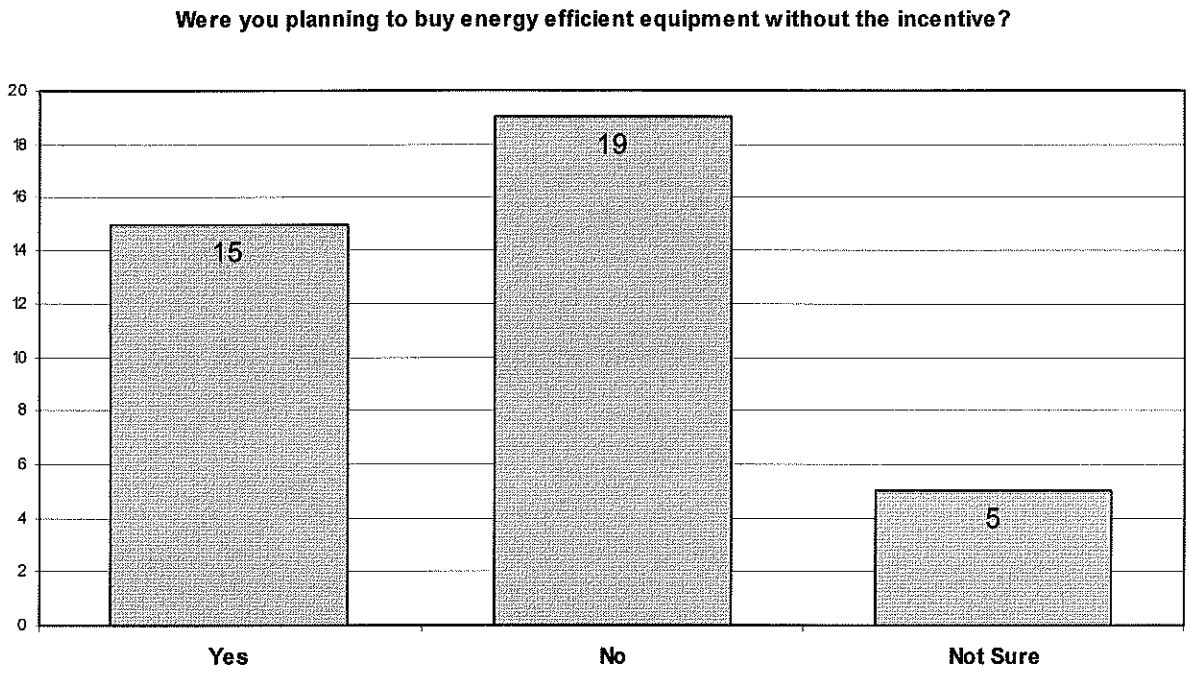
Program Application

Over half (63%) of the participants surveyed filled out the paperwork themselves, while the others had their contractors fill out the forms. Of those that filled out the application themselves, all but one found the application easy to understand. The customer was filling out the

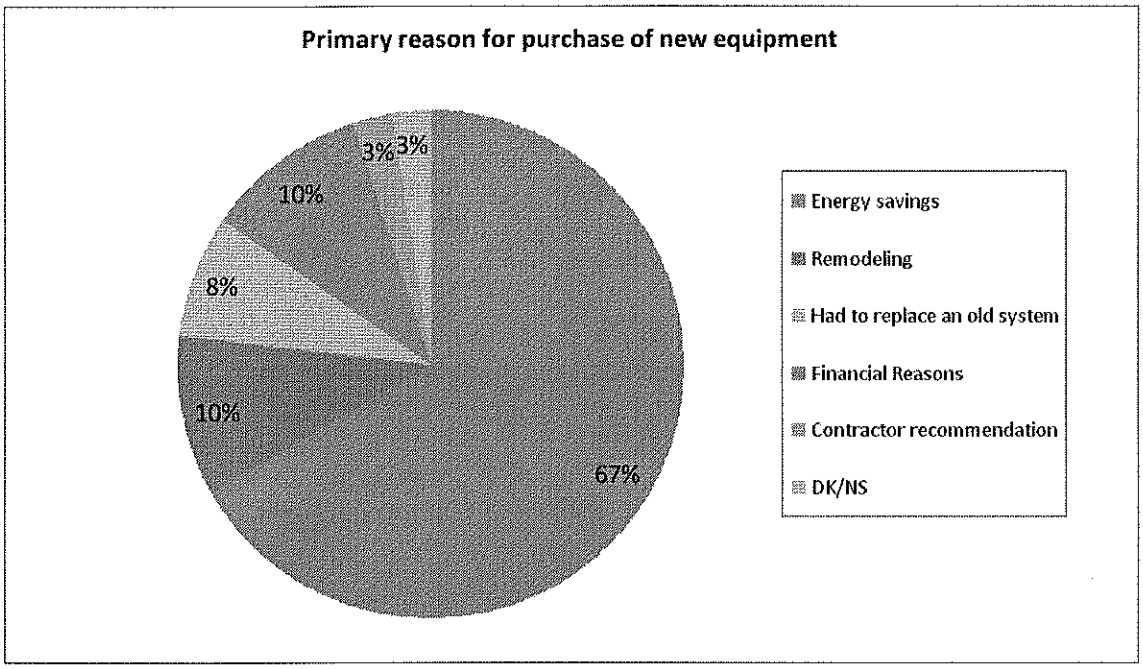
application for a custom project, and found that the form was "deceptively simple, a lot of information on the form and because it was a custom program it was more complicated". His suggestion was to make it clear who should be called if there are any questions on the application if there is a need for help.

Reasons for Participating

Out of the 39 customers surveyed, over half of them would not have considered the energy efficient option without the rebate. However, 15 (38%) of them would have considered the energy efficient option even without Empire's rebate.



The most commonly cited reason (67%) for purchasing the new equipment was for the energy savings. The other common reasons were tied to remodeling and the need to replace old equipment.



We asked the customers how important the incentive was in their decision to purchase the more energy efficient option. A very high percentage (85%) indicated that the rebate was the primary or an important reason for the decision to install the energy efficient option, as can be seen in the table below. Twenty-seven out of the 39 we surveyed (69%) said they would have delayed the project if the rebate had not been available. Seven of them said they would have delayed the project indefinitely (until the equipment needed to be replaced because of failure), and those that gave a timeline for delay, the average delay for the project would have been 13 months.

	Count	Percent
Primary reason	15	38.5%
Important reason	18	46.2%
Not so important	2	5.1%
Minor reason	2	5.1%
Not a reason	2	5.1%

Other Reasons for Energy Efficiency

We asked the customers if there were other reasons they decided to go with the more energy efficient option, their responses are below:

- We are trying to "go green" to set a good example for the school district.
- Long-term savings was another reason for purchasing the energy efficient products.
- Another reason I/we chose to buy the energy efficient equipment was to lower the monthly utility bills.
- Increasing the comfort level of our facility was another reason for purchasing the energy efficient equipment.
- We wanted to meet our corporate lighting standard.

- We wanted to reduce the maintenance costs.
- Our old system was troublesome, so improving ease of use/maintenance was also a reason for upgrading to the energy efficient system.
- I/we knew it was better in the long run to go with more efficient equipment.
- I/we decided that since our building was new, it would be more efficient in the long run to use higher efficiency products.
- A green initiative is going on throughout the district; the energy management system is a cornerstone and a great reason to go with high efficiency equipment.
- An additional reason we purchased the energy efficient equipment was to go green and save as much energy as we can.
- Another reason we chose to go with the higher efficiency equipment was because we had energy conservation in mind, and our old system was starting to become problematic.
- Energy savings.
- Utility savings was another reason we purchased the energy efficient equipment.
- I/we knew it was better in the long run to go with more efficient equipment.
- To improve capitol and hold down expenses.
- Cutting costs and lowering bills were two of the other reasons for purchasing the higher efficiency equipment.
- The quality of light is much better, that in itself was a good reason to purchase the higher efficiency equipment.
- Not only was the payback about 2 years, but I am also personally interested in efficiency, so the rebate combined with those additional reasons left me no reason not to purchase the high efficiency equipment.
- Energy savings and quality of light were additional reasons why we purchased the energy efficient equipment.
- Going green was a secondary reason for purchasing the high efficiency equipment.
- The quality of light is much better and was a good reason to purchase the higher efficiency equipment.
- An additional reason we purchased the high efficiency equipment was to add more value to the real estate for the future.

Ten out of the 39 (26%) surveyed customers have made additional energy efficient improvements to their facilities. Here is what they have done:

- We have also replaced an air conditioner with one that is more efficient.
- Other energy efficiency actions we have taken include white roofs, replacing windows, and lighting retrofits.
- We have added insulation and controlling the thermostats more wisely, which has produced a 25% savings in our utility bills, regardless of the rate increase.
- We have also switched to an energy efficient compressed air system and added light sensors, resulting in a 28% increase in savings.
- Another energy efficiency action we have taken includes behind the computer lighting, saving us $2000 per year.
- We've installed lighting and HVAC upgrades.
- We've installed a new roofing system, fans, and weather stripping.

- We installed programmable thermostats. (n=2)
- Additional efficiency measures include motion detectors and on an on-demand hot water heater, saving us 31% on our bill.

Suggestions for Increasing Program Participation
All the suggestions for increasing program participation involved an increase in program promotion or advertising. However, some had more specific suggestions, which are listed below.

- More advertising and promotion. (n=27)
    - Print brochures containing information about lighting and visuals, and distribute them to contractors.
    - Have the hardware stores advertise it.
    - Put out some public service announcements - in print, on the radio or on television.
    - Target non-profit groups, as they may not realize that they qualify.
    - Include advertisements for the program with customers' bills. Residential customers may inform their companies about the program.
    - More advertising, possibly in the bills, and show customers what they could save.

What Works Well
- What really works about the program is that is not only helps out the customers, but the utility company as well. It's a win-win situation.
- The program really works well because they do a good job and do it in a timely fashion.
- The program not only helps out the customers, but also Empire Electric by reducing demand placed on them. It also gives an immediate incentive to the customer.
- It's simple and effective, and the information is easy to find and accurate.
- It helps customers out immediately and also gives back in the long run.
- The program works because it gives an incentive to upgrade, it's easy to do, and the incentive comes quickly.
- The C&I program works well because it provides rebates.
- The program works really well because it's a win for everybody, saves money and helps the environment.
- It is very easy to participate in.
- It works well because it saves money and is based on total consumption, and a customized process is a better way to do the rebates.
- The program works well because it's simple.
- The program is effective because it helps people afford and embrace energy efficiency.
- It works well due to the simple fact that it helps customers cover the costs.
- It helps people lower their energy usage and adds more to your return on the investment.
- The payback is quick, the incentive is nearly immediate, and it provides significant long-term energy savings.
- It works well because it saves money and energy,

- The program is so simple. It's money for a good cause, and I don't know why anybody wouldn't do it.
- The incentive is a good dollar amount, other programs seem less substantial.
- The program is effective because it allows better and brighter lighting for less money.
- It's very easy to participate.
- It drastically decreases the payback time for these kinds of projects.
- The rebate turnaround is fairly quick and the application is not very difficult to complete.
- The program is quick and effective.
- It promotes energy efficiency by immediately giving customers assistance with the initial costs, and reduces energy consumption and utility bills in the long run.
- Everything is prompt and smooth; it started on time, they worked around our schedule and there is little customer inconvenience.
- It reduces energy usage.
- The program works because it encourages people that aren't necessarily huge energy consumers to become more energy efficient.
- It works because it is straightforward.
- It conserves energy and has a quick pay out time.
- It's a smooth process and the response is quick.
- It makes people more aware of the environment and the incentive provides an extra kick.
- It saves money and pays for itself quickly.
- It saves money and helps people increase their property values and reduce their carbon footprints.

What Doesn't Work Well

Customers also had comments about what doesn't work well.

- Figuring out what to needs to be submitted with the application can be confusing.
- The program does not allow third parties to fill the forms out for the applicant.
- They do not offer it to industrial users; the largest energy users.
- The incentive is a bit low, if it were higher, I would have switched out more fixtures.
- The costs of the upgrade are not always fully identified.
- The approval letter and the invoice didn't arrive at the same time.

Program Satisfaction

This section presents the results of the satisfaction survey. The surveyed customers were asked to rate their satisfaction with various components of the program using a 1 to 10 scale where a 1 indicates that that were very dissatisfied and a 10 indicating that they were very satisfied. Figure 1 below presents the mean satisfaction scores that were reported for the C&I Rebate Program.

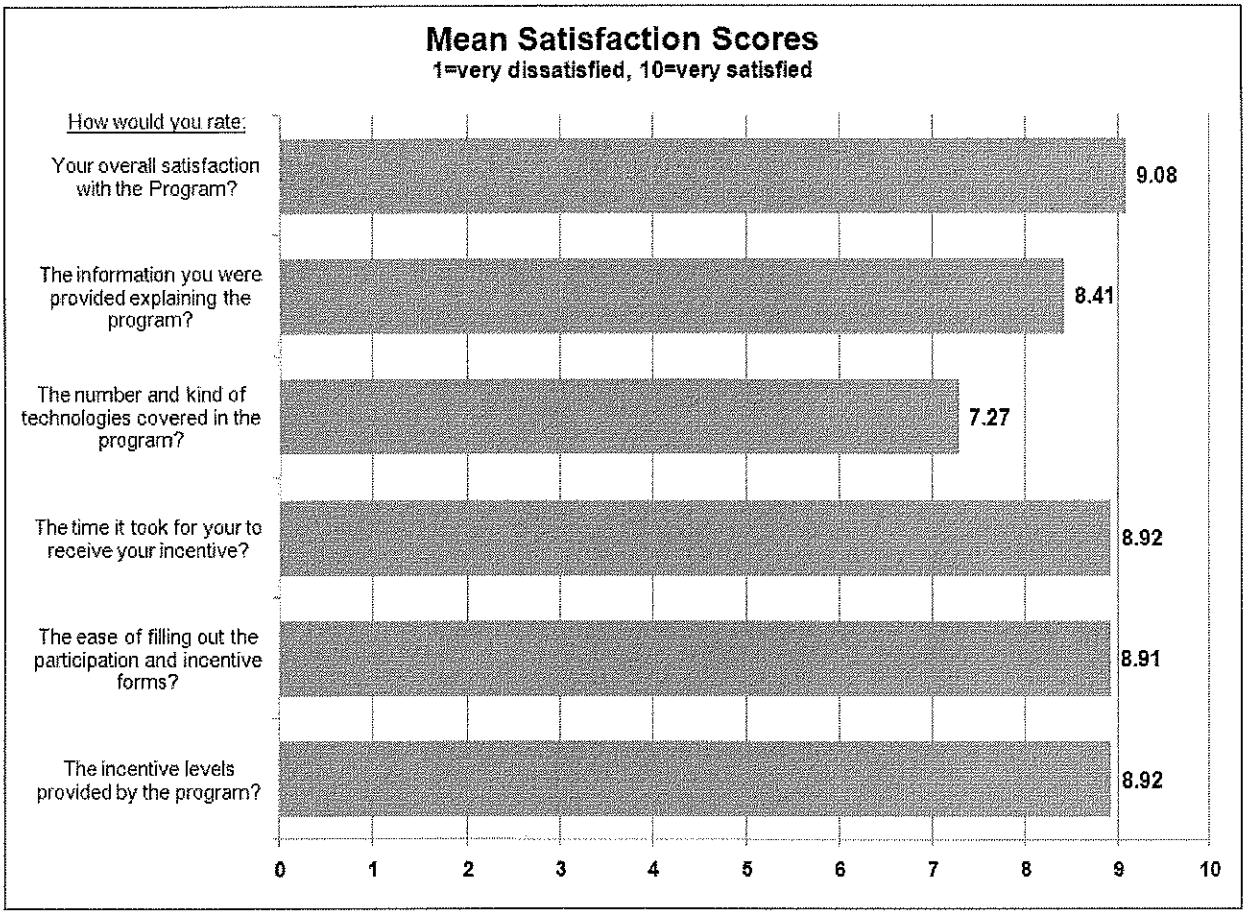


Figure 1. Mean Satisfaction Scores

The highest mean score (9.08/10) was for the program overall, and the lowest was for the number and kinds of technologies covered. This may indicate that there is a lack of awareness among the customers about the custom rebate, which will rebate virtually any energy efficiency project that has a payback of more than two years. All of the other aspects of the program received a mean score of 8.41 – 8.92, which are very high scores that indicate that the program is running well from the perspective of the customers that have participated.

However, there were a few low scores. If a customer gave a satisfaction score of 7 or lower, we followed up with the question asking why they scored that component so low and how that aspect of the program could be improved. These responses are presented below.

Technologies

- They could offer incentives for other improvements, such as roofing, weatherization, and generators.
- The program does not target their biggest users.
- An itemized list of covered technologies would be helpful.

Information about the Program

- Make it a little less technical and maybe provide examples.

- A little more detail about the program, such as covered technologies, would have helped.

Impact Analysis Results

An extract from the program tracking database covering paid projects from June, 2007 through the end of May, 2009 was received from Empire. These data were analyzed to identify the type and numbers of measures installed by participants by program element. These data were used to define the methods used to conduct the impact evaluation.

The analysis was broken down into prescriptive and custom program elements. Within the prescriptive program, lighting and HVAC measures were analyzed[2]. Within the custom element, the projects were segmented into lighting and "other" categories. A sample of lighting and other projects was selected and formed the basis of the analysis.

Prescriptive Lighting

An extract from the program tracking database covering paid projects from June, 2007 through the end of May, 2009 was received from Empire. These data were analyzed to identify the type and numbers of measures installed by participants by program element. These data were used to define the methods used to conduct the impact evaluation.

The lighting program tracking system showed lighting measures installed in sites representing a total of 18 participating customers. The types and quantity of measures installed are shown in Table 1.

Table 1. Lighting Measures Installed Under Program

Measure	Measure Group	Installation counts
High Performance T8 Fixtures - 3 lamps	Linear Fluorescent	97
Retrofit T8 Lamps	Linear Fluorescent	2,309
Retrofit T8 Ballasts	Linear Fluorescent	662
T5/T5HO Fixtures - 4 lamp minimum	High Bay Fluorescent	54
Switch Replacement Sensors	Lighting controls	49
Ceiling/ Remote Sensors	Lighting controls	23

Customers were segmented into four standard building types. The number of participants in each building type category is shown below:

Table 2. Participation by Building Type

Building Type	Number of Participants
Light Industrial	7
Office	1
Retail	2
Warehouse	1
Library	3

[2] During the program evaluation period, no applications for motor rebates had been processed.

The energy and demand savings were estimated for each lighting measure in the program tracking database using the following engineering equations:

$$kW_{savings} = \sum_{i}^{buildings} \sum_{j}^{measures} units_{i,j} \times kWsaved_{j} \times CDF_{i}$$

$$kWh_{savings} = \sum_{i}^{buildings} \sum_{j}^{measures} units_{i,j} \times kWsaved_{j} \times FLH_{i,j}$$

where:

units = quantity of each lighting measure installed in each building type
kWsaved = unit kW savings for each lighting measure
CDF = coincident demand factor by building type
FLH = full load lighting hours by building type

The unit kW savings assigned to each lighting measure are shown in Table 3.

Table 3. Lighting Fixture Wattage Savings Assumptions

Description	Measure Wattage	Baseline Fixture	Baseline Wattage	Watt/fixture savings
High Performance T8 Fixtures - 3 lamps	88	T12- 34W - 4' 3 Lamp - Magnetic	120	32
T5/T5HO Fixtures - 4 lamp minimum	304	400 W metal halide	455	151

For T-8 lamp and electronic ballast measures, an average savings per lamp for 1, 2, 3, and 4 lamp T-8 fixtures was used, as shown below.

Table 4. Savings Assumptions for Lamp and Ballast Replacements

Description	Measure Wattage	Baseline Fixture	Baseline Wattage	Watt/fixture savings	Watts/lamp savings
T8-4 ft 1 lamp	30	T12- 34W - 4' 1 Lamp - Magnetic	44	14	14.0
T8-4 ft 2 lamp	60	T12- 34W - 4' 2 Lamp - Magnetic	77	17	8.5
T8-4 ft 3 lamp	88	T12- 34W - 4' 3 Lamp - Magnetic	120	32	10.7
T8-4 ft 4 lamp	112	T12- 34W - 4' 4 Lamp - Magnetic	150	38	9.5
Average					10.7

The average savings per lamp includes savings for upgrading from magnetic to electronic ballasts. Since the program rules require concurrent lamp and ballast replacement, the per-lamp savings in the Table above was applied to the total number of lamps rebated to account for both

lamp and ballast savings. Note, the reported rebated number of lamps per rebated ballast is 3.5; reflecting a mix of fixture types.

Unit demand and energy savings assumptions for lighting controls are shown in Table 5.

Table 5. Unit Demand and Energy Savings for Lighting Control Measures

Fixture	KWh/unit	KW/unit
Ceiling/Remote Sensors	994	0.27
Switch Replacement Sensors	397	0.11

The lighting coincident demand factor assumption of 0.8 used by Empire for the custom lighting measures was applied to the prescriptive lighting measures. Average lighting operating hour assumptions for each building type were taken from the California Database for Energy Efficiency Resources (DEER) study[3]. These data are shown in the Table below:

Table 6. Annual Full Load Operating Hour Assumptions by Building Type

Building Type	Hours of Operation
Light Industrial	2860
Office	2808
Retail	4368
Warehouse	2860
Library	4248

The lighting unit kW savings and operating hour assumptions across the participant building types were combined using the equation above. The annual energy and demand savings for the prescriptive lighting program was estimated at 142,273 kWh per year, with a coincident demand savings of 39 kW.

Prescriptive HVAC

The prescriptive HVAC program had fairly modest participation, with 6 HVAC units rebated over 5 participating customers. Each customer was assigned to a building type, and a series of prototype building energy simulation models were developed for each of these building types. The list of building types and participants is shown in the Table below:

Table 7. Prescriptive HVAC Program Participants

Building Type	Number of Participants
Small Office	3
Small Retail	1
Warehouse	1

[3] 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report, Itron, Inc. Vancouver, WA. December, 2005. Available at http://www.calmac.org/publications/2004-05_DEER_Update_Final_Report-Wo.pdf

The prototypical simulation models were derived from the California Database for Energy Efficiency Resources (DEER) study, with adjustments make for local building practices and climate. A description of each prototype simulation model is shown in Appendix E. The simulations were run with long-term average (TMY-3) weather data for Joplin, MO.

The size and efficiency of the rebated HVAC units are shown in the Table below:

Table 8. Prescriptive HVAC Equipment Efficiency

Unit	Type	Size	SEER	EER
1	Split AC	5	14	12
2	Split HP	4	15	12.5
3	Split HP	5	16	12.5
4	Split AC	5	14.5	11
5	Split AC	5	16	12

Note, since these units are installed in commercial buildings, they are assumed to be 3 phase units. The baseline for a 3 phase unit in this size range is SEER 12 / EER 10. The savings for these units calculated from the simulation model is shown in the Table below:

Table 9. Unit Energy and Demand Savings for Prescriptive HVAC Systems.

Type	Size Category	SEER	EER	Building Type	kWh/ton savings	kW/ton savings
Split AC	< 65 kBtu/hr	14	12	Small Office	150	0.099
Split HP	< 65 kBtu/hr	15	12.5	Small Retail	196	0.118
Split HP	< 65 kBtu/hr	16	12.5	Small Office	262	0.119
Split AC	< 65 kBtu/hr	14.5	11	Small Office	181	0.054
Split AC	< 65 kBtu/hr	16	12	Warehouse	179	0.099

The unit energy and demand savings shown in table above were applied to the inventory of rebated HVAC systems in the program tracking database to estimate the total savings associated with the prescriptive HVAC program. The annual energy and demand savings for the prescriptive HVAC program component was estimated at 5,545 kWh per year, with a coincident demand savings of 3 kW.

Custom Program Component

The custom component of the C&I program covered a variety of lighting, HVAC, building shell and appliance measures. The breakdown of measure types by expected kWh savings is shown in Figure 2.

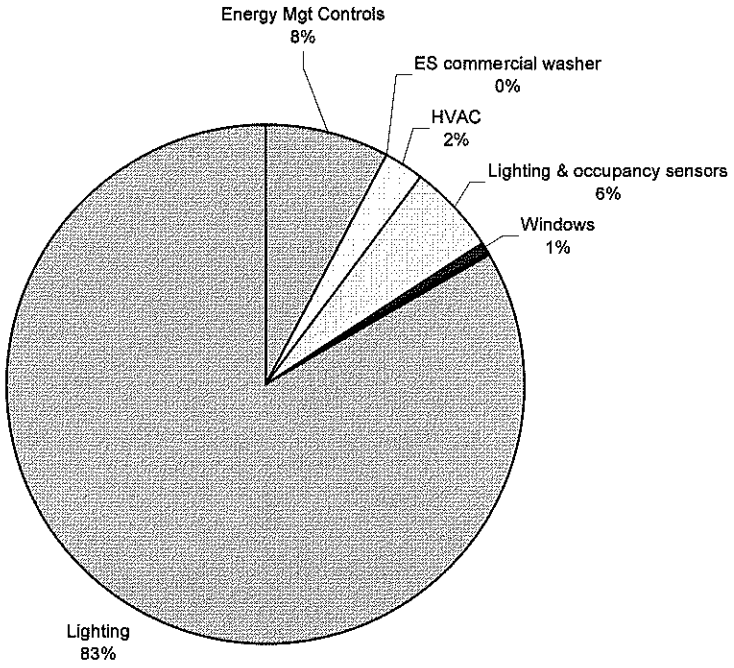


Figure 2. Measure Breakdown in Custom C&I Program

The majority of the savings from the C&I program come from custom lighting and lighting controls projects. From June 2007 through May 2008, a total of 38 custom lighting projects were paid, with an expected total savings of 2.7 GWh. The projects included installation of T-8 linear fluorescent fixtures, high-bay fluorescent fixtures, exit signs, and occupancy sensors controls.

An additional 12 additional custom projects were paid during the program cycle, covering high efficiency rooftop unit replacements, energy management and control systems, high performance windows and commercial washers.

To evaluate the custom projects, the projects were segmented into two categories – lighting and "other." The sampling strategy assumed a lower variability in the lighting projects savings relative to HVAC projects, which comprise the majority of the "other" projects. An *error ratio* was used to define the strength in the relationship between the tracking estimates of savings and the evaluated estimate of savings across the project population. A lower error ratio implies a stronger association between the tracking and evaluated estimates; a higher error ratio implies a weaker association[4]. For the lighting projects, an error ratio of 0.2 was assumed and a sampling precision of 0.1 was selected. For the other projects, an error ratio of 0.5 was assumed and a

[4] For more information about the error ratio, see "The California Evaluation Framework" Chapter 13: Sampling, pg 340. http://www.tecmarket.net/documents/California%20Evaluation%20Framework%20Jan%202006.pdf

relative precision of 0.3 was selected. The sampling assumptions and sample size calculations are summarized below:

Table 10. Custom Program Sample Design

Parameter	Lighting	Other
Error ratio	0.2	0.5
Relative precision	0.1	0.3
Population	38	12
Sample size	8	4
Estimated savings	3,514,049 kWh	436,783 kWh
Sampling error	351,405 kWh	131,035 kWh
Overall sampling error	482,440 kWh	
Overall sampling precision	0.122	

Since the "other" category accounts for a relatively small portion of the total savings, using a more relaxed sampling relative error criterion of 0.3 still provided an overall sampling relative precision of around ±12%.

Custom Lighting

Custom lighting projects were evaluated by taking a simple random sample of participating projects conducting an engineering review on those projects. A sample of 8 of the lighting projects was drawn at random from the list of 38 total projects. Application files for each of the 8 customers plus 4 backup selections were received from Empire. The list of projects reviewed is shown below:

Table 11. Custom Lighting Project Sample

Project	Building Type	Project Description	Claimed kWh savings	Claimed kW savings
1	Retail	T-8 lighting and LED exit signs	21,024	4.9
2	Warehouse/Distribution	High Bay Fluorescent Fixtures	165,744	23.8
3	Manufacturing	T-8 lighting and High Bay Fluorescent Fixtures	6,921	1.5
4	Retail	T-8 lighting	72,293	11.0
5	Retail	T-8 lighting	18,405	5.6
6	Grocery	T-8 lighting	239,797	32.9
7	Warehouse/Distribution	High Bay Fluorescent Fixtures	14,502	2.8
8	Warehouse/Distribution	T-8 lighting and High Bay Fluorescent Fixtures	200,581	19.9

Fixture wattage assumptions were reviewed against a table of standard fixture watts compiled by the California utilities for the Standard Performance Contract (SPC)[5] program. The businesses were contacted by phone to verify lighting system operating hours, and the assumptions used in the applications were updated accordingly. Self reported operating hours by daytype (workday,

[5] See http://www.sce.com/NR/rdonlyres/F7AD732A-BEEA-43FA-A57D-71D8FF0EF8D7/0/090601_SCE_B_Standard_Fixture_Watts.pdf

Saturday, Sunday and Holiday) were projected to annual operating hours. The projected operating hours assumed 5% of the fixtures serve as egress lights and remain on at all times. Revised energy savings estimates were computed using these updated assumptions for each of the sampled projects.

In general, there were minor variations in the wattage assumptions used in the calculations. A plot of the ratio of the total fixture kW assumed in the application to the total evaluated fixture kW is shown in the Figure below:

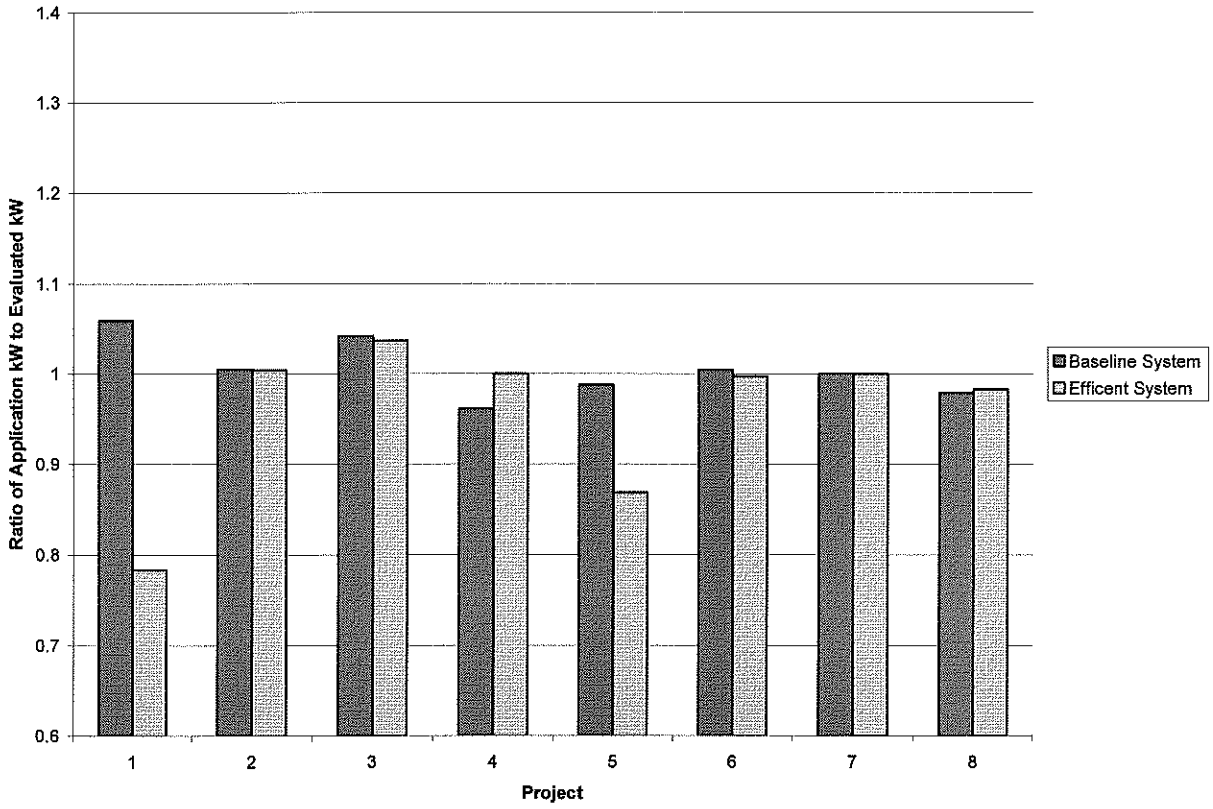


Figure 3. Variability in Lighting Connected Watts Assumptions

Note, values greater than 1 indicate the application used a fixture wattage higher than the assumptions used in this evaluation. Projects 1 and 6 show a situation where the baseline wattage was overestimated and the efficient wattage was underestimated, leading to a decrease in the kW savings relative to the original estimate.

The variation in fixture watts assumptions for popular fixture types relative to the standard values in the SPC table is shown in Table 12.

Table 12. Variation in Fixture Watts Assumptions Across Sampled Projects

Fixture type	SPC Standard Watts	Application Watts Range	Notes
2 lamp 4 ft T-8	60	51 - 76	Average 63.4 W
4 lamp 4 ft T-8	118	58 - 114	Some fixtures identified as 4 lamp T-8 were likely entered as 2 lamp fixtures
400 W Metal Halide	458	455 - 475	Average 460 W
2 lamp 8ft T-12 ES	128	138	Systematic difference across the board

The differences did not significantly affect to the total connected kW calculations, but point out the potential need for standardization in the fixture watts assumptions across contractors.

A similar chart showing the ratio of the operating hours used in the application to the operating hours verified from the phone surveys is shown in Figure 4.

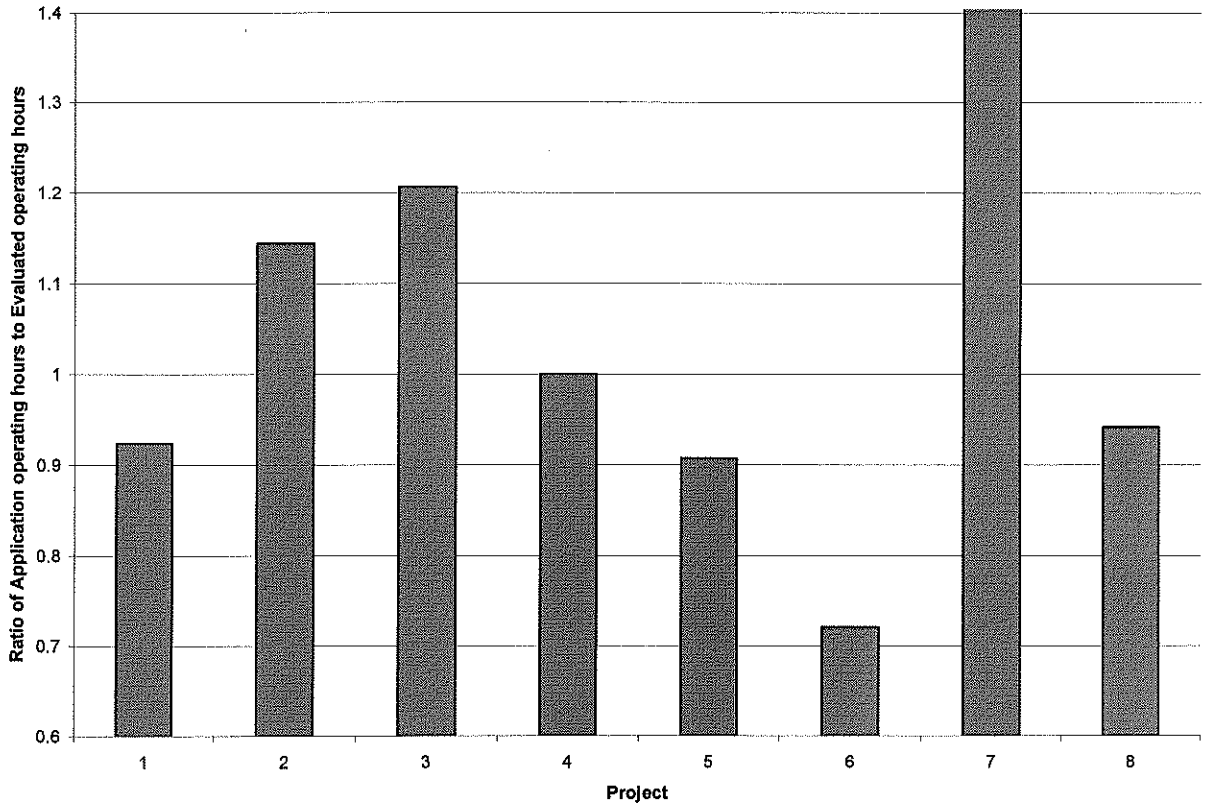


Figure 4. Variation in Application vs. Evaluated Operating Hour Assumptions

There is much more variability in the operating hour assumptions than the fixture watts assumptions. For example, the operating hours for project 6 were underestimated by about 30%, while the operating hours for project 7 were overestimated by about 40%. This is expected, since facility operations can only be surmised during project development.

The overall energy savings results for the custom lighting project sample are summarized in the Table below. The claimed and evaluated savings are shown, along with the project and sample realization rate (RR). Realization rate is defined as the ratio of the evaluated savings to the claimed savings; projects with a realization rate greater than 1 exceeded the expectations, while projects with a realization rate less than 1 performed below expectations.

Table 13. Summary of Custom Lighting Engineering Review

Project	Building Type	Claimed kWh savings	Evaluated kWh savings	RR[6]	Claimed kW savings	Evaluated kW savings	RR
1	Retail	21,024	10,099	0.48	4.9	2.1	0.43
2	Warehouse/Distribution	165,744	144,178	0.87	23.8	23.7	1.00
3	Manufacturing	6,921	6,128	0.89	1.5	1.5	1.00
4	Retail	72,293	80,966	1.12	11.0	12.3	1.12
5	Retail	18,405	16,611	0.90	5.6	4.5	0.80
6	Grocery	239,797	328,895	1.37	32.9	32.6	0.99
7	Warehouse/Distribution	14,502	8,018	0.55	2.8	2.4	0.86
8	Warehouse/Distribution	200,581	214,629	1.07	19.9	20.4	1.03
	Total	739,267	809,524	1.10	102	100	0.97

Although several of the projects came in with realization rates below 1, the largest project in the sample exceeded the claimed savings by about 37%, bringing the overall realization rate for the sample to 1.10 for kWh savings. The overall sample realization rate for kW savings came in near 1.0, reflecting generally good agreement on the fixture watts assumptions.

Custom "Other"

A sample of four projects was selected for engineering review. The projects sampled are summarized below:

Table 14. Custom "Other" Project Sample.

Project	Building Type	Project Description	Claimed kWh savings	Claimed kW savings
1	Big Box Retail	Hi efficiency rooftop air conditioners	23,216	11.7
2	Church	Energy Management Control System	70,545	0.0
3	Hotel	Energy Management Control System[7]	205,232	0.0
4	Primary School	Energy Management Control System	33,423	0.0

Each project was assigned to a standard building type, and a series of DOE-2 building energy simulations was conducted for each building type. The details of the prototypical building models are shown in Appendix C. Prototypical Building Descriptions. The results of the

[6] RR refers to the realization rate, which is the ratio of the evaluated savings to the claimed savings.
[7] This project was carried out in two phases under two different applications. Both phases were evaluated together as a single project.

simulations were compared to the engineering calculations during the engineering review process. A brief description of each of the projects follows:

Project 1. Big Box Retail. The project involved the normal replacement of 7 packaged rooftop units with high efficiency units. A new, standard efficiency unit conforming to ASHRAE Standard 90.1-2004 was used as the baseline. A simulation of the Big Box Retail prototype was conducted using the DOE-2.2 building energy simulation model. Unit energy savings were calculated for packaged rooftop unit replacements of various sizes and efficiencies. The savings estimated for each of the 7 packaged rooftop unit replacements from the DOE-2 simulations are summarized below:

Table 15. Energy Savings Summary for Project 1.

Qty	Unit size (ton)	Baseline		Measure		Unit Savings		Total Savings	
		Efficiency	Units	Efficiency	Units	kWh/ton	kW/ton	kWh	kW
1	5	12	SEER	13	SEER	78	0.056	390	5.0
1	7.5	10.3	EER	11.3	EER	139	0.100	1,042	7.5
4	17	9.7	EER	11.5	EER	242	0.173	16,478	11.8
1	19.2	9.7	EER	11	EER	190	0.136	3,642	2.6
Total								21,551	12.4
Demand savings with 0.8 coincidence factor applied									9.9
Savings from tracking database								23,216	11.7
Realization rate								0.93	0.85

Project 2. Church. The project involved the implementation of a centralized Energy Management Control System to control the thermostat settings of 32 packaged air conditioners located throughout the facility. The combined cooling capacity of the controlled units is 261 tons. The assembly prototype was used to estimate the savings from implementing a temperature setback strategy on each of the units. The baseline assumed constant thermostat setpoints of 70°F for heating and 75°F for cooling. The measure control strategy assumed unoccupied period setpoints of 65°F for heating and 80°F for cooling. The energy savings are summarized in the Table below:

Table 16. Energy Savings Summary for Project 2.

Parameter	Value
Savings per ton from DOE-2 model	203 kWh/ton
Total tons	261
Total savings	52,915
Savings from tracking database	70,546
Realization rate	0.75

No peak demand savings were claimed for this measure.

Project 3. Hotel. Project involved installation of a guest room energy management system in 93 hotel rooms served by packaged terminal heat pumps (PTHP). The system uses occupancy sensors to turn the PTHPs on and off based on room occupancy, and a wall-mounted thermostat

to control the units. Energy savings result from reduced run hours from the occupancy sensor control and tighter room temperature control from the wall-mounted thermostat. The Hotel prototype was used to estimate the annual energy consumption from the PTHP systems serving the guest rooms. An evaluation study literature review was conducted to identify measured energy savings from similar control systems[8]. The results of the analysis are summarized below:

Table 17. Energy Savings Summary for Project 3.

Parameter	Value
Annual energy consumption per ton from DOE-2 model	1,726 kWh/ton
PTHP size	0.75 ton
PTHP quantity	93
Total tons	70 tons
Energy savings (as a fraction of total consumption) from lit review	0.21
Total savings	25,285 kWh
Savings from tracking database	205,232 kWh
Realization rate	0.12

No peak demand savings were claimed for this measure. The engineering calculations supporting the savings claim were conducted by the manufacturer of the control system. The savings calculations overestimated the annual energy consumption of the PTHP system, thereby overestimating the annual savings expected from the controller.

Project 4. Primary School. The project involved the implementation of a centralized Energy Management Control System to control the thermostat settings of 24 packaged air conditioners located throughout the facility. The combined cooling capacity of the controlled units is 98 tons. The primary school prototype was used to estimate the savings from implementing a temperature setback strategy on each of the units. The baseline assumed constant thermostat setpoints of 70°F for heating and 75°F for cooling. The measure control strategy assumed unoccupied period setpoints of 65°F for heating and 80°F for cooling. The energy savings are summarized in the Table below:

Table 18. Energy Savings Summary for Project 4.

Parameter	Value
Savings per ton from DOE-2 model	348 kWh/ton
Total tons	98
Total savings	34,104
Savings from tracking database	33,423
Realization rate	1.02

No peak demand savings were claimed for this measure.

A summary of the results for all projects in the custom "other" sample is shown in Table 19.

[8] Hotel guest room energy management systems were evaluated as a component of the Southern California Edison IDEEA program evaluation. See "Southern California Edison 2004-2005 IDEEA Constituent Program Evaluations, Vol. 1. Prepared for Southern California Edison by Quantec LLC. June, 2008. Available at www.calmac.org.

Table 19. Energy Savings Summary for Custom "Other" Sample.

Project	Building Type	Claimed kWh savings	Evaluated kWh savings	RR	Claimed kW savings	Evaluated kW savings	RR
1	Big Box Retail	23,216	21,551	0.93	11.7	9.9	0.85
2	Church	70,545	52,915	0.75	0.0		
3	Hotel	205,232	25,285	0.12	0.0		
4	Primary School	33,423	34,104	1.02	0.0		
	Total	332,416	133,855	0.40	11.7	9.9	0.85

Note, the realization rates for most projects were within the range of about 0.75 to 1.0, with the exception project 3, which had a poor realization rate. The low realization rate and high expected savings for project 3 pulled the sample realization rate for kWh savings down to 0.4.

Program Energy and Demand Savings

The total program energy and demand savings were estimated separately for prescriptive and custom program elements. The prescriptive measure savings were estimated for all participants as described in the section above. The custom program savings were estimated by applying the sample realization rates calculated above to the total estimated savings for the custom program participants by measure type. The results of these calculations are shown in the Table below:

Table 20. Total Gross Program Energy and Demand Savings

Program Element	Claimed Savings		Realization Rates		Evaluated Savings	
	kWh	kW	kWh	kW	kWh	kW
Custom lighting	3,514,049	493	1.10	0.97	3,848,013	479
Custom other	436,783	14	0.40	0.85	175,880	12
Prescriptive lighting					142,273	39
Prescriptive HVAC					5,545	3
				Total	4,171,711	532

Benefit Cost Test

Table 21. Benefit Cost Test Results for the C&I Rebate Program

	Prescriptive		Custom		Total	
Test	NPV	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio
Total Resource Cost	+ $43,484	1.65	+ $1,219,274	1.96	+ $1,261,982	1.95
Societal Cost	+ $50,460	1.76	+ $1,409,161	2.11	+ $1,458,845	2.09
Participant Cost	+ $147,481	3.34	+ $4,319,371	4.59	+ $4,466,852	4.53
Utility Cost	+ $53,831	3.08	+ $1,335,519	3.85	+ $1,388,786	3.81
Ratepayer Impact Measure	- $2,460,983	0.43	- $2,356,908	0.44	- $2,460,983	0.43

The total resource cost test showed a positive net present value (NPV) for the Commercial & Industrial Rebate Program is $1,261,982. This indicates that, over a 15-year effective useful life, the avoided energy and avoided demand savings will be sufficient to recuperate and exceed the initial program cost, less the incentives, of $68,043 plus the participants' equipment cost of $1,264,970. A benefit cost ratio greater than one, 1.95, shows that this program can be considered economical from the combined perspective of the utility and the ratepayers. A sensitivity analysis concludes that the program would remain economical unless the participants' costs exceeded $2,526,952.

The societal cost test also produced a positive NPV for the C&I Rebate Program is $1,458,845. The societal test aims to represent the program from the point of view of the society as a whole, capturing all benefits and costs, including externalities. In this case, externalities are made up of the known avoided environmental damage costs, totaling $247,758. This amount was added to the savings from the TRC test and the benefit cost ratio was recomputed to be 2.09. Again, the ratio is greater than one. Therefore, the program is deemed cost effective from the societal perspective.

To supplement these tests, a participant cost test and a utility cost test were done. The purpose of these tests is to isolate the participants and the utility and assess the program's cost effectiveness from both perspectives. The tests both produced a positive NPV and a benefit cost ratio greater than one for the C&I Rebate Program is $4,466,852 with a ratio of 4.53 and $1,388,786 with a ratio of 3.81, respectively. This means that the benefits outweigh the costs for both the participants and the utility. This program is therefore cost effective from both the perspective of the participant and the utility.

Finally, a ratepayer impact measure test was done. This test is a measure of the difference between the change of total revenues paid to a utility and the change in total costs paid by a utility. The test produced a negative NPV and a benefit cost ratio of less than one, -$2,460,983 and 0.43, respectively. Thus, this program is not cost effective from the perspective of the ratepayer because rate levels will increase as a result of this program. If retail rates are higher than marginal costs, few programs pass this test. This is because the benefit of avoided supply costs will be eclipsed by the revenue losses.

Table 22. Parameter Values and Assumptions for Benefit Cost Tests

Parameter	Value		Assumption	Value
Number of Participants	67		Avoided Energy Cost	$0.03436
Project Life (years)	15		Demand Cost	$51
Project Analysis Year 1	2009		Environmental Externalities	$0.0031
kWh/yr. Saved	4,171,973		Retail Rate	$0.08355
kW/yr. reduction	532		Escalation Rate	3.00%
Utility Project Cost	$494,094		Societal Discount Rate	3.22%
Incentive Cost	$426,051		Participant Discount Rate	3.22%
Participant Cost	$1,264,970		Utility Discount Rate	8.44%

Appendix A: C&I Rebate Program: Management Interview Instrument

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Empire Commercial and Industrial Program. We'll talk about the C&I Program and its objectives, your thoughts on improving the program and its participation rates, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Program Objectives

1. In your own words, please describe the Small Commercial and Industrial Incentive Program's objectives.

2. In your opinion, which objectives do you think are being met or will be met? How do you think the program's objectives have changed over time?

3. Are there any program objectives that are not being addressed or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed? Do you think these changes will increase program participation?

4. Should the program objectives be changed in any way because of market conditions, other external or internal program influences, or any other conditions that have developed since the program objectives were devised? What changes would you put into place, and how would it affect the objectives?

5. Do you think the incentives application process offered through the C&I program is easy to understand and complete?

6. Do you think the incentives offered through the program are large enough to entice the C&I community to purchase the high efficiency items? Why or why not?

7. Do you think the incentives cover the right equipment? Do you think there is equipment that is currently incentivized that should not be, or equipment that is not covered that should be?

8. Which measures have been most used? Why, and why have other measures not been adopted?

9. What kinds of marketing, outreach and customer contact approaches do you use to make your customers aware of the program and its options? Are there any changes to the program marketing that you think would increase participation?

10. How do you inform trade allies and contractors about the program? How effective has this been in getting participation from the contractors?

11. Are there any changes to the incentives or marketing that could possibly increase participation in the program?

12. Thinking about how your program enrolls participants, what do you think your level of freeridership is for this program? (That is, what percent of the equipment rebated through the program would have been purchased and installed without the program's incentive?)

13. What do you think the level of spillover is for this program? (That is, what percent of the participants take similar actions in their businesses that are not rebated through the program?)

Overall Small C&I Incentives Management

14. Describe the use of any advisors, technical groups or organizations that have in the past or are currently helping you think through the program's approach or methods. How often do you use these resources? What do you use them for?

15. Overall, what about the Commercial and Industrial Program works well and why?

16. What doesn't work well and why? Do you think this discourages participation?

17. Can you identify any market or operational barriers that impede a more efficient program operation?

18. If you had a magic wand and could change any part of the program what would you change and why?

Program Design & Implementation

19. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

20. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

21. How do you manage and monitor or evaluate contractor involvement or performance? What is the quality control and tracking process? What do you do if contractor performance is exemplary or below expectations?

23. In your opinion, did the incentives cover enough different kinds of energy efficient products?

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

If no, 22b. What other products or equipment should be included?

_____

_____

24. In what ways can the Commercial and Industrial Program's operations be improved?

25. Do you have any suggestions for how program participation can be increased?

Appendix B: C&I Rebate Program: Facility Manager (Participants) Interview Instrument

Hello, my name is _____. I am calling on behalf of Empire District Electric to conduct a customer survey about the Commercial and Industrial Program. May I speak with _____ please?

If person talking, proceed. If person is called to the phone reintroduce.
If not home, ask when would be a good time to call and schedule the call-back:

Call back 1:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 2:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 3:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 4:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 5:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 6:	Date: _____,	Time: _____	❑AM or ❑PM
Call back 7:	Date: _____,	Time: _____	❑AM or ❑PM

❑ Contact dropped after seventh attempt.

We are conducting this survey to obtain your opinions about the Commercial and Industrial Program. We are not selling anything. The survey will take about 10-15 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

1. Our records indicate that you participated in the Commercial and Industrial Program in <date> and that you installed <technology> through the program and received an incentive for your purchase. Do you recall participating in this program?

1. ❑ Yes, *begin* — *Skip to Q2.*
2. ❑ No,
99. ❑ DK/NS

1a. **This program was provided through Empire Electric. In this program, you purchased an energy efficient lighting, HVAC, motor, pump, or other energy efficient equipment. In exchange for purchasing the energy efficient option, Empire Electric provided your company with an incentive.**

Do you remember participating in this program?

1. ❑ Yes, *begin* → *Go to Q2.*
2. ❑ No,

99. ❑ DK/NS ——

If No or DK/NS terminate interview and go to next participant.

2. How did you become aware of the C&I Program?

- **a.** ❑ Empire Electric sent me a brochure
- **b.** ❑ Empire Electric called and talked to me about it
- **c.** ❑ Empire Electric website.
- **d.** ❑ A contractor I was working with told me about the program
- **e.** ❑ An equipment supplier
- **f.** ❑ I saw an ad in _____
- **g.** ❑ Other _____
- **h.** ❑ DK/NS

3. When you first heard about the program and considered taking advantage of the incentive, did you do any additional investigation to confirm the program's offering, or was the information you had adequate to make a participation decision?

- **a.** ❑ The information was adequate
- b. ❑ Didn't need to confirm/Nothing
- **c.** ❑ Went to the web site
- **d.** ❑ Called or emailed Empire Electric
- **e.** ❑ Called or emailed a contractor
- f. ❑ Called or emailed a salesperson
- g. ❑ Other: _____
- h. ❑ DK/NS

If c, d, e, f, g: **4. How well did this work for you, were you able to acquire a more complete understanding of the program?** *Note: many may have only heard about this through their contractors and thus had minimal involvement, so this question may only apply to a few of them.*

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

5. Did you have additional questions that were not answered? Were there questions that you were unable to answer or information that you were unable to obtain?

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

5a. What were they?

_____

_____

6. **Who filled out the program incentive forms for your company?**
   - **a.** ❑ I did
   - **b.** ❑ Someone from my company did
   - **c.** ❑ The contractor
   - **d.** ❑ The salesperson
   - **e.** ❑ Someone from Empire Electric

7. **Who submitted the forms to Empire Electric?**
   - **a.** ❑ I did
   - **b.** ❑ Someone from my company did
   - **c.** ❑ The contractor
   - **d.** ❑ The salesperson
   - **e.** ❑ Someone from Empire Electric

8. *If they filled it out.* **Was the incentive form easy to understand?**

   1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

   If not, 8b. **Do you remember what it was that was not clear or which part of it was difficult?**

_____

_____

9. **Did you have any problems receiving the incentives?**

   1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

   If yes, 9b. **Please explain the problem and how it was resolved. Was it resolved to your satisfaction?**

_____

_____

10. **Did you originally plan on purchasing the exact same efficiency level in the equipment you purchased before you knew that there was an incentive offered by Empire Electric?**

    1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

11. In your decision process, did you search for or consider other, less energy efficient equipment that might have cost less?

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

12. **What was the primary reason that you decided to purchase or upgrade your equipment?**

1. ❑ Remodeling
2. ❑ Equipment failure
3. ❑ Contractor recommendation
4. ❑ Energy Savings
5. ❑ Got a good deal
6. ❑ It was an old system
7. ❑ Combination of above: *list*: _____

13. **I would like to ask how important the program incentive was in your decision to buy the more energy efficient model. Would you say the incentive was…** *(read and check the best response).*

a. **# The primary reason why you purchased the high efficiency model,**
b. **#An important reason, along with other reasons,**
c. **#One of the reasons, but it was not the most important,**
d. **#One of the reasons, but it was a minor or unimportant reason, or**
e. **#It was not a reason at all,**
f. **#DK/NS.**

14. If the incentives were not available from the program, would you have delayed your purchase, or would you have made the purchase at the exact same time?

a. # The purchase would have been delayed – **How long do you think you might have waited to make the purchase?** _____
b. # The purchase would have been made at the same time
c. #DK/NS

15. Were there other reasons in addition to the incentive that you went with the high efficiency <technology> instead of something less expensive to purchase?

_____

_____

16. When firms have experience with energy efficiency programs or products they sometimes make similar decisions to continue the energy savings in other parts of

their business. Have you taken any other energy efficiency actions that may have been, in some way, influenced by your experiences with the Empire Electric program?

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

a. *If yes,* **What have you done?**
b. *If yes,* **How much money do you think you have saved as a result?**

_____

_____

17. One of the objectives that the program would like to see over the next year is increased participation of businesses like yours. Can you think of things that the program can do to help increase participation or help increase interest from people like yourself?

a. #Increase general advertising
b. #Increase advertising in trade media
c. #Present the program in trade or associated meetings
d. #Offer larger incentives
e. #Offer incentives on other items/include other items
f. #Have program staff call C&I customers
g. #Make the process more streamlined for customers
h. #Make the process more streamlined for contractors
i. #Other: _____

18. **During your participation process, did you need to contact Empire Electric to obtain information about the program?**

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

If yes, 18b. **Were your questions or needs effectively handled by Empire Electric?**

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

18c. **How might this be improved?**

_____

_____

19. Overall, what about the C&I Program works well and why?

_____

_____

20. What doesn't work well and why?

_____

_____

We would like to ask you a few questions about your satisfaction with the program. For these questions we would like you to rate your satisfaction using a 1 to 10 scale where a 1 means that you are very dissatisfied with the program and a 10 means that you are very satisfied.

21. How would you rate your satisfaction with.

a. The incentive levels provided by the program

1 2 3 4 5 6 7 8 9 10

b. The ease of filling out the participation and incentive forms

1 2 3 4 5 6 7 8 9 10

c. The time it took for your to receive your incentive

1 2 3 4 5 6 7 8 9 10

d. The number and kind of technologies covered in the program

1 2 3 4 5 6 7 8 9 10

e. The information you were provided explaining the program,

1 2 3 4 5 6 7 8 9 10

For each item above that received a score of 8 or less ask:
21a. What could have been done to make this better?

For item a: the incentive levels provided by the program

_____

_____

For item b: the ease of filling out the participation and incentive forms

_____

_____

For item c: the time it took for your to receive your incentive

_____

_____

For item d: the number and kind of technologies covered in the program

_____

_____

For item e: the information you were provided explaining the program

_____

_____

22. Considering all aspects of the program, how would you rate your overall satisfaction with the Program?

1 2 3 4 5 6 7 8 9 10

If score is 8 or less ask: **What could have been done to make your experience better, or have we already covered it?**

_____

_____

Appendix C. Prototypical Building Descriptions

The prototypical simulation models were derived from the California Database for Energy Efficiency Resources (DEER) study, with adjustments make for local building practices and climate. A description of each prototype simulation model follows.

Assembly

A prototypical building energy simulation model for an assembly building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 23.

Table 23. Assembly Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	34,000 square feet Auditorium: 33,240 SF Office: 760 SF
Number of floors	1
Wall construction and R-value	Concrete block, R-5
Roof construction and R-value	Wood frame with built-up roof, R-12
Glazing type	Multipane Shading-coefficient = 0.84 U-value = 0.72
Lighting power density	Auditorium: 1.9 W/SF Office: 1.55 W/SF
Plug load density	Auditorium: 1.2 W/SF Office: 1.7 W/SF
Operating hours	Mon-Sun: 8am – 9pm
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% oversizing assumed.
Thermostat setpoints	Occupied hours: 75 cooling, 70 heating Unoccupied hours: 80 cooling, 65 heating

A computer-generated sketch of the prototype is shown in Figure 5.

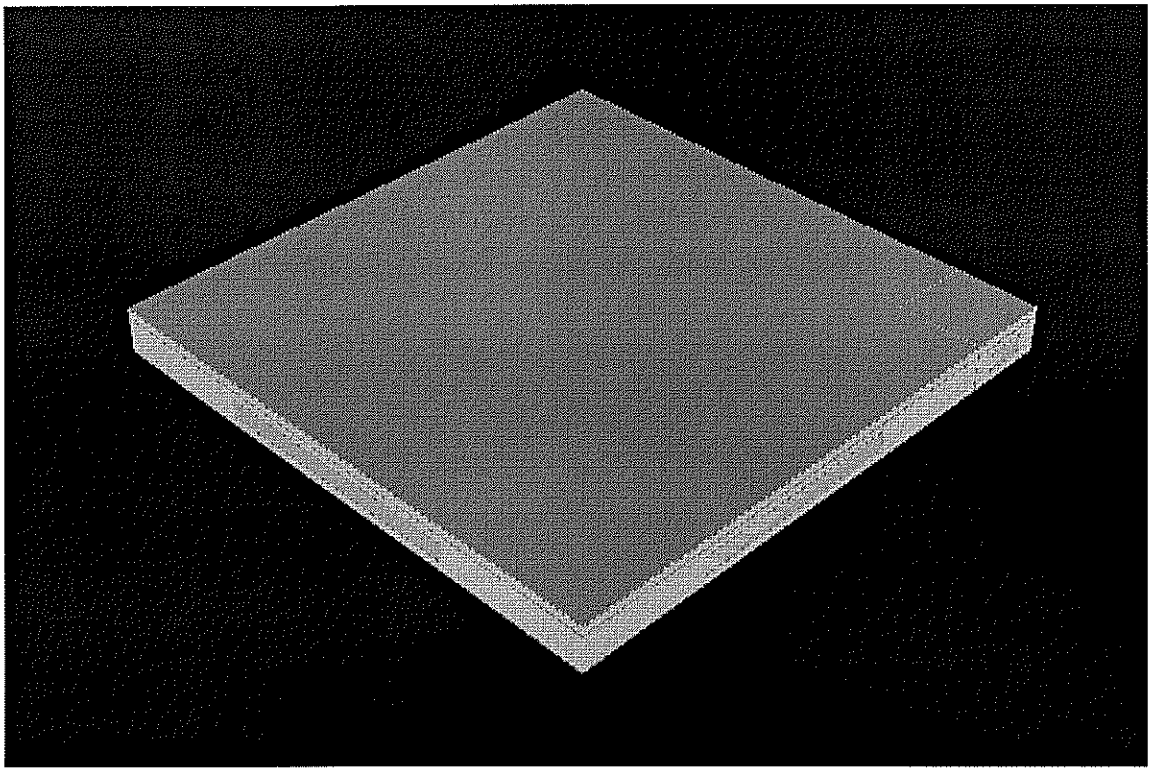


Figure 5. Assembly Building Rendering

Big Box Retail

A prototypical building energy simulation model for a big box retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 24.

Table 24. Big Box Retail Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	130,500 square feet Sales: 107,339 SF Storage: 11,870 SF Office: 4,683 SF Auto repair: 5,151 SF Kitchen: 1,459 SF
Number of floors	1
Wall construction and R-value	Concrete block with insulation, R-7.5
Roof construction and R-value	Metal frame with built-up roof, R-13.5
Glazing type	Multipane; Shading-coefficient = 0.84 U-value = 0.72
Lighting power density	Sales: 2.15 W/SF Storage: 0.85 W/SF (Active) 0.45 W/SF (Inactive) Office: 1.55 W/SF Auto repair: 1.7 W/SF Kitchen: 2.2 W/SF
Plug load density	Sales: 1.15 W/SF Storage: 0.23 W/SF Office: 1.73 W/SF Auto repair: 1.15 W/SF Kitchen: 3.23 W/SF
Operating hours	Mon-Sun: 10am – 9pm
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% oversizing assumed.
Thermostat setpoints	Occupied hours: 75 cooling, 70 heating Unoccupied hours: 80 cooling, 65 heating

A computer-generated sketch of the prototype is shown in Figure 6.

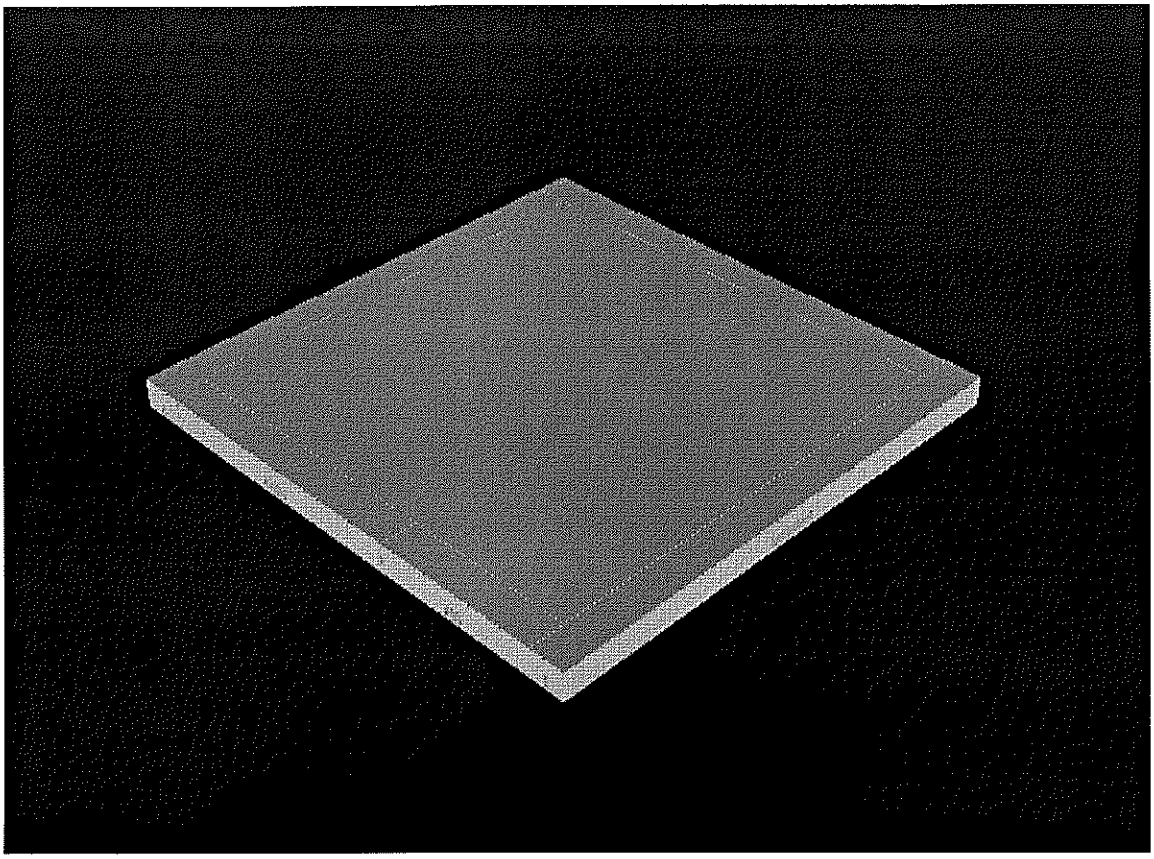


Figure 6. Big Box Retail Building Rendering

Hotel

A prototypical building energy simulation model for a Hotel building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 25.

Table 25. Hotel Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	200,000 square feet total Bar, cocktail lounge – 800 SF Corridor – 20,100 SF Dining Area – 1,250 SF Guest rooms – 160,680 SF Kitchen – 750 SF Laundry – 4,100 SF Lobby – 8,220 Office – 4,100 SF
Number of floors	11
Wall construction and R-value	Block construction, R-7.5
Roof construction and R-value	Wood deck with built-up roof, R-13.5
Glazing type	Multipane; Shading-coefficient = 0.84 U-value = 0.72
Lighting power density	Bar, cocktail lounge – 1.7 W/SF Corridor – 1.0 W/SF Dining Area – 1.7 W/SF Guest rooms – 0.6 W/SF Kitchen – 4.3 W/SF Laundry – 1.8 W/SF Lobby – 3.1 W/SF Office – 2.2 W/SF
Plug load density	Bar, cocktail lounge – 1.2 W/SF Corridor – 0.2 W/SF Dining Area – 0.6 W/SF Guest rooms – 0.6 W/SF Kitchen – 3.0 W/SF Laundry – 3.5 W/SF Lobby – 0.6 W/SF Office – 1.7 W/SF
Operating hours	Rooms: 60% occupied 40% unoccupied All others: 24 hr / day
HVAC system type	Central built-up system: All except corridors and rooms 1. Central constant volume system with perimeter hydronic reheat, without economizer; 2. Central constant volume system with perimeter hydronic reheat, with economizer; 3. Central VAV system with perimeter hydronic reheat, with economizer PTAC : Guest rooms

Characteristic	Value
	PSZ: Corridors
HVAC system size	Based on ASHRAE design day conditions, 10% oversizing assumed.
Chiller type	Water cooled and air cooled
Chilled water system type	Constant volume with 3 way control valves,
Chilled water system control	Constant CHW Temp, 45 deg F setpoint
Boiler type	Hot water, 80% efficiency
Hot water system type	Constant volume with 3 way control valves,
Hot water system control	Constant HW Temp, 180 deg F setpoint
Thermostat setpoints	Occupied hours: 76 cooling, 72 heating Unoccupied hours: 81 cooling, 67 heating

A computer-generated sketch of the prototype is shown in Figure 7. Note, the middle floors, since they thermally equivalent, are simulated as a single floor, and the results are multiplied by 9 to represent the energy consumption of the 9 middle floors.

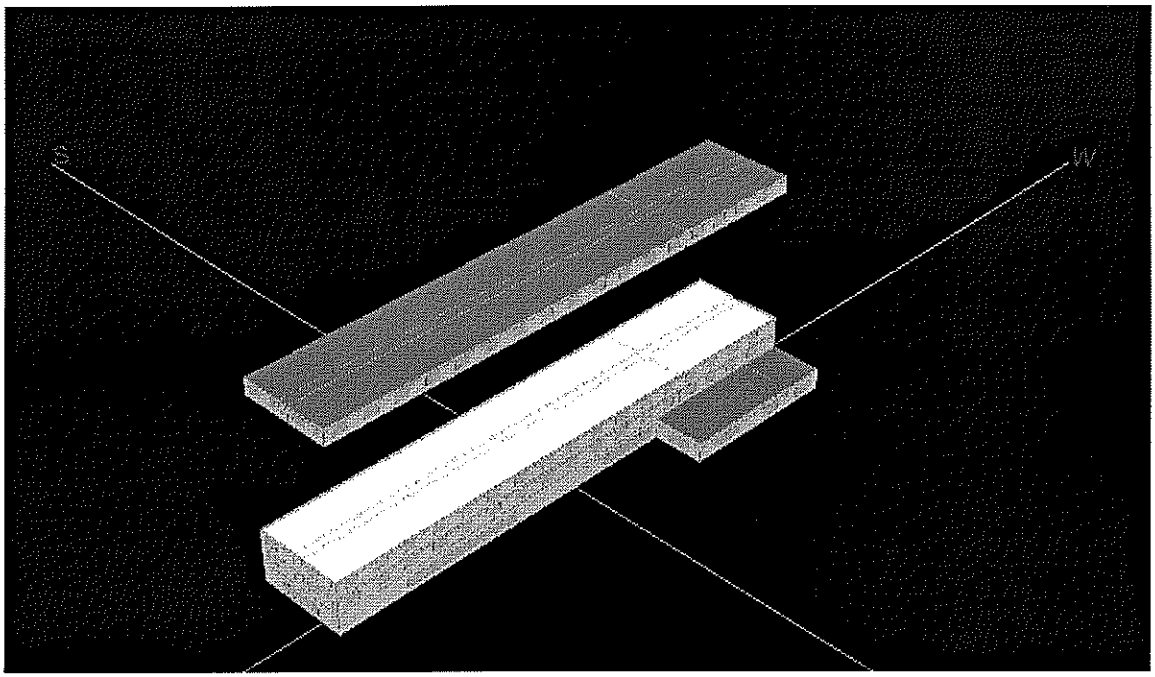


Figure 7. Hotel Building Rendering

Primary School

A prototypical building energy simulation model for an elementary school was developed using the DOE-2.2 building energy simulation program. The model is really of two identical buildings oriented in two different directions. The characteristics of the prototype are summarized in Table B-4.

Table B-4. Elementary School Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	2 buildings, 25,000 square feet each; oriented 90° from each other Classroom: 15,750 SF Cafeteria: 3,750 SF Gymnasium: 3,750 SF Kitchen: 1,750 SF
Number of floors	1
Wall construction and R-value	Concrete with brick veneer, R-7.5
Roof construction and R-value	Wood frame with built-up roof, R-13.5
Glazing type	Multipane Shading-coefficient = 0.84 U-value = 0.72
Lighting power density	Classroom: 1.8 W/SF Cafeteria: 1.3 W/SF Gymnasium: 1.7 W/SF Kitchen: 2.2 W/SF
Plug load density	Classroom: 1.2 W/SF Cafeteria: 0.6 W/SF Gymnasium: 0.6 W/SF Kitchen: 4.2 W/SF
Operating hours	Mon-Fri: 8am – 6pm Sun: 8am – 4pm
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% oversizing assumed.
Thermostat setpoints	Occupied hours: 75 cooling, 70 heating Unoccupied hours: 80 cooling, 65 heating

A computer-generated sketch of the prototype is shown in Figure 8.

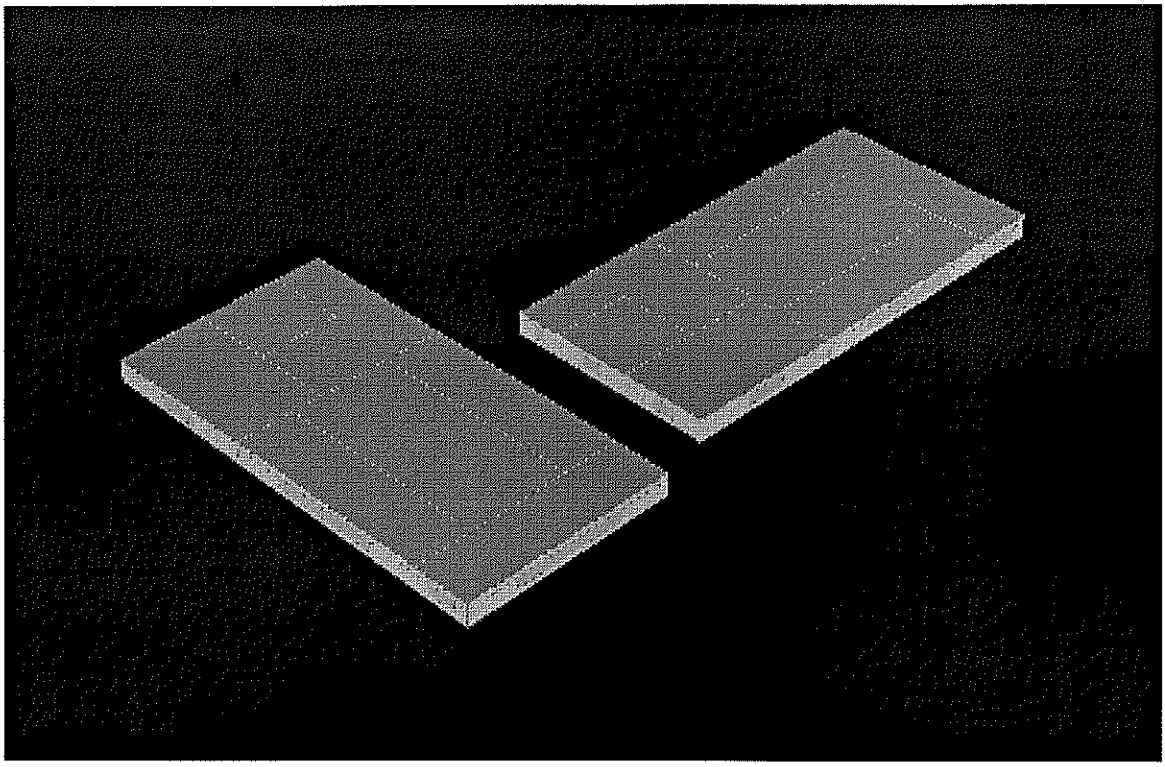


Figure 8. School Building Rendering

Small Office

A prototypical building energy simulation model for a small office was developed using the DOE-2.2 building energy simulation program. The characteristics of the small office prototype are summarized in Table 26.

Table 26. Small Office Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	10,000 square feet
Number of floors	2
Wall construction and R-value	Wood frame with brick veneer, R-7.5
Roof construction and R-value	Wood frame with built-up roof, R-13.5
Glazing type	Multipane; Shading-coefficient = 0.84 U-value = 0.72
Lighting power density	Perimeter offices: 1.55 W/SF Core offices: 1.45 W/SF
Plug load density	Perimeter offices: 1.6 W/SF Core offices: 0.7 W/SF
Operating hours	Mon-Sat: 9am – 6pm Sun: Unoccupied
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% oversizing assumed.
Thermostat setpoints	Occupied hours: 75 cooling, 70 heating Unoccupied hours: 80 cooling, 65 heating

A computer-generated sketch of the small office prototype is shown in Figure 9.

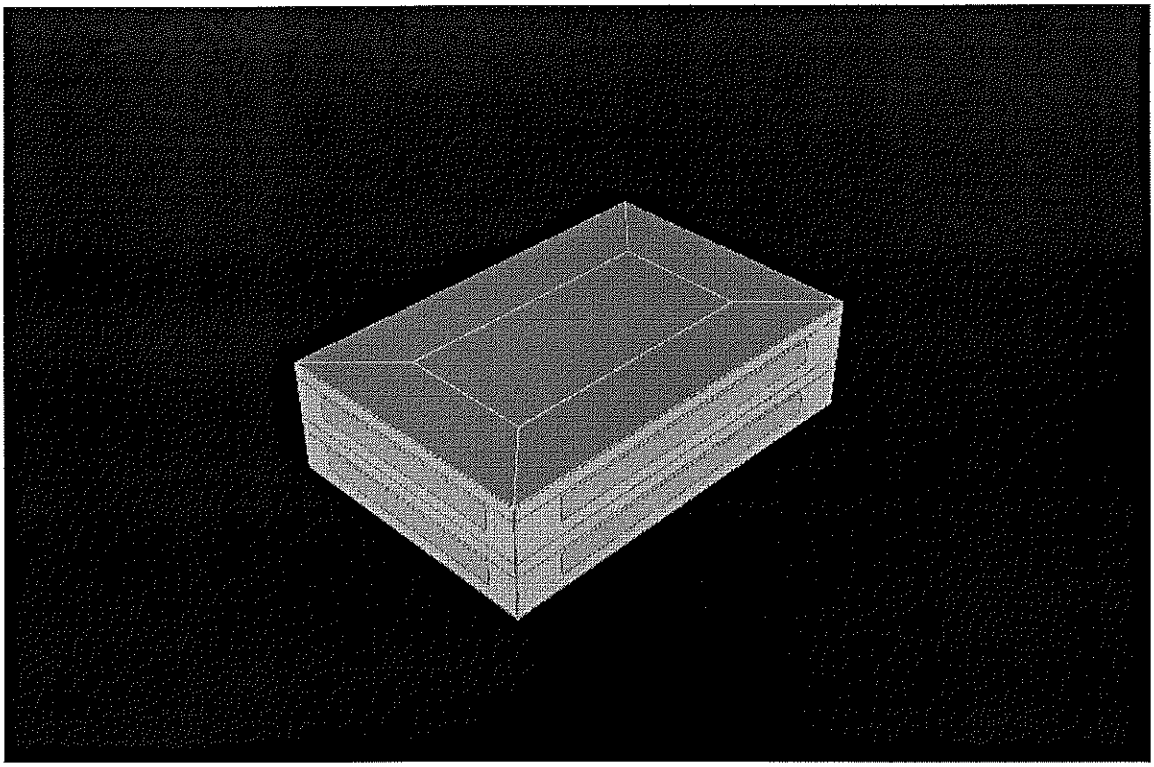


Figure 9. Small Office Prototype Building Rendering

Small Retail

A prototypical building energy simulation model for a small retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the small retail building prototype are summarized in Table 27.

Table 27. Small Retail Prototype Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	6400 square foot sales area 1600 square foot storage area 8000 square feet total
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer, R-7.5
Roof construction and R-value	Wood frame with built-up roof, R-13.5
Glazing type	Multipane; Shading-coefficient = 0.84 U-value = 0.72
Lighting power density	Sales area: 2.15 W/SF Storage area: 0.85 W/SF (Active) 0.45 W/SF (Inactive)
Plug load density	Sales area: 1.2 W/SF Storage area: 0.2 W/SF
Operating hours	10 – 10 Monday-Saturday 10 – 8 Sunday
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% oversizing assumed.
Thermostat setpoints	Occupied hours: 75 cooling, 70 heating Unoccupied hours: 80 cooling, 65 heating

A computer-generated sketch of the small retail building prototype is shown in Figure 10.

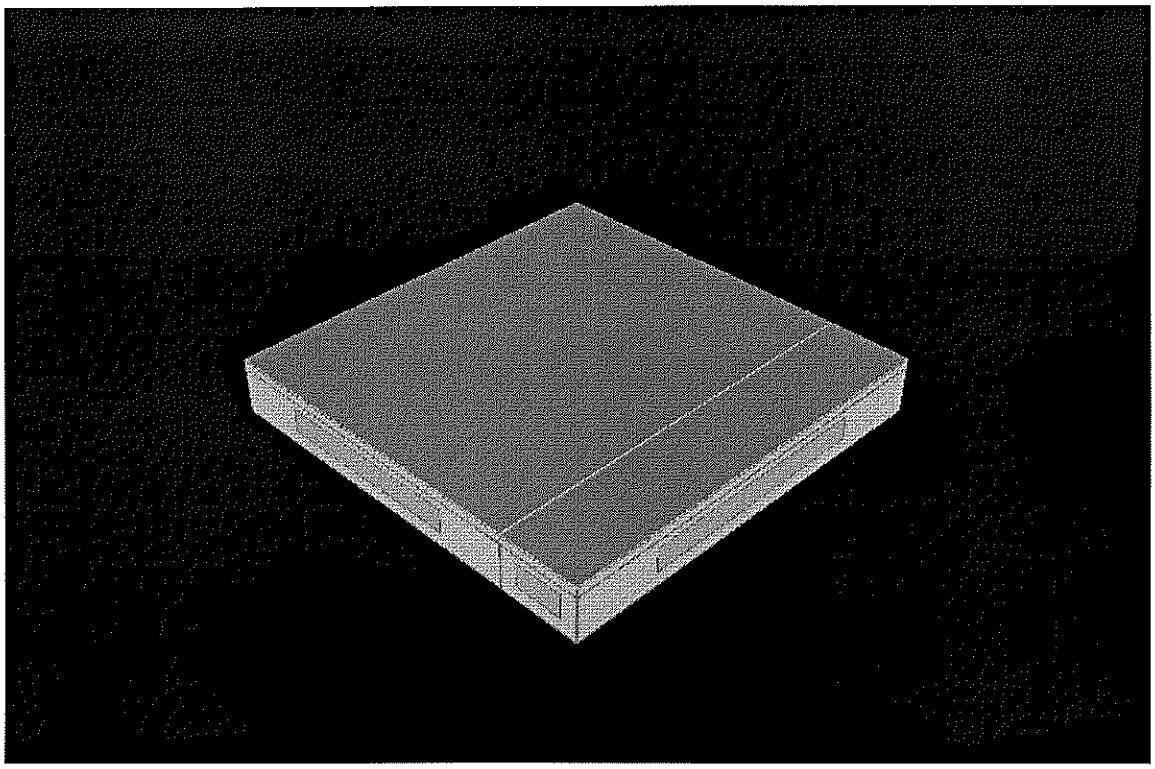


Figure 10. Small Retail Prototype Building Rendering

Warehouse

A prototypical building energy simulation model for a warehouse building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 28.

Table 28. Warehouse Prototype Building Description

Characteristic	Value
Vintage	Existing (1970s) vintage
Size	500,000
Number of floors	1
Wall construction and insulation R-value	Concrete block, R-5
Roof construction and insulation R-value	Wood deck with built-up roof, R-12
Glazing type	Multipane; Shading-coefficient = 0.84 U-value = 0.72
Lighting power density	0.9 W/SF
Plug load density	0.2 W/SF
Operating hours	Mon-Fri: 7am – 6pm Sat Sun: Unoccupied
HVAC system type	Packaged single zone, no economizer
HVAC system size	Based on ASHRAE design day conditions, 10% oversizing assumed.
Thermostat setpoints	Occupied hours: 80 cooling, 68 heating Unoccupied hours: 85 cooling, 63 heating

A computer-generated sketch of the prototype is shown in Figure 11.

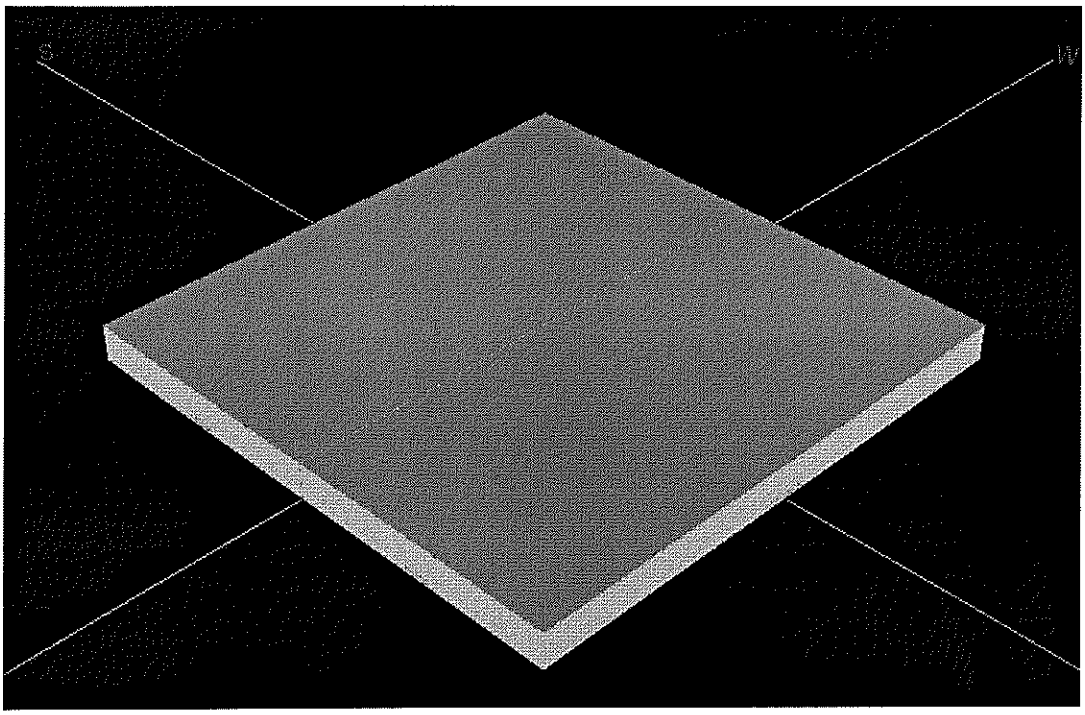


Figure 11. Warehouse Building Rendering

Appendix D. Audit Rebate Considerations

Our first recommendation for the C&I report suggests that the rebate for the audit portion of the C&I Program be structured differently. As this recommendation brought up questions about other methods of rebating audits or current programs that could serve as an example for Empire to help guide a new audit rebate structure, we have included this appendix which provides a list of ideas for consideration.

The following types of mechanisms are designed to increase the chances that customers implement audit recommendations in the C&I sector:

1. Customer is given the audit for 50% of delivery cost as long as they implement at least one of the major recommendations within 12 months of the audit. If they don't implement, they are billed for the remaining 50% of the audit cost.
2. Tie the rebate to the cost of the audit (with an upper limit), and consider targeting the rebate to a specific end use.
3. Customer is given audit for free but must pay a fee per square foot if some percentage of the measures found to be cost effective are not implemented.
4. Customer pays for the entire audit cost up front but gets a check/ rebate for ½ of the cost paid, if they install 50% or some threshold of the measures found to be cost effective.
5. Rebate the cost of the audit into a calculated rebate package that covers all key measures and rebate the package after all installations are completed and inspected.

NYSERDA provides funding for audits, but requires a cost share that is only reimbursed with the installation of measures. The funding for the audits is not likely driven by square footage but has some relative metric. Call Brian Platt at NYSERDA for more details (518) 862-1091, extension 3309.

Final Report

An Evaluation of the Residential Central Air Conditioning Program

Results of Process and Impact Evaluations

Prepared for
Empire District Electric Co.

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December 8, 2009

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Executive Summary

About This Report

This report presents the results of process and impact evaluations of Empire Electric's Residential Central Air Conditioning (CAC) Program. This program's primary goal is to provide financial incentives to Empire District Electric's customers through a rebate for high efficiency central air conditioning systems. The incentives provided are expected to lower participant's utility bills by replacing an inefficient CAC unit with a high efficiency unit. This evaluation focuses on participants that received a rebate between June 2007 and May 2009.

Summary of Findings

1. The Residential CAC Program operates efficiently and smoothly with high levels of satisfaction from the contractors.

2. The training sessions are working for most of the contractors. They report high levels of satisfaction (9.6 on a 10-point scale) with the knowledge of the instructor, and the lowest (7.8 out of 10) with the convenience of attending the session.

3. Of the contractors surveyed, 92% of them are very satisfied with the communications they have had with Empire.

4. Contractors report that increased sales and profits is the primary benefit of their participation in the program, and that their business has improved through increased sales, profits, and exposure. Some of them have added other energy efficiency equipment to their offerings, such as high-efficiency water heaters and programmable thermostats.

5. The savings from the Residential CAC Program are summarized in the table below. More details can be found in Impact Analysis Results.

	kWh savings	Non-coincident kW savings	Coincident kW savings
Gross program savings	568,339	518	389

Recommendations

TecMarket Works and Building Metrics have the following recommendations for the Residential CAC Program:

1. Empire should make it so that information about the Residential CAC program (and other efficiency programs) easier to find on the company's web site. The web site serves as the primary source of energy efficiency program information for its customers, and the program managers are fielding calls about where to find program information online. The addition of a more meaningful phrase in place of the "Smart Energy Solutions" tab, or placing a link on the left pane of the page for energy efficiency information may help

guide customers to the information more easily and decrease the number of calls that the program managers have to field.

2. When the contractors were asked for suggestions for improving the program, the most common suggestion was that they would like to submit the applications online. This can be provided as an option, even if manual J calculations are required to be submitted via pdf file submissions.

3. Contractors are doing a good job of informing their customers of the program, as most of them indicated that they inform their customers about the rebates offered by Empire for choosing a higher efficiency unit. However, they need to be more informed about what systems are covered, and would like to have printed materials to share with their customers.

4. The Residential Central Air Conditioning (CAC) Program is a rebate program for home AC units that are SEER 15 or greater. However, the program also provides rebates for heat pumps and geo-thermal heat pumps. There are contractors that are not aware that geothermal heat pumps are covered by the program, so an effort should to be made to inform contactors on the equipment that is covered by the program. Including both SEER and EER levels and the corresponding rebate amount in program materials will allow customers and contractors interested in the program to make their choice with all of the rebate options available.

5. The SEER-based rebate structure as it currently is set is working well for Empire.

6. Promote the program to all contractors in the Empire service territory. After over two years of program operations, there are still contractors that are not aware of the program and therefore are not informing their customers of the rebate opportunity. A direct mailing to all contractor businesses in the service territory should be considered.

7. Empire should consider adding AC tune-up rebates to program offerings.

8. Empire should consider adding duct testing and sealing training and rebates to program offerings.

9. Empire should consider establishing a documentation path for contractors to demonstrate expertise and experience conducting manual J calculations and exempt those contactors from the training if they demonstrate skill in this area.

10. Empire should also consider incenting attendance at the workshop so that the experienced manual J contactors do not feel it is a waste of their time and a drain on profits.

11. Empire needs to clearly state that inclusion on the list is not an endorsement of the performance of the contactor or their work and state that inclusion is only an indication that the contractor has demonstrated the ability to properly size program covered units to the conditions of the home.

12. Empire may want to consider increasing the rebate level for geo-thermal systems. Empire's practice is to rebate geo-thermal systems at the highest ($500) level, which only covers a small portion of the costs associated with these systems. However, cost effectiveness of these systems is marginal at best. Empire might want to be careful promoting something that is not cost effective for the customer.

13. Empire has sent program materials to all known contractors; however, there is no registration point for them. TecMarket Works suggests that Empire should consider purchasing a list of contractors to work from.

Introduction

This report presents the results of a process and impact evaluation of the Residential Central Air Conditioning (CAC) Program. The evaluation examined participants that received a rebate for purchasing a high efficiency central AC system between June 2007 and May 2009.

Program Description

The Residential High Efficiency CAC Program encourages residential customers to purchase and install energy-efficient central air conditioning and heat pumps by providing financial incentives to offset a portion of the equipment's higher initial cost. The program's long-range goal is to encourage contractors/distributors to use energy efficiency as a marketing tool, thereby stocking and selling more efficient units and moving the entire CAC and heat pump market toward greater energy efficiency.

Incentives are set at approximately 50% of incremental cost. Incentives are available for systems that meet the following criteria:

Split Central Air Conditioner
SEER greater than or equal to 15[1]
EER greater than or equal to 12.5
Air Source Heat Pump
SEER greater than or equal to 15
HSPF greater than or equal to 8.5

The rebates are as follows:

- SEER of 15 to 15.9 = $400 rebate
- SEER of 16 to 16.9 = $450 rebate
- SEER of 17 or higher = $500 rebate

An additional feature of the program is to offer training in Manual D and Manual J calculations and System Charging and Airflow for HVAC contractors. Manual J is the industry standard residential load calculation method. The training offers step-by-step examples of properly sizing equipment and also addresses principles of heat transfer. The training teaches HVAC contractors to accurately perform and document cooling load calculations and reduces over-sizing. Manual D training provides instruction on the impact of duct design on heating and cooling load while the System Charging and Airflow segment of the course addresses airflow and charging procedures and standards.

Estimated participation is 520 for year 1, 650 for year 2, and 780 annually thereafter. The program began June 4, 2007; 167 units were rebated in year 1, and 181 units were rebated in year 2.

[1] SEER = Seasonal Energy Efficiency Ratio. The higher the SEER rating of a unit, the more energy efficient it is. The SEER rating is the Btu of cooling output during a typical cooling-season divided by the total electric energy input in watt-hours during the same period.

Evaluation Methodology

The study methodology consisted of three parts. These are:

1. A process evaluation consisting of in-depth interviews with the program management.
2. A contractor survey.
3. An energy impacts analysis using engineering algorithms.

Process Evaluation Methodology

The process evaluation included a design and operations review via management interviews to discuss various aspects of the program, such as the level of the rebates and types and models of equipment offered. The interview instrument for the management interview can be found in Appendix A: Management Interview Protocol.

Participant Survey Methodology

TecMarket Works was provided with the contact information for 72 contractors that partner with Empire District Electric for the CAC program. We contacted each of them a maximum of 7 times in order to maximize our response rate for this study, and were able to complete surveys with 41 contractors for a 57% response rate.

We spoke with them about a variety of topics, including but not limited to:

- Their understanding of the program's objectives and goals
- The technologies that are covered by the program
- Their satisfaction with the program and its training services
- Communication with Empire staff
- Satisfaction of their customers with the high efficiency options

The survey employed can be found in Appendix B: Residential CAC Program: Contractor Interview Instrument.

Energy Savings Analysis Methodology

The impact evaluation used an engineering-based approach to estimate program savings. The impact evaluation effort consisted of the following steps:

1. Analysis of program participation tracking system data
2. Development and calibration of prototypical building energy simulation models
3. Simulation of measure energy savings
4. Calculation of gross program energy and demand savings

Program Tracking System Analysis

Program participation records covering the period from June 2007 to May 2009 were obtained from Empire District Electric. The data, delivered as a Microsoft Excel workbook, contained customer name and address, installing vendor contact information, system type and efficiency, unit make and model number, rebate amounts, etc. These data were examined to identify the number and types of customers and HVAC systems that participated in the program.

The distribution of equipment type listed in the program tracking database is shown in Figure 1 below.

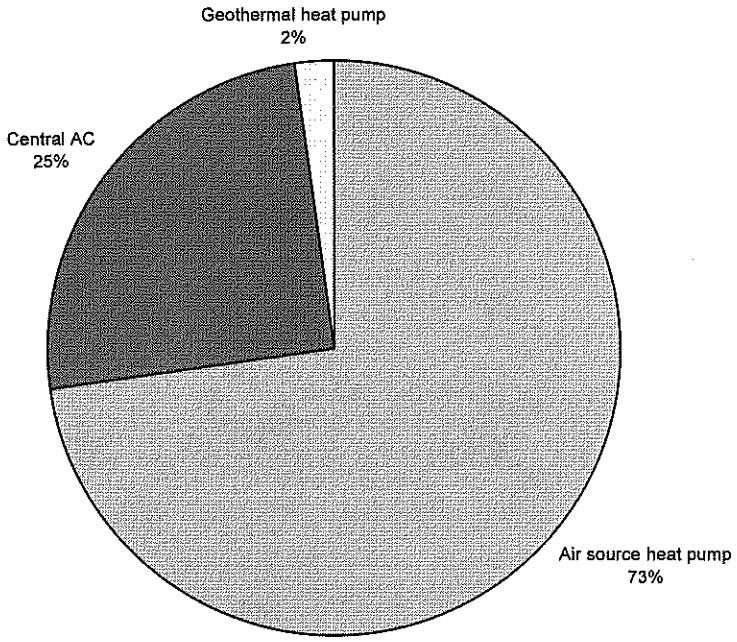


Figure 1. Equipment Distribution

Note the majority of the units rebated were air source heat pumps. Central air conditioners accounted for about a quarter of the applications. Geothermal heat pumps were a minor part of the program.

The distribution of central air conditioner unit efficiency is shown below in Figure 2.

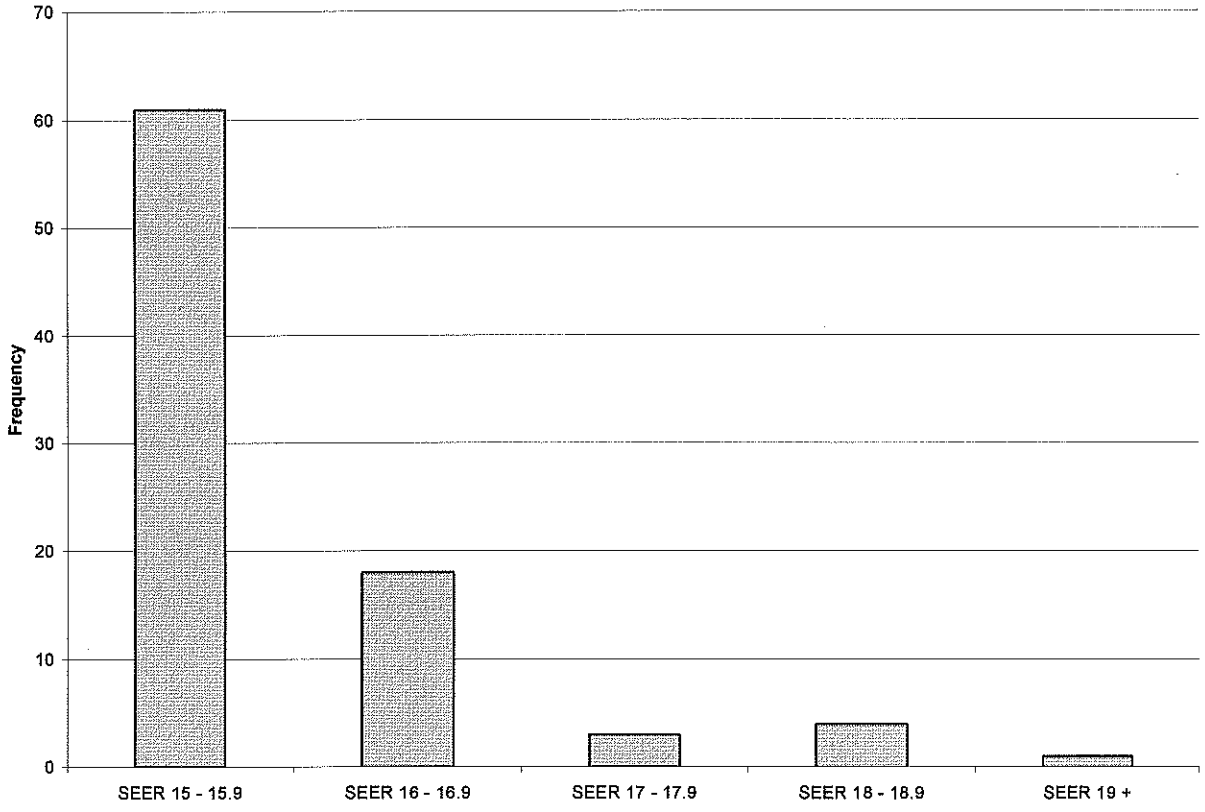


Figure 2. SEER Distribution for Central Air Conditioners

Note, most of the applications were in the range of SEER 15-16. The distribution of the air source heat pump efficiency is shown in Figure 3 below.

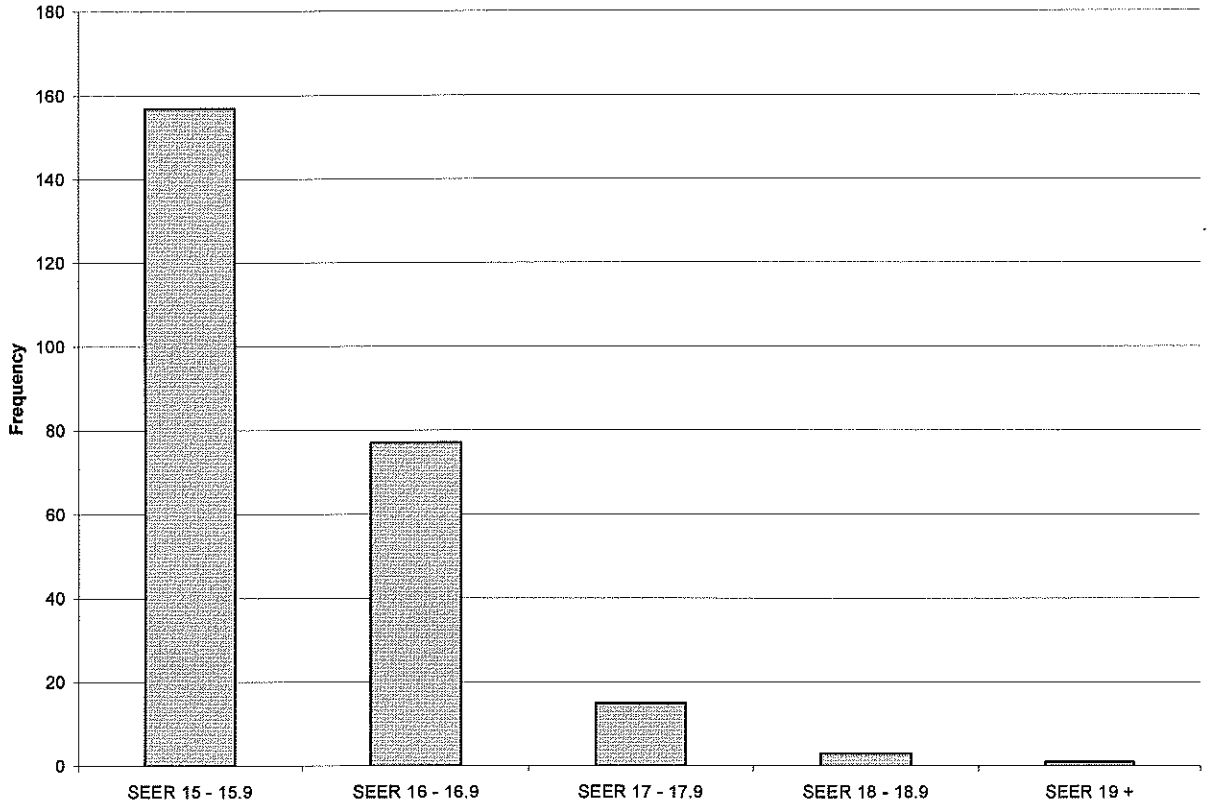


Figure 3. SEER Distribution of Air Source Heat Pumps

As with central air conditioners, the majority of the applications were for SEER 15-16 units, though a higher fraction of SEER 16-17 units were received for air source heat pumps relative to central air conditioners.

The size distribution of all units is shown in Figure 4.

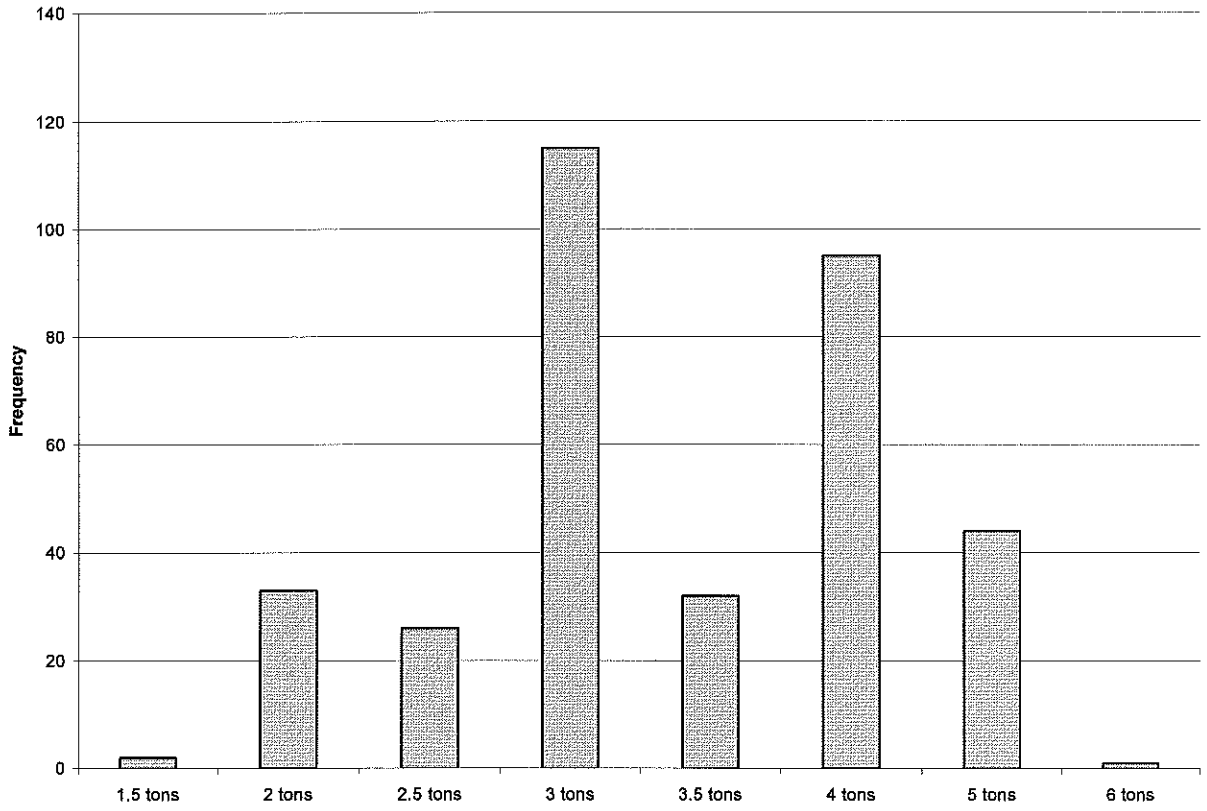


Figure 4. Unit Cooling Capacity Distribution

Note, three ton units were the most popular unit size, followed closely by 4 ton units. There were a significant number of 5 ton units also in the population.

Prototypical Building Model Development

The impact analysis for the Residential CAC program is based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study, with adjustments made for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. Each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 5.

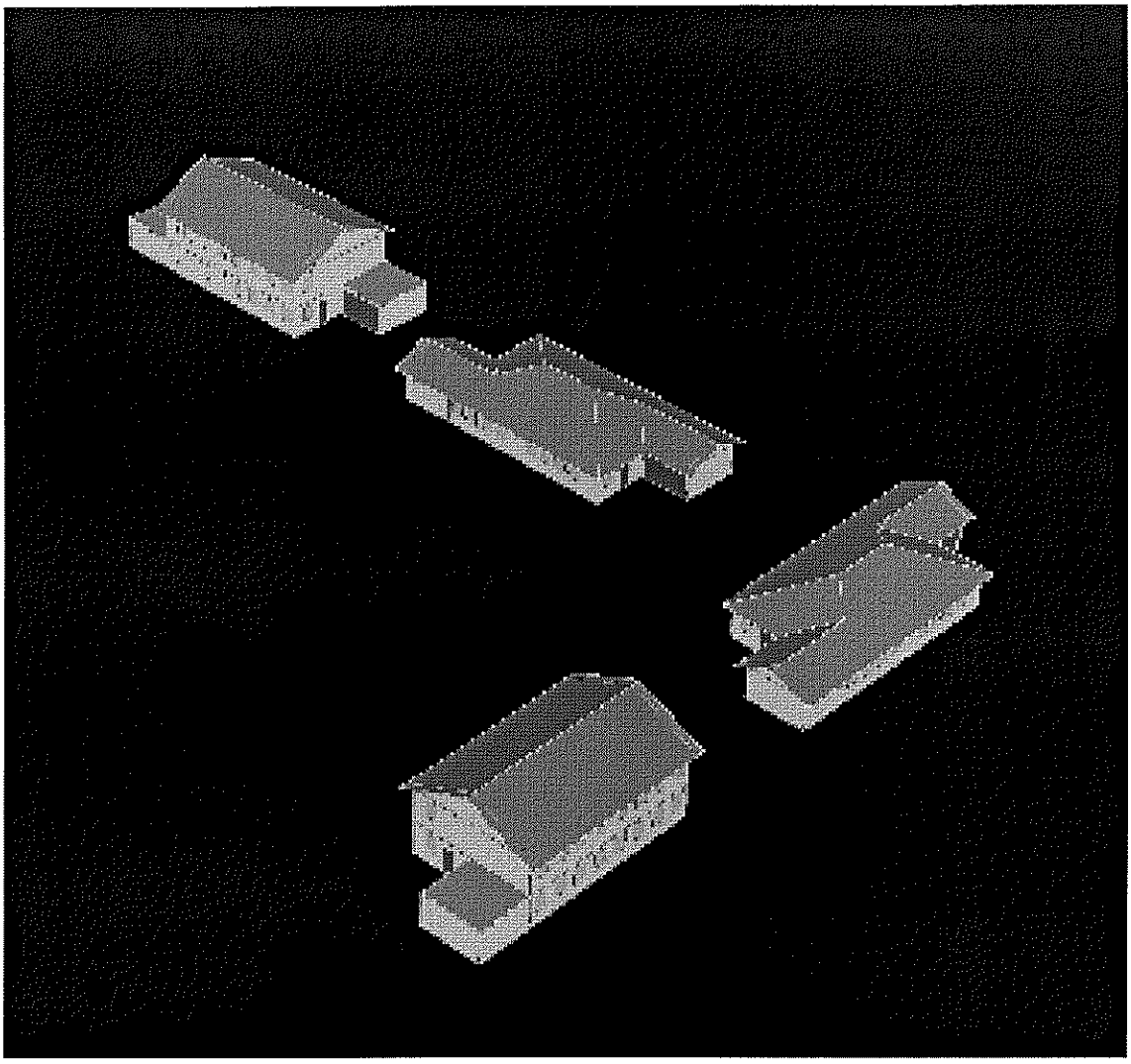


Figure 5. Computer Rendering of Residential Building Prototype Model

We also added a basement to each building to create another set of 4 buildings, allowing us to simulate the impact of the energy efficiency measures on buildings with and without basements.

Data from the US Energy Information Agency (EIA) Residential Energy Consumption Survey (RECS)[2] and the 2002 International Energy Conservation Code (IECC) were used to define the prototype models. The general characteristics of the residential building prototype model are summarized in Table 1.

[2] See http://www.eia.doe.gov/emeu/recs/contents.html

Table 1. Residential Building Prototype Description

Characteristic	Value
Vintage	Three vintages simulated – Old (pre 1980), Average (1980 -2000) and New
Conditioned floor area	1 story house: 1465 SF (not including basement) 2 story house: 2930 SF (not including basement)
Wall construction and R-value	Wood frame with siding, R-value varies by system type and vintage
Roof construction and R-value	Wood frame with asphalt shingles, R-value varies by system type and vintage
Glazing type	Average of single and double pane; properties vary by system type and vintage
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing.
HVAC system efficiency	Baseline SEER = 13 Furnace efficiency = 0.78 AFUE
Thermostat setpoints	Heating setpoint = 70, cooling setpoint =75. Night setback/setup of 5 degrees in runs with setback thermostats.
Duct location	Buildings without basement: attic Buildings with basement: basement
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	20% total, evenly distributed between supply and return
Cooling season	April 27th – Oct 8th
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

Wall, Floor and Ceiling Insulation Levels

The assumed values for wall, floor and ceiling insulation and the assumed average R-value by vintage and HVAC system type is shown in Table 2.

Table 2. Wall, Floor and Ceiling Insulation R-Value Assumptions by Vintage

Vintage	Assumed R-value of exterior wall	Assumed R-value of ceiling	Assumed R-value of floor (buildings without basements)	Assumed R-value of basement wall
Old	3.5	17.5	uninsulated	uninsulated
Average	11	19	11	uninsulated
New	13	38	19	uninsulated

Windows

Table 3. Glazing Property Assumptions by Vintage and HVAC System Type

Vintage	U-value	SHGC
Old	0.9	0.80
Average	0.65	0.75
New	0.35	0.55

Measure Savings Analysis

The prototype model was simulated with a variety of efficiency measures to develop a series of savings estimates. Air conditioning systems were simulated with a baseline SEER 13 air conditioner and with a series of high efficiency air conditioners ranging from SEER 14 to SEER 17. Heat pump systems were simulated with a baseline SEER 13 heat pump and with a series of high efficiency heat pumps ranging from SEER 14 to SEER 18. Standard heat pumps were simulated with electric resistance backup, while dual fuel heat pumps were simulated with a gas furnace backup.

The basic efficiency assumptions for each of the air conditioner and heat pump measures are shown in Table 4. These data were taken from an extensive study of residential air conditioners and heat pumps conducted for the California DEER update study.[3] Besides these basic efficiency parameters, an extensive set of performance curves were developed representing mean performance of production units in each SEER category. These performance curves describe unit efficiency as a function of outdoor temperature, part-load efficiency, and so on. These curves were also applied to air conditioner and heat pump measures in each SEER category.

[3] Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Table 4. Baseline and Measure Performance Assumptions

Type	Efficiency	Fan Type	EER	Sensible Heat Ratio	Air flow (CFM/ton)	Heating COP
Air conditioner	SEER 13	Std 1-speed	11.1	0.75	376	
	SEER 14	EC motor	12.2	0.78	395	
	SEER 15	EC motor	12.7	0.7	319	
	SEER 16	EC motor	11.6	0.81	409	
	SEER 17	EC motor	12.3	0.8	422	
Heat pump	SEER 13	Std 1-speed	11.1	0.725	337	3.28
	SEER 14	EC motor	12.2	0.73	352	3.52
	SEER 15	EC motor	12.7	0.81	436	3.74
	SEER 16	EC motor	12.1	0.78	400	3.48
	SEER 17	EC motor	12.5	0.81	430	3.26
	SEER 18	EC motor	12.9	0.8	428	3.66
Geothermal Heat Pump	EER 13.4	Std 1-speed	13.4	0.73	337	3.1
	EER 17	Std 1-speed	17	0.73	337	3.8
	EER 19	Std 1-speed	19	0.73	337	4.1

Influence of Right Sizing and Refrigerant Charge and Airflow Testing
Contractors participating in the Residential CAC program are expected to attend training in proper HVAC system sizing (Manual J) and refrigerant charge and airflow testing. Evidence of Manual J (or equivalent) sizing is required as an attachment to the rebate application. The analysis assumes that the rebated systems were oversized by 20% of the Manual J load, and were adjusted for proper charge and air flow during installation. The baseline system is assumed to be a standard-efficiency (SEER 13) unit that has not been properly sized or installed. The baseline system is assumed to be oversized by 50% of the Manual J load; with the unit efficiency and capacity adjusted to account for average installation practices.

To account for average installation practices, the analysis follows the procedure used by the 2005 DEER[4] study to estimate the energy savings from refrigerant charge and air flow testing. The baseline unit compressor cooling efficiency is reduced by 13%, the total cooling capacity is reduced by 11% and the sensible cooling capacity is reduced by 7%. These factors were applied to the baseline SEER 13 system, while the efficiency of the rebated unit is assumed to conform to the manufacturer's data.

Run Matrix
This set of measures resulted in a simulation run matrix as follows in Table 5:

[4] The DEER study references a paper by Mowris, et al., *Field Measurements of Air Conditioners with and without TXVs,* Proc. 2004 ACEEE Summer Study on Energy Efficiency in Buildings. American Council for an Energy-Efficient Economy, Washington, D.C.

Table 5. Set of Measures

Category	Number	Description
Building Vintage	3	Old Average New
Foundation type	2	With and without basement
HVAC systems	3	Air conditioner with gas furnace Standard heat pump with electric backup Geothermal heat pump
Air conditioner efficiency levels	5	Base and 4 measures
Standard heat pump efficiency levels	6	Base and 5 measures
Geothermal heat pump efficiency levels	3	Base and 2 measures

The set of simulations described above were conducted for Joplin, Missouri using TMY3[5] long term average weather data from the National Renewable Energy Laboratory. The results for each of the vintages were weighted according to the relative frequency of each vintage in the overall population. The weights used in the analysis were derived from the RECS[6] data, showing number of units by year of construction and foundation type by climate characteristics, as shown in Table 6 below:

Table 6. Weights Used by Building Characteristics

Category	Value	Weight
Vintage	Old	0.66
	Existing	0.34
Foundation Type	No Basement	0.77
	Basement	0.23

The simulated savings were normalized per ton of cooling capacity and applied to the unit sizes in the tracking system.

[5] Typical Meteorological Year (TMY) dataset version 3 (2008) produced by the National Renewable Energy Laboratory (NREL). See http://www.nrel.gov/docs/fy08osti/43156.pdf
[6] Residential Energy Consumption Survey (RECS). See http://www.eia.doe.gov/emeu/recs/contents.html

Evaluation Findings

Process Evaluation

This section presents the results from the in-depth management interviews performed with Sherry McCormack and Kelly Chenoweth.

Program Objectives

Both of the program managers have a clear vision of the objectives of the Residential CAC Program; to increase the energy efficiency of Central Air Conditioners among Empire's residential electric customers in a way that delivers a peak load reduction on the system during the summer peak consumption periods.

The program has not achieved the estimated demand reductions described in the original program plan, however, the program managers believe the program has been beneficial for gaining programmatic experience, for understanding the operations of the residential AC markets, and has helped establish an operational foundation and programmatic frameworks for achieving greater savings as the program progresses. Managers noted that there are additional applications coming in "almost every day", increasing the program's energy impacts and boosting participation rates.

The SEER threshold requirements for a rebate through the Residential CAC program (15 SEER or greater) are moving people to purchase units that are at or above the minimum federal standard for Energy Star units, however, if the federal standards change, Empire feels that they will need to increase the SEER threshold and the rebate levels in order to offset the additional incremental costs associated with the higher efficiency units.

Program Design

Empire District, working with Applied Energy Group (AEG), designed the program and established its operational conditions. Empire held multiple focus groups with contractors to obtain feedback on the training portion of the program. Focus group participants consisted of contractors through whom the program was to be offered. The contactors were recruited by personal invitation from Empire personnel. Sherry McCormack called a selection of contractors operating within the Empire service territory and invited a diverse group of contractors who agreed to participate. The focus group focused on obtaining contactor advice on market baseline conditions and targeted levels of efficiency required to make the program cost effectively achieve the needed energy savings. The focus group also addressed different operational approaches for gaining contactor support and for moving the higher efficiency units into the market.

Technologies and Efficiency Levels

Central Air Conditioners

The focus groups were used to help determine the baseline threshold SEER rating for setting rebate levels that move sales above the threshold. AEG helped Empire conduct the focus groups. Following the focus groups, AEG recommended that the program focus on incenting units with a

15 or greater SEER. The program managers agreed that SEER 15 could meet the objective of the program if enough units could be installed. The focus group also determined that SEER 13 and 14 models should be considered the baseline standard level of efficiency and that if the program covered the SEER 15 (or higher) units the program would make a difference to the customers who are looking to obtain added value in their purchase decision.

Heat Pumps

Empire provides rebates to customers for installing heat pumps if applications are submitted for a rebate on a high efficiency heat pump. The heat pumps that are rebated through the program must have an efficiency rating of at least 15 SEER, 12.5 EER and 8.5 HSPF.

To document that the program is not promoting fuel-switching, Empire sends a survey to a portion of the customers that have purchased a heat pump and submitted an application for a rebate through the CAC program. The customer indicates on the survey that the program did not influence their decision to install a heat pump and that the rebate did not make them change their mind about which technology to purchase, but that the program did influence their purchase of a higher efficiency model of a heat pump. With these survey results, Empire can provide a rebate and demonstrate that the customer elected on their own to install a heat pump and document that Empire is not encouraging fuel switching by promoting energy efficient technologies.

The program provides rebates for but does not promote energy efficient geo-thermal heat pump systems. One of the program managers suggested that this could and should be promoted by the program and included in program materials because installing a geo-thermal heat pump should not be considered fuel-switching if the original system was a heat pump. For geo-thermal systems, Empire's practice is to rebate geo-thermal systems at the highest ($500) level, which only covers a small portion of the costs associated with these systems. Empire may want to consider increasing the rebate level for geo-thermal systems.

If Empire can offer rebates for geo-thermal systems that result in energy savings and these systems are not considered fuel-switching, TMW recommends that the program materials be changed to include geo-thermal heat pumps in their marketing and outreach material and in the program's decision support materials to customers and contactors.

Other Technologies

Empire program managers have considered expanding the Residential CAC program to include other technologies as a means of increasing both program participation and energy savings. In addition to heat pumps (discussed above) other cooling technologies including room and window AC units and programmable thermostats have been considered. However, the program managers believe that these technologies may more appropriately fit in different Empire program, such as an appliance rebate program.

Program Operations

Sherry McCormack led the development and implementation of the Residential CAC program. On a day-to-day basis, she fields calls from customers and contractors and responds to questions from contractors regarding how they can be placed on the approved contractors list. She also fields calls from customers who would like to view the approved contractors list or learn how

they can apply for and receive a rebate for an AC unit. In her capacity as one of the program managers, Sherry McCormack also coordinates the contractor training efforts by establishing the dates and locations for the training workshops and acquiring the trainers to teach the workshops. She also conducts outreach efforts to reach new contractors and enroll them in the training workshop. After the training session is completed, Empire staff creates and mails certificates of completion to the contractors that successfully complete the training. These contractors are then placed on the approved vendor list.

The other CAC program manager, Kelly Chenoweth, receives the applications, reviews them for content and accuracy and approves or rejects them. According to Mr. Chenoweth, he approves about 95% of the applications submitted. Once the applications are approved they are given to Sherry McCormack for rebate processing. Sherry McCormack enters the information into the tracking database and sends the rebate check to customer. According to the program managers, the examination, approval and processing of applications is completed in 10 to 14 days. The program managers have noted that few applications are rejected, and that most of rejections occurred during the early stages of the program when there was some level of confusion because of unclear technology and rebate application guidelines. In the early stages of the program, some of the contractors were installing equipment that did not meet the program's SEER requirements. For example, in a few cases customers thought that they had installed a SEER 15 AC unit. However, Empire would declare it a 14.5 SEER after an examination of the make and model number. This condition occurs because some manufacturers are inaccurate in the labeling of their units. For example, a unit is labeled by the manufacturer as an "Elite 15 Series" unit, suggesting an SEER of 15. However, these units perform at a 14.5 SEER level rating unless they are installed with an EC motor which increases the operational efficiency by one-half a point to 15.0. This issue was discussed with the contractors who were instructed to make sure that 14.5 SEER units were not included in the program applications. This issue was both identified and resolved during the early start-up months of the program's operations.

Contractor Training

In order for HVAC contractors to be placed on the approved contractor's list, they must complete ACCA Manual J training. Contractors can meet this requirement by either completing Empire's training workshop or by providing documentation of ACCA Manual J calculation training obtained from another training provider.

Empire offers free one-day training sessions covering both ACCA Manual J and Manual D calculations in early spring (March) prior to the cooling season, and also during the mid-to-late winter months (when contractors are typically not as busy). To maximize participation, training is offered in five cities: Joplin, Springfield, Webb City, Republic, and Aurora. The scheduling of the training sessions are informed by contractor advice pertaining to the best times and locations for their industry. During the training Empire provides food, beverages and full-color brochures describing the program and the program's requirements.

The training offered by Empire is not software based; rather the manual's calculations are taught so that the attendees understand the math behind it and can conduct the calculations without a computer and the associated software. Empire's goal for offering the training is to have contractors become more aware of the calculation approach and understand the importance of

performing proper load calculations. The program managers feel that the contractors need to know how the calculations are actually done, even though dealers usually use software to do these calculations. For the contractors with calculation experience, the training sessions serve as a refresher course and helps assure calculation accuracy. For the contractors that don't know how to do the Manual J load calculations, the training helps them understand the calculation approach and be able to conduct those calculations.

The contractors' primary benefit for completing the training session is that they are listed by Empire as an "approved contractor", which enhances their standing in the market. The program becomes not only an approach for assuring the reliability of the contractors' recommendations, but also allows contractors to up-sell a better product to their customers at a better price than what could be provided without the program.

According to one of the program managers, only one contractor has complained that Empire is "implying that he needs training". This particular contractor was offended by the training requirement because he has been in business for 30 years and has a deep knowledge of the equipment and industry. There are others that have expressed that they don't feel that they need to attend the training, but they are willing to attend in order to be listed as an approved contractor. Because the contractors are typically small businesses that must be both profitable and focused to succeed in the market, asking contractors who are already experts at manual J calculations, to complete a training course may not be necessary. Empire should consider establishing a documentation path for contractors to demonstrate expertise and experience conducting manual J calculations and exempt those contactors from the training if they demonstrate skill in this area. Empire should also consider incenting attendance at the workshop so that the experienced manual J contactors do not feel it is a waste of their time and a drain on profits. However, even contactors who already knew how to do manual J calculations have reported to TecMarket Works that they were happy to attend and that they learned something from the training despite their reservations. Additional information about the contractors' thoughts on the training sessions can be found in the section: Contractor Survey Results.

Approved Contractor List

The CAC program's approved contractor list is available on Empire's web site and allows residential customers to select an approved contractor for selecting and installing a high-efficiency air conditioner. However, having this list of approved contractors presents a challenge for the program managers because there are three levels of dealers that can be placed on the approved contractor list. These are:

1. Contractors that attended a training session who are automatically added to the approved contractor list.
2. Contractors with previous load calculation training. These contractors provide documentation of training they received elsewhere. Empire reviews their documentation, and places them on the approved contractor list.
3. Contractors waiting to attend a training session. If a contractor has a current customer that wants to do business with them and also wants to receive the program rebate, the contractor can verbally commit to attend the next training session. These contractors can be provisionally placed on the approved list if they send a copy of the

load calculation and it passes a review by the program manager. This is done to maintain good relationships with the contractors and allow them to do business with their customers who want to receive the program's rebate.

The problem with this approach is that the program managers don't always know what the contractor has done to be put on the list. A contractor can be provisionally placed on the list but not yet be documented on manual J calculations. Because being on the list can be considered an endorsement by Empire and the list suggests to the customers that the contractor is qualified it is possible to be on the list and not yet be training certified. Empire is concerned that being on the list can suggest that Empire is essentially endorsing an untrained contactor for AC equipment sizing calculations. However, TecMarket Works suggests that this problem may not be significant in that once placed on the provisional list the contractor is obligated to obtain the training or demonstrate past training. If the contactor can follow a path by which they can be certified by demonstrating manual J calculation skills, this issue can be addressed. In addition we have found that most contactors who are not able to conduct manual J calculations tend to follow rules of thumb pertaining to sizing decisions. There is also evidence within the evaluation community that the energy savings from units not sized via a manual J calculation also provide energy savings approximately equal to the saving achieved via the manual J calculations. That is to not excessively over-size the units and to allow enough operational time to dehumidify the air that is in the home. Having the ability to document manual J calculation expertise instead of requiring attendance at a training event may serve the same purpose and reduce performance uncertainty regarding contractors who do not complete the training. This can be done by having the contractors not wanting to attend the training send a manual J calculation to the program manager that, if accurate, allows the contractor to be listed, but rejects the contractor if the calculations are in error or exclude key calculation components.

Another issue with the approved contractor list is that one of the program managers believes that there are contractors on the list that should not be endorsed by Empire due to their having poor work histories in the area. This manager thinks that Empire should remove contactors from the list if there are documented cases of poor performance. TecMarket Works agrees, but suggests that removal from the list must be for a performance cause demonstrating repetitive poor performance for program-covered installations. In addition, Empire needs to clearly state that inclusion on the list is not an endorsement of the performance of the contactor or their work and state that inclusion is only an indication that the contractor has demonstrated the ability to properly size program covered units to the conditions of the home. The list should also clearly state that Empire assumes no responsibility for the performance of the contactor or the equipment installed by the contactor and that contractor selection is up to the customer. The program managers also noted that exclusion from the list may only be as a result of the contactor's lack of knowledge about the program, rather than exclusion for cause. The list needs to clearly state that exclusion from the list does not indicate a lack of knowledge, skills or professional performance. Allowing contactors to demonstrate manual J calculation ability would help add contractors to the list as they learn about the program and submit documentation of manual J skills.

The program manager occasionally has contractors calling to inquire about the programs and to understand why they are not included on the list. The unlisted contactors are upset that they are

not on the approved list of contractors, and that this condition leads to awkward conversations and less pleasant relationships with area businesses. Empire strives to maintain positive relationships with the contractors, because they are important trade allies and they support and promote energy efficient equipment. This program manager would rather not have an approved contractor list and have all area contractors qualified to submit the applications with the summary of the load calculation attached to the application. This seems like a reasonable approach in view that the manual J calculations have to be reviewed and approved prior to a rebate being sent. However, if Empire wants to continue with the list, these contactors can be asked to provide manual J documentation and then added to the list. In addition, TecMarket Works recommends that a mailing be sent to all registered HVAC contractors after Empire purchases a list of contractors in the service area that presents the program to each contractor and asks for documentation of manual J calculation ability to be added to the list if they are not currently listed. In addition, Empire can provide correspondence to equipment manufacturers, distributors, wholesalers and dealers asking them to inform their installation contractors about the program and encouraging them to ask their contractors to provide manual J calculation documentation.

A third issue with the approved contractor list is that after the contractors are on the approved list, they only have to send in a form stating that they performed the calculations; they do not have to submit the actual calculations that were performed. Therefore, the approved contractors may be simply signing the form and skipping the calculations, or altering numbers to get a desired (rebate-qualifying) result. However, this issue is not deemed significant by TecMarket Works as long as they have demonstrated the skill needed to perform the calculation. It is unlikely that experienced contractors are improperly sizing covered units to a significant degree, and the energy savings are still being achieved. That is, the savings are provided because of the efficiency difference between the same sized units that would have been installed.

However, TecMarket Works agrees that if a load calculation is required (and we are not suggesting that it be required) to qualify for the rebate then the actual calculations should be provided with the application to ensure that they are being completed.

Program Participation

Both of the program managers feel that participation levels and subsequent energy savings from the program could improve.

The CAC program is marketed through newspaper advertising, bill stuffers, bill messaging, and through the contractors. One manager believes that the contractors do a good job of promoting the program, while another believes that Empire could do a better job getting program information out to the contractors for them to promote the program with. After more than two years of program operations, there are still contractors calling Empire each week stating that they had just heard about the program and would like more information about how they and their customers can participate. A mailing to all contractors, distributors, dealers and wholesalers would go a long way to solving this problem.

A program manager explained that 35% of the central air conditioning units in use in Empire's service territory are at least 10 years old. As these units are replaced the potential for achieving

savings is provided in the market. If Empire were to capture the majority of these units though the program the program could meet its energy savings goals. However, there are challenges in getting the word out to the contractors that they need to enroll in the program and explain to their customers that energy efficient improvements are worth the extra cost. A mailing to all contractors in and around the territory can help reach this objective. Other methods of promoting the program and increasing participation are discussed below.

Web Site Promotion

Empire relies heavily on the company's web site for promotion of the CAC program. The Empire web site allows contractors and customers to access program information, application forms, and the approved contractor list. However this information can be difficult for many people to find, especially when equipment changes are typically made while working with their selected contractors. Typically when a unit needs to be replaced, customers discuss the options with their contractors who must install the equipment. It is important for the contractors to be allied with the program. The marketing efforts need to focus on the contractors and trade allies, as well as, but to a lesser degree, the customer making the purchase decisions. This is not to suggest that improvements to customer marketing cannot be achieved. For example, the program may be able to increase participation by making the information easier to find on the Empire web site. The program information on the Empire web site is under a tab called "Smart Energy Solutions", which may be difficult for people to associate with energy efficiency program offerings. While Empire's energy efficiency programs do indeed offer "smart energy solutions", the phrase does not indicate that there are programs and financial incentives for energy efficiency improvements to Empire's customers.

TecMarket Works agrees that using the web is the fastest and most cost-effective way to provide current program information to a wide audience. In addition changes to the approved contractor list or other program changes can be made almost immediately available to the customer that uses the web to inform purchase and installation decisions.

However, the program information needs to be easier for the average customer to find. TecMarket Works asked two of its staff members to measure the amount of time it took to find the program information on Empire's web site. It took one employee 25 minutes to find the CAC program information on Empire's web site. Another employee needed 4 minutes to find the information. TecMarket Works suggests that web pages for energy programs be designed so that inexperienced searchers can find the information they need by spending no more than 5 seconds on each page leading to the information needed by that customer. Searches that take 10 seconds per page or more by a new visitor should be considered improperly designed. The path to the information needed should be readily available and apparent to customers within a few seconds per page and take no more than a minute or two for the new visitor to reach the information needed after first clicking on the Empire website link.

The "Smart Energy Solutions" tab on Empire's web site should be changed to a more descriptive tab name such as "Energy Efficiency Solutions" or "Customer Options for Saving Energy" or similar descriptive link. Empire has space across the web page's tab view for better wording. Empire should consider more descriptive headings for these tabs. Alternatively, there could be a

direct link to all program offerings through a new logo or mascot for all of Empire's energy efficiency programs housed on the main web page or via a clear and convenient link.

Other Ideas for Increasing Participation

Another suggestion offered by the program managers for increasing program participation is to include an AC tune-up component. The service could be offered to all customers, not just those that purchased their AC unit through the CAC program. This service would allow customers to improve the efficiency of their central air units when their systems need repair or service. TecMarket works agrees. Evaluation reports indicate that tune-ups can increase the energy efficiency of the units that are not routinely well serviced if they are conducted by a well trained tune-up contractor that uses specialized sensors and pressure gages and that are careful not to damage pressure valves, lines and seals. However, tune-ups provided by unskilled, semi-skilled or untrained contactors can increase consumption. As a result this option needs to be carefully considered and planned.

New HVAC systems installed under the program may be able to qualify for the ACCA Quality Installation (QI) program[7]. The QI program addresses system sizing, proper refrigerant charge and air flow, and duct leakage sealing. The current contractor training addresses the first two issues; adding a duct leakage sealing component could produce installations that meet the QI spec. Duct leakage sealing in homes with ductwork located in unconditioned attics and crawl spaces can bring additional energy savings and comfort improvements. An additional incentive could be offered for installations that are QI compliant. Simulation modeling conducted for this evaluation indicated that sealing ducts in unconditioned spaces can increase energy savings by about 9% in air conditioner installations and about 20% in air source heat pump installations.

[7] See http://www.acca.org/quality/

Contractor Survey Results

TecMarket Works surveyed 41 out of 72 contractors that are on the approved contractor list for a 57% response rate. The responses and analyses are presented below, and the survey instrument used for this evaluation can be found in Appendix B: Residential CAC Program: Contractor Interview Instrument.

The contractors surveyed by TMW had an average of almost 20 months of experience with the Residential CAC program, as displayed in the table below. The program has been operating since June of 2007 (about 26 months at the time of the survey).

	Duration of Experience
Average	19.75 months
Minimum	8 months
Maximum	24 months

Contractor Involvement with the Program

At the start of the survey, TMW asked the contractors how they were involved with the Residential CAC program in order to hear their explanation of how they participate and utilize the program. Below is a bulleted list of their responses. The first statement is in bold and serves as a summary statement for contractors' involvement, and the statements below are each of the unique statements provided by the contractors during the interview.

- **We do a load calculation and then tell the customer about the program and how to qualify for a rebate:**
  1. We evaluate what the customers' needs are and what their desires are, then use a computer program to analyze loads to size the equipment.
  2. We get calls from clients and we go out to evaluate their home and current system, then we do calculations and advise them on what to purchase.
  3. We do load calculations and tell them about the minimum efficiency needed to qualify for the Empire rebate.
  4. First we make sure they're Empire customers, and then we calculate heat loss and gain on their home, evaluate their equipment needs, and let them know how they can receive the application forms to fill out.
  5. When we get a call from someone to replace equipment, we do a load calculation to see what equipment they need and tell them about program.
  6. We ask our customers if they have Empire service, and if they do we tell them about the rebate, we do heat load calculations and look up the numbers.
  7. We do load calculations, measure dimensions, and size units appropriately.
  8. First we determine if the customer is with Empire, then we perform measurements of the house and Manual J calculations, and then make recommendations for a system that qualifies for the rebate.
  9. We gather material to inform our customers of programs and who offers them, then we size up their house, do a load calculation, and let them know what SEER rating is best for them.

10. We normally do a load calculation, survey their current equipment, and then walk them through the process. We let them know what's available at what cost and the rebates and tax credits that they qualify for.
11. I size the equipment, do a load setting on the home, and then get the customer whatever paperwork they need to send in.
12. When we get a call, we go out to do a load calculation or see what the problem is and make recommendations from there. If applicable, we tell the customers what rebates are out there.
13. We go measure the customer's house and tell them about the rebate to see if they are interested and then do a heat load calculation.
14. I provide them with ARI certs and load calculations and then inform them of the program.

- **We just let the customer know that the rebate exists and how to qualify.**
  1. We just tell the customer what needs to happen if they want to take advantage of the program.
  2. We look at equipment that's included in the program, and then let the customers know what they have to purchase to get the rebate.
  3. We let our customers know that there is a rebate for more efficient units.
  4. We inform our customers of the program's rebate and the government tax credit.
  5. We inform our customers of the rebate and then make sure they will qualify.
  6. We educate our customers about the federal government requiring 13 SEER or better, and the numbers required to get the rebate.
  7. We inform our customers about the federal credits and other incentives. Most of them don't know there are such offers out there.
  8. We inform them about the rebate when they are looking to buy new equipment.
  9. We make sure they are aware of the rebate and offer them equipment that is covered by it.
  10. Our people are qualified for the Manual J load calculations and we push for the best equipment so we inform the customers about the qualifying products.
  11. We inform our customers about the rebate if they are looking to replace old equipment or are building new homes.
  12. Basically, we quote higher efficient equipment and bring up the rebate. If a customer is interested, we continue to talk to them about it. Often people are looking for efficient equipment to begin with and the rebate is just an extra bonus.

- **We use the rebate as a selling point.**
  1. We push the high efficiency options to our customers, but we use the rebate program to help sell them.
  2. If the customer lives in Empire's territory, we get the application form and use it as part of our proposal.
  3. It seems that all of our customers want to make sure they're getting the rebate through the program, so it really helps us sell the high efficiency equipment.
  4. We try to get our customers to purchase a unit that qualifies for the rebate if they have Empire service.

- **We don't try to push them into anything. We just tell them their options**
  1. We always present our customers with all of the options. We don't push people into things, we just give them all the information they need and show them the energy savings chart.
  2. We don't take any steps or push anything unless we're asked by the customer.

- **Miscellaneous**
  1. We sell high efficiency units and like to help our customers save a little money. We try to stay educated ourselves so that we can educate our customers.
  2. After going out and checking out what they need or what the problem is, if a rebated item fits the criteria, I let them know.
  3. I'm a wholesaler, but I provide my dealers with information regarding the rebates and that allows them to push it to their customers.
  4. We give them a bid, do a Manual J on the house, and then see what they are interested in.
  5. We teach customers about the requirements and load calculations and the importance of the SEER rating.

Eight of the surveyed contractors (20%) offered suggestions for streamlining the process for program participation, and most of them suggested that it be more convenient if the forms could be filled out online.

1. The rebate could be filled out over the internet instead of requiring people to print them out. (n= 6)
2. Make the program requirements clearer; people sometimes don't understand the program.
3. It's a hassle to do the paperwork and heat load calculations, but they seem necessary.

Reasons for Participation
All but one contractor surveyed provided TMW with a comment summarizing their reasons for participation. The first statement is in bold and serves as a summary statement for contractors' involvement, and the statements below are each of the unique statements provided by the contractors during the interview.

- **It's a selling incentive; it saves the customer money.**
  1. It's another selling incentive and it helps the customers get some money back.
  2. To inform and help customers. It also helps close deals.
  3. People like the rebates and it helps me make the sale.
  4. It's a good selling point.
  5. It generates sales.
  6. It allows us to sell more high efficiency units and give something back to the customers.
  7. I can offer the customer a better value and they get a better unit that saves more money.
  8. It increases sales and helps my customers.
  9. It helps us sell more units and it helps us get the customers better equipment.
  10. It helps increase sales, and customers have asked for it.

- **It allows the customer to upgrade to better equipment and higher efficiency.**
  1. It gives the customers a chance to get an upgrade.

2. We do it for the benefit of the customers, to help them get better equipment and higher efficiency.
3. It upgrades people's equipment. They like the idea of getting something for nothing.
4. We sensed that it was a good program to induce the customer to upgrade equipment.
5. To help customers get more efficient equipment. It also helps sell higher-end equipment.
6. It gets our customers away from the "bottom of the line," cheap units, and towards more efficient units.
7. So we can sell our customers a better product.

- **We participate to get the most for our customers. Our clients wanted us to participate.**
  1. We were asked to participate. Our clients want it.
  2. It is easy to work with and the customers like to save money and energy.
  3. We like to be personal with the customers and get them the best deal possible.
  4. It is a good service for the customer. We don't work on commission; customer service is our driving force.
  5. We want customers to have lower utility bills and reduce their carbon footprint.
  6. To be able to save people money.
  7. The rebates help my customers save money.
  8. To keep our customers happy.
  9. One of our customers found out about the program and introduced us to it.
  10. We do it for the rebates, and for our customers
  11. To get the best options for our customers.
  12. Most generally, we do it for our customers and their happiness.
  13. We participate for the customers' sake.

- **We want to stay competitive.**
  1. We want to build a service department and keep up with what everyone else has to offer.
  2. We're in it to make money, to sell high-end equipment, and to take care of the customer.
  3. We want to be on the cutting edge and also give our customers an extra hand.
  4. To sell more units, especially high efficiency equipment. I've been pushing it for about 5 years.
  5. To give customers the best possible prices and options for equipment.

- **Miscellaneous**
  1. It gives customers extra benefits to become more efficient and we get to have our name on the list of certified dealers.
  2. It helps my high-end customers.
  3. It offers people another option to look at.

Many of the contractors had suggestions for increasing the participation levels in the program. The majority of the suggestions (8 out of 23, or 35%) involve increased advertising. Their comments are as follows:

- **Increase program promotion and advertising.**
  1. Put something in the bills that they send to customers, or something else to advertise. Dealers shouldn't have to push the program, Empire could be more proactive.

2. Empire should send out more letters promoting the program to its customers.
3. Get the word out about the program. Some of the smaller contractors may not even know about it.
4. Get the word out to people, maybe through a flier in the mail.
5. Let people know about the program. Get them more informed.
6. Advertise. Get some form of ad out on the news about the training workshops for contractors. Print ads and place them in supply houses.
7. Send customers and contractors more information about the program.
8. Advertise it more.

- **Make it easier to get qualified and participate.**
  1. Offer the training class more often.
  2. Make it easier to participate. Buying a program for load calculations and distributing it would be a big help. Such programs are expensive.
  3. Make it easier to get qualification.
  4. Manual J requirements might be part of why some contractors don't want to participate.
  5. The main thing is the paper work, getting it started can be tough, but then it's fine.

- **Offer some type of incentive to the contractors.**
  1. Maybe Empire should give an incentive to the dealer or contractor.
  2. Offer something to the contractors in exchange for pushing the rebated items.
  3. It would be nice to not have to do all the legwork, such as the heat load and the paperwork. Contractors don't get any compensation for that.
  4. Maybe offer some kind of incentive to the contractors.

- **Educate contractors (and public) on the benefits of participation.**
  1. It's hard to do because many contractors are set in their ways, perhaps more education would help.
  2. Provide education, many contractors aren't aware of the program.
  3. Convince contractors that it will create more business.
  4. Educate the public on why they should switch to high efficiency HVAC and help the HVAC companies out a bit more.

- **Increase the incentive amount.**
  1. The incentives aren't high enough.
  2. Increase the incentives.

Benefits of Participation

Contractors reported that they receive many benefits from participation in the program, but most of them (23 out of 37, or 62%) report that the main benefit of participation is the benefit of increased sales and profits, but they also cite being recognized as an approved vendor, and increased satisfaction with their customers. All of the contractors said that their customers generally respond positively when they are told about the program's rebate.

- **By participating in the program, we get more business and it makes us more money.**

1. We get a bigger client base.
2. We get more business.
3. We are able to charge a higher price per job.
4. We get more business.
5. We might wind up selling a little more.
6. We get more sales, especially from higher efficiency units.
7. We get more money in the bank.
8. Selling more high efficiency equipment equals more money.
9. It opens the door to new customers.
10. We maintain a higher profit margin.
11. We get a small improvement in sales, especially with the federal tax return.
12. We get increased sales and better profitability.
13. We get more sales.
14. It drives the cost of the equipment sales up, increasing general revenues.
15. It helps the customer and we see an increase in sales.
16. We can sell more units and make customers happy about a rebate.
17. We are selling higher priced equipment.
18. We get the satisfaction of selling better equipment.
19. We get increased sales and good publicity.
20. We get nothing directly, just a job from the customer.
21. We sell more equipment and I feel we sell more high efficiency equipment. Also, I get to do what's right.
22. We get increased sales.
23. We get an increase in customers.

- **Empire publishes our name saying that we are certified to sell the equipment.**
  1. Empire publishes our name indicating that we're certified and qualified.
  2. My customers can go on the website and see that we are certified with Empire.
  3. We are distinguished from those companies that are not involved.

- **It allows us to offer our customers the best equipment available.**
  1. The biggest benefit is being able to offer customers even more competitive options.
  2. We get to offer customers everything that's available for them.
  3. We can provide better quality equipment.
  4. Customers are able to upgrade to higher efficiency units.
  5. I am getting a better deal for my customers.
  6. We get to sell higher efficiency equipment.

- **We are able to have a better relationship with our customers.**
  1. We are able to provide better customer service.
  2. We are able to have a better relationship with our customers.
  3. We are able to have a better relationship with the customer and sell more high efficiency units.
  4. We are able to help the customer out more.
  5. We get higher customer satisfaction.

We also asked the contractors about the benefits that their customers received through this program. They most often cited that the customers would have lower energy bills in the long run when they opt for the rebated units. All of the contractors surveyed said that their customers are very satisfied with their rebated equipment. Their responses are as follows:

- **The customer gets the money back and a higher efficiency unit.**
  1. They get cash back and more efficiency.
  2. They are getting the rebate and have a better system.
  3. They get a more efficient piece of equipment.
  4. Along with upgraded equipment, they spend less money upfront, and get more savings and a better warranty.
  5. The units are more efficient.
  6. They are getting a more energy efficient unit.
  7. They get better equipment for less money.
  8. They get the rebate money and lowered utility costs.
  9. They have the chance to buy a higher quality piece of equipment.
  10. The rebate encourages them to buy higher efficiency equipment, leading to lower utility bills.

- **The customer is going to save money on their energy bills in the long run.**
  1. Over the long haul, they're going to save money.
  2. They get lower utility cost, lower installation cost, and more comfort.
  3. They lower their energy bills for the long term.
  4. They get a utility cost reduction.
  5. They save money in the long run.
  6. They are getting a break on equipment cost and saving money in the long run.
  7. They will have lower monthly bills.
  8. The rebate allows them to get a little better equipment than they would have otherwise and they will save on bills from now on.
  9. The new unit will pay for itself in about two years through savings on the electric bill.
  10. They get the initial rebate and long term savings.
  11. They save money now and in the long run.
  12. They will have lower utility bills.
  13. They save money in the long run and get a little back now.
  14. They will see energy savings for a long time.
  15. It saves them money in the long run and it's a quieter unit.
  16. They save money.
  17. Their efficiency goes up and they save money in the long haul.
  18. They get lower utility bills.

- **Miscellaneous**
  1. They get a new warranty, a rebate, and more home selling options.
  2. In the short term, they get the rebate. Long term, they have a better warranty.
  3. They get piece of mind. They know they're getting the best technology that's out there.
  4. Half the price of the upgrade is covered.
  5. They save money and help the electric company.

6. They save money and get a quieter unit.
7. They save money and get more comfort and a quieter machine.
8. They get a much better product, their home is better taken care of, they get long term energy savings, and better quality control.
9. Their power usage goes down, and they get a better warranty.
10. They save money and can make their home more comfortable.
11. They get more comfort and savings.

We asked the contractors if customer callbacks have increased or decreased with the rebated equipment. Four out of 38 (11%) said that customer callbacks have increased, and when asked why, they provided the following responses:

1. We get more calls because there are some issues with the thermal expansion valves on the indoor coils. We have had to do many replacements.
2. A little bit more because sometimes different thermostats are necessary or we get folks that don't understand. The problem is usually the homeowner, not the equipment.
3. Higher efficiency units can be a bit quirky, therefore calls increase a little, but once the systems are set up properly, the calls stop.
4. We get more calls because many older homes have older thermostats that must be upgraded to be programmable with the new units.

Changes to Contractors' Business as a Result of Participation
Over half of the surveyed contractors indicated that their participation in the Residential CAC program has resulted in changes to their business, and that the changes are positive.

Table 7. Has your participation in the program made a change in your business?

	Percent Responding
Yes	54%
Maybe a little	21%
No	26%

Comments about changes to the contractors' businesses as a result of their participation:

- **Yes, our business has improved.**
  1. Yes, all the coops have improved.
  2. Yes, all the rebate programs work together.
  3. There is probably some. People may upgrade to a little higher efficiency and that improves our business through higher sales.
  4. Yes, I get more sales overall.
  5. Yes, I make more profit the more expensive the equipment is.
  6. Yes, it has helped some. It helps close some deals.
  7. Yes, we have gotten more jobs.
  8. Not a whole lot, it has been steady, about the same as last year. There was no drop-off due to the economy though, so that could be attributed to the program.
  9. Yes, people are trying to be more cost effective.
  10. Yes, it sets us above the lower rung of service providers.

11. Yes, we get better referrals.
12. Yes, especially last winter. It promoted a lot of work.
13. Yes, it allows for more sales of higher efficiency units.
14. Not as much as I had hoped, but it has helped.
15. Yes, it has enabled us to sell higher efficiency models.
16. Yes, it has allowed us to sell more high efficiency units.
17. We think so, we have started doing a lot more ground source than we used to.
18. I'm sure it has helped sell higher efficient equipment.

- **No, our business has not improved.**
  1. I run such a small business that this probably hasn't changed anything.
  2. No, I don't think so.
  3. No, because we don't push it.
  4. Not particularly, we've been able to sell more high efficiency though.
  5. It really hasn't, we've always give the option of higher efficiency.
  6. I only cover a small portion of Empire's district, so not a noticeable difference.

- **Maybe, it's hard to say.**
  1. Not enough to say definitely.

Table 8. Do you market equipment differently?

Do you market equipment differently in general?	Percent Responding
Yes	31%
No	69%
Do you market CAC-rebated equipment differently?	
Yes	39%
No	61%

Comments provided about how they market AC units differently:

1. Yes, we sell more efficient equipment.
2. We more aggressively try to sell a higher SEER piece of equipment.
3. We present more options to the customer.
4. There is more emphasis on comfort for the home and energy cost.
5. If units have rebates, I'll push those a bit more.
6. Yes, we lean more toward specific units than before.
7. I bid high efficiency every time. I bid unless they say otherwise.
8. We always push high efficiency.
9. I push high efficiency units more than I did before the program.

In addition, four of the contractors indicated that they have added other energy efficient equipment to their inventory such as high-efficiency water heaters and programmable thermostats as a result of increased customer interest in more efficient products that may be related to the program's rebate.

The contractors we spoke to estimate that their sales of high-efficiency heat pump and AC units have increased by about an average of 38% since the program started, and they estimate that about 70% of the sales of high efficiency AC units occurred with the help of the program rebate. All but one of the contractors interviewed believe that the Residential CAC program should continue and provide the incentive for customers to opt for the higher efficiency units.

Reported Problems

Very few contractors reported any problems with the Residential CAC program. Of the 41 surveyed, 9 (22%) indicated that they had issues with the program.

1. It's the lowest rebate out there, but it's a simple process.
2. I have had trouble finding the forms to print out.
3. It seems tailored to the wealthy consumers. Also, manufacturers have semi-efficient equipment that is hard to sell now.
4. To get to the required efficiencies is a pretty good cost increase.
5. People didn't see why they had to go to such a high efficiency unit, some can't afford it.
6. The first problem was having to go to the classes.
7. The required SEER rating is a bit high.
8. I've had issues arise with timeliness. A quick online access would be much better than the way it is now. Simplify the form so the customer can fill them out online as well.
9. Twice I filled out the papers and they came back saying that the customer wasn't qualified.

Only 4 (10%) of the contractors surveyed indicated that they received customer complaints regarding the program. The complaints received were explained as follows:

1. They didn't get the money, not sure about the particulars.
2. People with old units, 150,000 BTU for example, don't want to downsize according to load calculations.
3. It is hard to qualify for.
4. The paperwork can be confusing.

Fifteen percent (n=6) of the contractors said that customer call-backs have increased due to the equipment installed through the program, and that these issues usually stemmed from issues with variable speed drives, or with programmable thermostats not matching properly with the new equipment.

Only two (5%) of the contractors surveyed indicated that they had complaints about the program:

1. Many people don't run a load before they bid a job and don't know how to read their loads.
2. It can be difficult to attend the training sessions to become an approved contractor.

Technologies Covered by the Program

The contractors mostly agree that the proper technologies are covered by the program. Out of the 41 contractors surveyed, only seven felt that there should be changes made to the equipment that's rebated. Their comments are below:

1. Other providers are being more aggressive with geothermal.
2. Perhaps 14 SEER should be included, and the rebate should scale with tonnage.
3. Offering hybrid dual fuel system would be better than just going off of SEER ratings. Possibly lower the requirements.
4. Sometimes we fail to take our victories where we can get them. If a person has a gas furnace, we can put a heat pump on. If there's no variable speed gas furnace, there's no way to put on a heat pump.
5. Maybe lower the minimum SEER.
6. I'd like to see them cover dual fuel systems.
7. If anything, it should fall closer with the federal guidelines so there is some continuity.

Eleven of the surveyed contractors (27%) had some comments about other technologies that Empire should offer through this program:

1. Variable speed air handlers on a total electric system as well as dual fuel systems
2. Geothermal and high efficiency insulated electric water heater
3. Attic ventilators
4. Geothermal and dual fuel systems
5. 14 SEER systems
6. 2-stage compressors
7. Humidifiers
8. Ground source units, if they are not already covered, as well as solar assisted units
9. Hybrid systems and dual fuel systems

None of the contractors thought that any of the equipment included in the program should be removed.

Incentives Offered Through the Program

Over 80% of the interviewed contractors felt that the incentive levels were appropriate. Those that think they should be altered offered the following feedback:

1. I think the incentives should be a little bit higher. Some kickbacks to the dealer that is pushing it would be nice, too, as there's no incentive for the dealer to push the high efficiency items.
2. The rebate is too low, especially for ground source heat pumps.
3. It could maybe drop down to 14 SEER as a starting point.
4. The 16 SEER incentives should be higher, otherwise it's pretty good.
5. We sell Goodman equipment exclusively. Right now the rebate does not cover all of the additional costs.
6. Either the incentives need to be higher or they should start at a lower SEER (14 maybe). Also include higher rebates for ground source.

The contractors that TMW surveyed estimated that about 55% of their customers opt for the more efficient options covered by the rebate, and they offered the following comments:

- **The majority of our customers take advantage of the rebate.**
  1. Nearly everybody takes advantage of it, many people are already aware of the rebate when they come in.
  2. Most customers tend to go with high efficiency.
  3. Most people are already set on an efficient option. The incentive very rarely makes or breaks the deal.
  4. The rebate often pushes people over the fence; they usually take advantage of it.
  5. Most people are well informed and would buy the rebated items anyway.
  6. The Empire and federal incentives push them over the fence and they go with the efficient option.

- **The rebate does not seem to be enough for most of our customers to purchase the more efficient option.**
  1. I'm not sure if my customers would buy the high efficiency units or not without the rebate since the majority of my customers aren't in Empire's service territory.
  2. No, I think that a lot of people repair their old units with the current economy.
  3. The rebate does help some, about 35% go for it, but sales were higher before, when the economy was a bit better.
  4. I don't think the rebate is enough to convince someone who wasn't previously interested in high efficiency, but it helps those on the fence.
  5. Due to the economy, not as many are spending more money upfront for the high efficiency units.
  6. The rebate helps, but usually doesn't make or break the sale.
  7. Most often, the rebate is not enough to push someone over the fence if they are not already looking to get a high efficiency system.

- **The rebate helps to convince customers to go more efficient.**
  1. If the customer can afford the upgrade they take it.
  2. We have sold more high-end equipment this year than ever before.
  3. The rebate helps convince them to buy the higher efficiency units.
  4. The rebate brings them into the ballpark.
  5. For the first time in several years, customers look at spending more money to go more efficient.
  6. The rebate definitely helps, it covers around half of the cost of the upgrade.

Program Operations: Rebates

Most of the contractors (75%) didn't know how long it took for their customers to receive their rebates, but the ten contractors that were able to estimate the length of time indicated that they thought the rebates were received by the customers in about four weeks. The program managers estimate that it takes about 2 weeks for rebates to be delivered to the customers.

Program Operations: Communications and Materials

Almost all (92%) of the surveyed contractors are happy with the communication they have with Empire and program staff. Some of them provided comments about their communications with Empire staff:

- We don't usually need to talk to them, but they are great when we do.
- Anytime we call we get our questions answered.
- We have not had a lot of communication, but our questions have been answered quickly when we have them.
- I would give it a seven or eight out of ten. It has been fairly adequate, and they return calls.
- I don't talk to them often, but they are always very courteous.
- The Empire staff has been wonderful.
- They've always been good to talk to.
- They do a good job.

However, of the 41 contractors surveyed, 18 of them (44%) indicated that they would like some program materials to help encourage their customers to purchase the high efficiency units and apply for the rebate. Fifteen of them suggested that Empire distribute brochures or other printed materials to the contractors for them to share with their customers.

1. We would like pamphlets, fliers or some type of brochure to give to our customers.
2. We could use some brochures.
3. We don't have any brochures at all from Empire.
4. We don't really have much. We could use some materials to help bridge the gap to high efficiency.
5. We could sell better if we had more information that the customer could understand better.
6. It would be handy to have something to give the customers. The only thing I have is a sheet that I printed out. Handouts would be nice, and more professional.
7. I don't have any forms on hand; it would be good to have some.
8. It would help if I could have a guideline for exactly what qualifies for the rebate.
9. It'd be nice if Empire sent us some brochures.
10. Empire should send us out some program materials.
11. Empire doesn't supply me with any, I think they usually give it to the customers.
12. Everything I have comes from the Internet. I would like some brochures if they become available.
13. All the information is available online, but it would be nice if Empire printed and sent out some things for us.
14. It would be nice to have things sent to us, rather than available online for print.
15. I could use more. Everything has to be printed off the internet; Empire should print and distribute some.

What Works Well

Most of the contractors (90%) had responses when we asked them what they thought worked well in this program.

- **The rebate is a good motivator for customers to become more efficient.**
  1. The rebate is the main incentive for everybody, and they get a more efficient system.
  2. Just having the step-ups from one efficiency to the next is a good incentive to move up.
  3. The incentive for people to upgrade; money is a good motivator.
  4. It gives people more incentive to buy more efficient equipment.
  5. Money is a great motivator for contractors and homeowners.
  6. It is an inducement to buy better equipment.
  7. It gives customers an incentive to get more efficient equipment.
  8. It gives people a little extra reason to upgrade to a more energy efficient unit.
  9. It gives people an incentive to upgrade to an efficient unit.

- **The customer gets money back immediately and in the long run.**
  1. The customer gets a check back.
  2. The kickback to the customer is extra money in their pocket.
  3. The customer gets a quicker return.
  4. The whole process of offering rebates for high efficiency works because it's easy to do and the customer can reduce their utility bills.
  5. It gives the customer an option to go with better equipment that will save everyone money in the long run.
  6. It is a cash rebate and customers get it really quick.
  7. The incentive.
  8. Anytime people get money back they are happy.
  9. They have picked a high enough efficiency rating to make a difference in utility bills.
  10. It helps people save money and increases their comfort level.

- **The customer is able to purchase better equipment.**
  1. The customer sees that they get something back from the utility company. In the long run, they get better quality equipment and reduced utility costs.
  2. It gives the customer another option, saves money, and allows them to get better equipment.
  3. It helps people get better units.

- **It helps all three parties involved: Empire, the contractor, and the customer.**
  1. Everyone gets something out of it.
  2. It benefits all 3 parties involved.
  3. It helps us sell better units and customers save money on something they should ideally buy anyway.
  4. It helps out Empire, it helps contractors sell more units, and it helps the customers save money.

- **Miscellaneous**
  1. It's the right thing to do at the right time.
  2. Customers are geared into energy conservation and Empire is helping.
  3. The heat load helps the customer get the right unit, a proper match for their home.
  4. The fact that it actually helps to decrease the cost of the installation. Also, there is some rebate stacking with the tax credit.

5. It works well as long as the customer knows that the rebate exists.
6. It all works well.
7. Getting the contractors trained and educated is good because customers all go to different contractors.
8. They require model numbers to verify equipment put in which adds accountability.
9. Ultimately, it's up to the contractors whether it works well or not. If they are ill informed, the program won't work.

Suggested Improvements to the Program
About half (51%) of the contractors offered suggestions for improvements to the program. The most common response was about how they would like to see more promotion of the program, either through increased advertising or printed materials for customers.

- **Provide more information to the contractors and advertise more.**
  1. Give out more brochures to contractors to hand out to customers.
  2. Give a little more information to the homeowners, maybe a packet in their bill to make them aware of the rebate program.
  3. Provide literature for the contractors to give out or advertise it more.
  4. Try to get forms out to contractors.
  5. Give it more publicity.
  6. Advertise it in utility bills.
  7. Do more advertising, not many people are aware of it.

- **Lower the SEER rating requirement.**
  1. 15 SEER is pretty high, but maybe that's where it needs to be.
  2. Lower the minimum seer rating.
  3. If it were easier to get people to qualify, it would be a great incentive.
  4. Include SEER 14 units.

- **Increase the rebate.**
  1. Increase the rebate. (n=3)
  4. Increase the rebate on the 16 SEER.

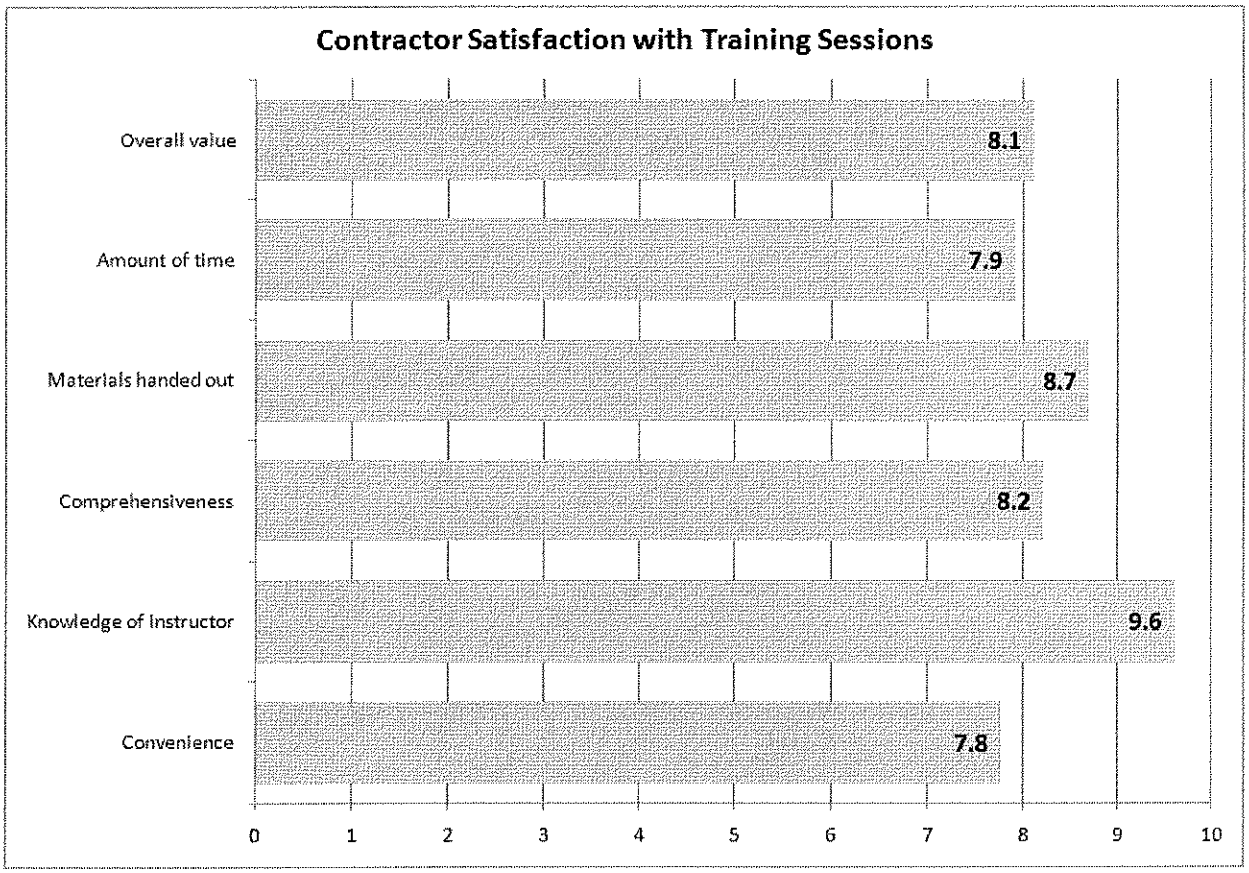
- **Cover dual-fuel systems.**
  1. Not enough equipment is covered, dual fuel for example.
  2. Include dual fuel systems.

- **Miscellaneous**
  1. Give higher incentives and send out flyers to show people the potential savings. Assume that people have a SEER 8 unit and show the savings at SEER 16. From our standpoint, the load calculations are difficult for new houses, and the old houses may not be accurate. Also, the class can be difficult to attend.
  2. Raise the incentives, make ground source rebates larger, and lower the minimum SEER to 14.

Contractor Training

Twenty of the contractors that TMW surveyed had completed the training session offered by Empire. We asked these contractors about their satisfaction with various components of the training sessions. We asked them about the convenience of attending the session, the knowledge of the instructor, the comprehensiveness of the subjects covered, the materials handed out at the session, the length of the session, and the overall value of the training session. We asked them to rank their satisfaction on a 1-10 scale, with a rank of 1 indicating that they were completely dissatisfied and 10 indicating that they were completely satisfied. Figure 6 below presents the mean satisfaction scores provided by the 20 contractors that completed the training and the phone survey.

Figure 6. Mean Satisfaction Scores



Training session attendees were most satisfied with the knowledge of the instructor, providing him with a mean satisfaction score of 9.6 out of 10. The lowest score (7.8) was given to the convenience of attending the session. However, this is still a good score, especially given the geographical area that Empire covers.

If the surveyed contractor provided a score of 7 or lower to any of these components, we asked for a comment about why they provided a lower score, or how the training could improve. These comments are provided below.

Convenience of the Training Session

- I had to get it elsewhere.
- It was in Aurora, which is quite a drive for me. I wish it were local.
- It was a long drive.
- It's tough to find time.
- Make it closer to Springfield.

Comprehensiveness of the Subjects Covered

- Make it a little longer session, so it's not so rushed.
- The instructor deals with a variety of homes.
- It would take more time to be comprehensive.
- The instructor went through the basics for too long and if you don't know the basics you shouldn't be in the class.

Materials Handed Out at the Session

- There could have been more. There wasn't a whole lot of stuff as far as tools to use. We don't want to do load calculations by hand since it can be done with computers. Empire should give people discounts on load calculation software and then teach how to use it.
- Some of the materials seemed old.
- More brochures and literature could have been utilized.

Amount of Time for the Training Session

- It was a bit short.
- I would have liked more time, maybe have it over 2 days.
- They kind of cram through it in the little class; it could have been longer.
- There was not enough time in there, too quick to teach somebody to do heat loss/heat gain calculations or to know how to properly set up a system.
- It needs to be longer and more in depth.
- It needed to be longer.

In addition to the satisfaction questions, we also asked the contractors that attended an Empire training session to tell us the most important thing they learned during the session. Their responses are below.

- **I learned more about heat load calculations.**
  1. I learned how to do load calculations by hand, and now I understand the computer software more.
  2. I got clarifications on load calculations.
  3. I learned more about load calculations.
  4. I learned how to do load calculations. I didn't have any experience with those and have used them a number of times since.
  5. I learned how to do load calculations.
  6. I learned how to interpret data from load studies.
  7. I learned the importance of load calculations.

8. I learned about load calculations.

- **The course was a good memory refresher.**
  1. It was a good memory refresher.
  2. It was a good confirmation, because we had already been doing the things that they talked about.
  3. It went back to the basics, a good refresher.

- **Miscellaneous**
  1. I learned about the technical parts of airflow.
  2. I learned more about heat loss/heat gain calculations.
  3. I learned about the differences on R-values in older homes/newer homes.
  4. It was good general information.
  5. I learned about airflow.
  6. I learned more about zone calculations.
  7. I got some good duct sizing information.
  8. I learned what to look for: windows, filtration.
  9. I learned about making sure efficiencies are right for the size of the home.
  10. I have started putting in larger filters since learning about the benefits.
  11. I learned that there are many people that don't know what they are doing out there.

Difficulty of Subjects Covered
Of the 17 contractors that responded to this question, over 76% of them thought that the difficulty level was about right.

	Percent Responding
About right	76%
Too complex	6%
Too basic	18%

Impact Analysis Results

Unit Energy and Demand Savings

A summary of the simulation results is shown in Table 9. Savings results are shown for each SEER class and air conditioner or heat pump type.

Table 9. Normalized Measure Savings from Prototype Simulations for Old and Existing Vintages

Type	Measure Efficiency	Baseline Efficiency	kWh/ton savings	kW/ton savings
Air conditioner	SEER 14	SEER 13 CAC with 150% oversizing and improper RCA adjustments	331	0.306
	SEER 15		339	0.320
	SEER 16		323	0.317
	SEER 17		416	0.371
Air source heat pump	SEER 14	SEER 13 air source heat pump with 150% oversizing and improper RCA adjustments	342	0.366
	SEER 15		461	0.472
	SEER 16		545	0.450
	SEER 17		585	0.439
	SEER 18		640	0.472
Ground source heat pump	EER 17	SEER 13 air source heat pump with 150% oversizing and improper RCA adjustments	631	0.495
	EER 19		720	0.543

Table 10. Normalized Measure Savings from Prototype Simulations for New Vintage

Type	Measure Efficiency	Baseline Efficiency	kWh/ton savings	kW/ton savings
Air conditioner	SEER 14	SEER 13 CAC with 150% oversizing and improper RCA adjustments	386	0.258
	SEER 15		393	0.287
	SEER 16		386	0.327
	SEER 17		484	0.378
Air source heat pump	SEER 14	SEER 13 air source heat pump with 150% oversizing and improper RCA adjustments	368	0.434
	SEER 15		490	0.491
	SEER 16		529	0.537
	SEER 17		550	0.530
	SEER 18		605	0.558

Note, the peak demand savings are not proportional to the difference in SEER, due to different strategies used by manufacturers to achieve a particular SEER rating and the influence of those strategies on energy efficiency under peak conditions. For example, units using multiple compressors can have high SEER ratings, while having relatively poor efficiency under peak conditions. Heat pumps save energy for both heating and cooling, thus the overall annual energy savings are greater for heat pumps than air conditioners. Also, heat pumps have different performance characteristics than air conditioners, causing differences in the demand savings within each SEER class.

Program Energy and Demand Savings

Gross Energy and Demand Savings

The gross unit energy and demand savings estimates described in the previous section were applied to the program tracking system. The HVAC unit make and model data were used to determine the unit nominal cooling capacity. The unit type and SEER designations were used to assign the appropriate gross savings by SEER category. Simulation results were interpolated for units falling between the SEER class results in the tables above. The simulation results were extrapolated from the highest SEER class savings for the few units with higher SEER than the values shown in the table above.

The savings were totaled across the participants listed in the program tracking system. The program total savings are based on 87 air conditioner applications, 253 air source heat pump applications, and 8 geothermal heat pump applications. The coincident demand savings were estimated using a coincidence factor for central air conditioning of 0.75.

Table 11. Program Gross and Net Savings Estimates

	kWh savings	Non-coincident kW savings	Coincident kW savings
Gross program savings	568,339	518	389

Benefit Cost Test

Table 12. Benefit Cost Test Results for the CAC Rebate Program

Test	Net Present Value	B/C Ratio
Total Resource Cost	+ $325,432	2.16
Societal Cost	+ $352,250	2.25
Participant Cost	+ $703,830	3.69
Utility Cost	+ $273,545	2.64
Ratepayer Impact Measure	- $320,199	0.58

The total resource cost (TRC) test showed a positive net present value (NPV) for the Central Air Conditioner Rebate Program of $325,432. This indicates that, over a 15 year effective useful life, the avoided energy and avoided demand savings will be sufficient to recuperate and exceed the initial program cost, less the incentives, of $19,265 plus the participants' equipment cost of $261,521. A benefit cost ratio greater than one (2.16) indicates that this program can be considered cost effective from the perspective of the utility and the ratepayer. A sensitivity analysis concludes that the program would remain economical until the participants' costs exceeded $613,770.

The societal cost test also produced a positive NPV for the CAC Rebate Program of $352,250. The societal test aims to represent the program from the point of view of the society as a whole, capturing all estimated benefits and costs, including externalities that are documented. In this case, externalities are made up of the avoided environmental damage costs, totaling $33,752. This amount was added to the savings from the TRC test and the benefit cost ratio was recomputed to be 2.25. Again, the ratio is greater than one. Therefore, the program is deemed cost effective from the societal perspective.

To supplement these tests, a participant cost test and a utility cost test were done. The purpose of these tests is to isolate the participants and the utility and assess the program's cost effectiveness from both perspectives. The tests both produced a positive NPV and a benefit cost ratio greater than one for the CAC Rebate Program at $703,830 with a ratio of 3.69 and $273,545 with a ratio of 2.64 respectively. This means that the benefits outweigh the costs for both the participants and the utility. This program is therefore cost effective from both the perspective of the participant and the utility.

Finally, a ratepayer impact measure test was done. This test is a measure of the difference between the change of total revenues paid to a utility and the change in total costs paid by a utility. The test produced a negative NPV and a benefit cost ratio of less than one of -$320,199 and 0.58 respectively. Thus, this program is not cost effective from the perspective of the ratepayer because rate levels will increase as a result of this program. If retail rates are higher than marginal costs, few programs pass this test. This is because the benefit of avoided supply costs will be eclipsed by the revenue losses.

Table 13. Parameter Values and Assumptions for Benefit Cost Tests

Parameter	Value		Assumption	Value
Number of Participants	348		Avoided Energy Cost	$0.03436
Project Life (years)	15		Demand Cost	$51
Project Analysis Year 1	2009		Environmental Externalities	$0.0031
kWh/yr. Saved	568,339		Retail Rate	$0.09459
kW/yr. reduction	398		Escalation Rate	3.00%
Utility Project Cost	$166,315		Societal Discount Rate	3.22%
Incentive Cost	$147,050		Participant Discount Rate	3.22%
Participant Cost	$261,521		Utility Discount Rate	8.44%

Appendix A: Management Interview Protocol

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Residential Central Air Conditioner Rebate program, which I will refer to as the CAC program. We'll talk about the CAC Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Program Objectives

1. In your own words, please describe the CAC Program's current objectives. How have these changed over time?

2. In your opinion, which objectives do you think are best being met or will be met?

3. Are there any program objectives that are not being addressed or not being addressed as well as possible or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed?

4. Should the program objectives be changed in any way due to technology-based, market-based, or management-based conditions? What objectives would you change? What program changes would you put into place as a result, and how would it affect the operations of the program?

Operational Efficiency

5. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program?

6. Please review with us how the CAC Program operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you to currently fulfill your duties.

7. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

8. Describe the evolution of the CAC Program. How has the program changed since it was it first started in June of 2007?

9. Do you have suggestions for improvements to the program that would increase participation rates or interest levels?

10. Do you have suggestions for improving or increasing energy impacts?

11. Do you have suggestion for the making the program operate more smoothly or effectively?

Program Design & Implementation

12. *(If not captured earlier)* Please explain how the interactions between the contractors, customers, and CAC's management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

13. How do you determine which heat pumps and air conditioners are included in the program? How do you determine what efficiency levels should be placed in the program for heat pumps and central AC units? What should be changed about this selection process? Do you think this would result in more contractors and/or customers participating in the program?

14. Describe your quality control and tracking process.

15. Are industry experts, trade professionals or peers used for assessing what the technologies or models should be included in the program? If so, how does this work?

16. Are industry experts and trade professionals used in other advisory roles? If so, how does this work and what kinds of support is obtained?

17. Describe CAC's contractor program orientation training and development approach. Are contractors getting adequate program training and program information? What can be done that could help improve contractor effectiveness? Can we obtain training materials that are being used?

18. In your opinion, did the incentives cover enough different kinds of energy efficient products?

1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

If no, 18b. What other products or equipment should be included and why?

19. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

20. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

21. Overall, what about the CAC program works well and why?

22. What doesn't work well and why? Do you think this discourages participation or contractor interests?

23. Can you identify any market, operational or technical barriers that impede a more efficient program operation?

24. In what ways can these operations or operational efficiencies be improved?

25. In what ways can the program attract more participants?

26. How do you make sure that the best information and practices are being used in CAC operations?

27. *(If not collected above)* What market information, research or market assessments are you using to determine the best target markets and program opportunities, market barriers, delivery mechanisms and program approach?

28. If you had a magic wand, what one thing would you change and why?

29. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix B: Residential CAC Program: Contractor Interview Instrument

Name: _____

Title: _____

Position description and general responsibilities:

_____

_____

_____

We are conducting this interview to obtain your opinions about and experiences with the Empire Residential Central Air Conditioner Rebate Program, which I will refer to as the CAC program. We'll talk about your understanding of the CAC Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Understanding the Program

We would like to ask you about your understanding of the CAC program. We would like to start by first asking you to…

1. Please review for me how you are involved in the program and the steps you take in the participation process. Walk me though the typical steps you take to help a customer become eligible for this program and what you do to receive or help the customer receive the program incentive.

2. What kinds of problems or issues have come up in the CAC program?

3. Have you heard of any customer complaints that are in any way associated with this program?

4. Have callbacks increased due to the program technologies?

Program Design and Design Assistance

4. Do you feel that the proper technologies and equipment are being covered through the program?

5. Are the incentive levels appropriate? How do they impact the choice by the customers of the higher efficient equipment?

6. Are there other technologies or energy efficient systems that you think should be included in the program?

7. Are there components that are now included that you feel should not be included? What are they and why should they not be included?

Reasons for Participation in the Program

We would like to better understand why contractors become partners in the CAC Program.

8. How long have you been a partner in the CAC Program? *(program started in June 2007)*

9. What are your primary reasons for participating in the program? Why do you continue to be a partner?.... *If prompts are needed...* Is this a wise business move for you; is it something you believe in professionally, is it that it provides a service to your customers, or other reasons?

10. Has this program made a difference in your business? How?

11. How do you think Empire Electric can get more contractors to participate in this program?

Program Participation Experiences

The next few questions ask about the process for submitting participation forms and obtaining the incentive payments.

13. Do you think the process could be streamlined in any way? How?

14. How long does it take between the time that you apply for your incentive, to the time that you and your customer receive the payments? Is this a reasonable amount of time? What should it be? Why?

15. Do you have the right amount of materials such as forms, information sheets, brochures or marketing materials that you need to effectively show and sell your CAC heat pumps and air conditioners? What else do you need?

16. Overall, what about the CAC Program do you think works well and why?

17. What changes would you suggest to improve the program?

18. Do you feel that communications between you and Empire's CAC program staff is adequate? How might this be improved?

19. What benefits do you receive as a result of participating in Empire's CAC Program or from selling CAC items?

20. What do you think are the primary benefits to the people who buy a CAC rebated item. Are there other benefits that are important to a potential customer?

Training Participation Experiences – if interviewee attended
The next few questions ask about training session you attended.

I will read a list of items, after I read each item please tell me how satisfied you are with that item. Please indicate on a 0 to 10 scale with a 10 meaning you are very satisfied and a 0 to mean you are very dissatisfied.

How satisfied are you with…

19. **The convenience of attending the training sessions?** _____Score

If 7 or less, **How could this be improved?**_____

_____

20. **The knowledge of the instructor?** _____Score

If 7 or less, **How could this be improved?**_____

_____

21. **The comprehensiveness of the subjects covered?** _____**Score**

If 7 or less, **How could this be improved?**_____

_____

22. **The materials and information handed out at the session**? _____Score

If 7 or less, **How could this be improved?**_____

_____

23. **How about the amount of time for the training session, was it …**

1) ❑ **Too long,**
2) ❑ **About right, or**
3) ❑ **Too short**?

24. **What would you say are the most important things you learned from the training session**?

Response:1 _____

Anything else? *If no, go to Q26.*

Response:2 _____

Anything else? *If no, go to Q26.*

Response:3 _____

25. **If you could change one thing about this session, what would that be?**

Response:1 _____

Anything else? *If no, go to Q27.*

Response:2 _____

26. **Were there topics that were too basic or too advanced, or that you think didn't belong in the session?**

Response:1 _____

Anything else? *If no, go to Q27.*

Response:2 _____

27. **Using a 0 to 10 scale, with 0 meaning not at all valuable and a 10 meaning very valuable, how would you rate the overall value of the training session?**

_____Score

Market Impacts and Effects

28. How do you make customers aware of the Program?

29. Are customers more satisfied with this equipment? Why or why not?

30. Do you have fewer calls or more calls to correct problems with the CAC appliances?

31. Do you market or sell the CAC equipment differently than your other equipment? How?

32. Other than the energy efficient heat pumps and air conditioners, has the program influenced you to carry other energy efficient equipment that is not rebated through the program?

    a. *If yes*, what do you now carry?

Central Air Conditioner Questions

33. Has the program influenced your decision to market or sell more high efficiency air conditioners than you would have without the program?

    a. *If yes,* To what extent?

34. Of those energy efficient central AC units that were rebated through the program, what percent of those customers do you think would have still gone with an energy efficient model if the Empire rebate were not available?

35. What percent of these customers do you think were in some way influenced by the rebate Empire offered?

36. What percent of your total high efficiency central AC sales were rebated through the Empire program last year?

37. In your opinion is the CAC program needed? Why?

Heat Pump Questions

38. Has the program influenced your decision to market or sell more high efficiency heat pumps than you would have without the program?

    a. *If yes,* To what extent?

39. Of those energy efficient heat pumps that were rebated through the program, what percent of those customers do you think would have still gone with an energy efficient model if the Empire rebate were not available?

40. What percent of these customers do you think were in some way influenced by the rebate Empire offered?

41. What percent of your total high efficiency heat pump sales were rebated through the Empire program last year?

We would like to know what your practices were before you became a partner in the program, and what you would offer your customers without the program.

42. Currently there are no plans to terminate the program, but we would like to know how the program affects contractors. If the program were to be discontinued, would you still offer the same energy efficient equipment options?

43. If the program were not offered, how would you structure pricing differently to make up for the program loss?

Recommended Changes from the Participating Contractors

44. Are there any other changes that you would recommend to Empire Electric for their Program not already discussed?

45. If you had a magic wand to make any changes you wanted to these programs, what changes would you make to this program?