VOLUME 5:

DEMAND-SIDE RESOURCE ANALYSIS

KCP&L GREATER MISSOURI OPERATIONS COMPANY (GMO)

INTEGRATED RESOURCE PLAN

CASE NO. EE-2009-0237

4 CSR 240-22.050

** PUBLIC **

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VOLUME 5: DEMAND-SIDE RESOURCE ANALYSIS

PURPOSE: This rule specifies the methods by which end-use measures and demand-side programs shall be developed and screened for cost-effectiveness. It also requires the ongoing evaluation of end-use measures and programs, and the use of program evaluation information to improve program design and cost-effectiveness analysis.

SECTION 1: IDENTIFICATION OF END-USE MEASURES

(1) Identification of End-Use Measures. The analysis of demand-side resources shall begin with the development of a menu of energy efficiency and energy management measures that provide broad coverage of—

1.1 CUSTOMER CLASSES

(A) All major customer classes, including at least residential, commercial, industrial and interruptible;

Greater Missouri Operations (GMO) utilized historical customer class energy usage, revenue, and customer count data for the residential, commercial, industrial, and interruptible customer sectors.

The commercial and industrial (C&I) customer data was sub-classified by market sector. The stratified data included segmentation of historical energy sales, usage, and customer count by both geographic region and by commercial and industrial (C&I) market sector.

The commercial and industrial (C&I) sectors are listed in Table 1 below:

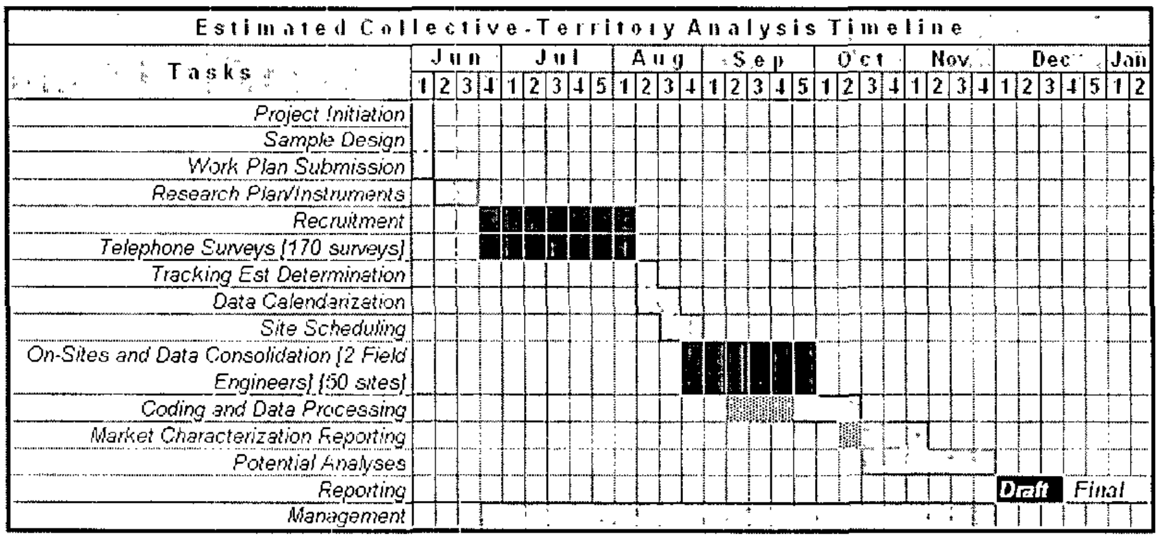
Table 1: C&I Sectors

Customer Class	Industry Segment	Industry Classification
C&I	Education	Colleges
C&I	Education	Schools
C&I	Large Office	Large Office
C&I	Manufacturing	Apparel
C&I	Manufacturing	Beverage & Tobacco Products
C&I	Manufacturing	Chemicals
C&I	Manufacturing	Computer & Electronic Products
C&I	Manufacturing	Elec. Equip., Appliances, & Components
C&I	Manufacturing	Fabricated Metal Products
C&I	Manufacturing	Food
C&I	Manufacturing	Furniture & Related Products
C&I	Manufacturing	Leather & Allied Products
C&I	Manufacturing	Machinery
C&I	Manufacturing	Nonmetallic Mineral Products
C&I	Manufacturing	Paper
C&I	Manufacturing	Plastics & Rubber Products
C&I	Manufacturing	Primary Metals
C&I	Manufacturing	Printing & Related Support
C&I	Manufacturing	Textile Product Mills
C&I	Manufacturing	Transportation Equipment
C&I	Manufacturing	Wood Products
C&I	Small Office	Small Office
C&I	Other	Data Center
C&I	Other	Farming
C&I	Other	Grocery
C&I	Other	Heavy Construction
C&I	Other	Hospital
C&I	Other	Hospitals
C&I	Other	Lodging
C&I	Other	Mining
C&I	Other	Nursing Homes
C&I	Other	Oil & Gas Extraction
C&I	Other	Petroleum & Coal Products
C&I	Other	Pipeline
C&I	Other	Power Distribution
C&I	Other	Power Generation
C&I	Other	Public Assembly
C&I	Other	Ref Warehouse
C&I	Other	Residential Housing Construction
C&I	Other	Restaurant
C&I	Other	Retail
C&I	Other	Services
C&I	Other	Transportation
C&I	Other	Warehouse
C&I	Other	Waste Treatment
C&I	Other	Water Supply

The geographic regions were defined as being either the GMO eastern district service region formerly named Missouri Public Service, or the St. Joseph, MO service region formerly named St Joseph Power & Light.

The residential sector was defined as being either single-family or multi-family premises.

An analysis of the multi-family sector is underway and has not been completed. GMO has engaged a consulting firm, RLW/ KEMA, inc. to conduct a multi-family appliance saturation study. RLW/KEMA has proposed the following schedule for the analysis of the multi-family sector:



1.2 DECISION-MAKERS

(B) All significant decision-makers, including at least those who choose building design features and thermal integrity levels, equipment and appliance efficiency levels, and utilization levels of the energy-using capital stock;

GMO staff meets regularly with customer groups, architects, engineers, trade representatives, contractors, distributors, public agency staff and others to discuss opportunities to discuss energy usage issues, review GMO's energy plan, discuss energy efficiency and demand response programs, and illicit feedback and suggestions.

Table 2: List of group meetings conducted in 2008

Date	Topic	Audience #	Organization
4/17/08	2008 Technical Seminars - Trade Show Booth on Commercial EE	[redacted]	[redacted]
4/1/08	GAS Green Event	[redacted]	[redacted]
4/5/08	Home Renovations Workshop	[redacted]	[redacted]
5/8/2008	Commercial Products and Services	[redacted]	[redacted]
5/8/2008	Empower, Comprehensive Energy Plan, Rebate Programs	[redacted]	[redacted]
5/10/2008	*Moving Forward with Energy Efficiency*	[redacted]	[redacted]
5/13/2008	4 Ways to Attract and Keep Customers	[redacted]	[redacted]
5/14/2008	Energy Efficiency	[redacted]	[redacted]
5/19/2008	No Presentation. They attended and coordinate the event	[redacted]	[redacted]
5/21/2008	Climate Protection Partnerships	[redacted]	[redacted]
5/22/2008	Energy Efficiency	[redacted]	[redacted]
5/24/2008	Round Table Discussion on Energy Efficiency	[redacted]	[redacted]
5/28/2008	Residential Products and Services	[redacted]	[redacted]
6/3/2008	Customer Programs-Residential	[redacted]	[redacted]
6/4/2008	Safety	[redacted]	[redacted]
6/4/2008	Customer Programs-Residential	[redacted]	[redacted]
6/7/2008	Energy Efficiency	[redacted]	[redacted]
6/10/2008	customer Programs-Commercial	[redacted]	[redacted]
6/11/2008	Custom Power Services	[redacted]	[redacted]
6/13/2008	Customer Programs-Residential	[redacted]	[redacted]
6/17/2008	CEP	[redacted]	[redacted]
	Acquisition Update	[redacted]	[redacted]
	Energy Efficiency	[redacted]	[redacted]
6/20/2008	Customer Programs-Residential	[redacted]	[redacted]
6/27/2008	Customer Programs-Residential	[redacted]	[redacted]
7/9/2008	Customer Programs-Business	[redacted]	[redacted]
7/15/2008	Customer Programs-Business	[redacted]	[redacted]
7/17/2008	Customer Programs-Business	[redacted]	[redacted]
7/23/2008	Customer Programs-Business	[redacted]	[redacted]
8/1/2008	Customer Programs-Business	[redacted]	[redacted]
8/8/2008	Customer Programs-Business	[redacted]	[redacted]
8/20/2008	Customer Programs-Business	[redacted]	[redacted]
8/27/2008	Customer Programs-Business	[redacted]	[redacted]
9/24/08	Energy Efficiency	[redacted]	[redacted]
9/9/08	Customer Programs-Business	[redacted]	[redacted]
9/9/08	Energy Efficiency	[redacted]	[redacted]
9/10/08	Customer Programs-Business	[redacted]	[redacted]
9/10/08	Customer Programs-Residential	[redacted]	[redacted]
09/18/08	Customer Programs-Business	[redacted]	[redacted]
09/25/08	Customer Programs-Business	[redacted]	[redacted]
09/18/08	Energy Efficiency	[redacted]	[redacted]
9/12/08	Customer Programs-Business	[redacted]	[redacted]
10/3/08	Customer Programs-Residential	[redacted]	[redacted]
10/22/08	Customer Programs-Residential	[redacted]	[redacted]
10/29/08	Volunteer/Comm Strategy	[redacted]	[redacted]
9/30/08	Customer Programs-Business	[redacted]	[redacted]
10/30/2008	Customer Programs-Business	[redacted]	[redacted]
10/2/2008	Customer Programs-Business	[redacted]	[redacted]
10/13/2008	Customer Programs-Business	[redacted]	[redacted]
10/23/2008	Customer Programs-Business	[redacted]	[redacted]
10/28/2008	Customer Programs-Business	[redacted]	[redacted]
10/29/2008	Customer Programs-Business	[redacted]	[redacted]
11/7/08	Customer Programs-Business	[redacted]	[redacted]
	Customer Programs-Residential	[redacted]	[redacted]
11/12/08	Customer Programs-Business	[redacted]	[redacted]
11/19/08	Careers/Electricity Produced	[redacted]	[redacted]
11/20/08	Customer Programs-Business	[redacted]	[redacted]
11/24/08	Customer Programs-Business	[redacted]	[redacted]
12/2/08	Customer Focused - Business	[redacted]	[redacted]
12/8/2008	Customer Focused - Business	[redacted]	[redacted]
12/16/2008	Customer Focused - Business	[redacted]	[redacted]

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Table 3: List Of Group Meetings Conducted In 2009

Date	Topic	Audience #	Organization
1/16/09	Customer Focused - Business	[redacted]	[redacted]
1/22/09	Energy Efficiency	[redacted]	[redacted]
1/28/2009	Energy Efficiency	[redacted]	[redacted]
2/5/2009	Energy Efficiency	[redacted]	[redacted]
2/5/2009	Energy Efficiency	[redacted]	[redacted]
2/10/2009	Energy Efficiency	[redacted]	[redacted]
2/10/09	Customer Focused - Residential	[redacted]	[redacted]
2/27/2009	Energy Efficiency	[redacted]	[redacted]
3/12/09	Energy Efficiency	[redacted]	[redacted]
3/17/09	Customer Focused - Residential	[redacted]	[redacted]
4/2/2009	Customer Focused - Business	[redacted]	[redacted]
4/14/2009	Energy Efficiency	[redacted]	[redacted]
4/16/09	Energy Efficiency	[redacted]	[redacted]
4/21/09	Customer Focused - Residential	[redacted]	[redacted]
4/22/2009	Customer Focused - Residential	[redacted]	[redacted]
4/22/2009	Customer Focused - Residential	[redacted]	[redacted]
4/22/2009	Energy Efficiency	[redacted]	[redacted]
4/22/2009	Energy Efficiency	[redacted]	[redacted]
4/22/09	Customer Focused - Residential	[redacted]	[redacted]
4/29/09	Customer Focused - Business	[redacted]	[redacted]
5/1/2009	Customer Focused - Business	[redacted]	[redacted]
5/5/2009	Customer Focused - Business	[redacted]	[redacted]
5/5/2009	Customer Focused - Business	[redacted]	[redacted]
5/6/2009	Customer Focused - Business	[redacted]	[redacted]
5/7/2009	Customer Focused - Business	[redacted]	[redacted]
5/12/2009	Energy Efficiency	[redacted]	[redacted]
5/12/2009	Careers	[redacted]	[redacted]
5/13/2009	Customer Focused - Business	[redacted]	[redacted]
5/14/2009	Customer Focused - Residential	[redacted]	[redacted]
5/16/2009	Energy Efficiency	[redacted]	[redacted]
5/18/2009	Energy Efficiency	[redacted]	[redacted]
5/19/2009	Energy Efficiency	[redacted]	[redacted]
5/21/2009	Energy Efficiency	[redacted]	[redacted]
5/27/2009	Customer Focused - Business	[redacted]	[redacted]
5/27/2009	Energy Efficiency	[redacted]	[redacted]
5/28/2009	Energy Efficiency	[redacted]	[redacted]
5/29/2009	Customer Focused - Business	[redacted]	[redacted]

1.3 MAJOR END USES

(C) All major end uses, including at least lighting, refrigeration, space cooling, space heating, water heating and motive power; and

The majority of the residential end-use measures identified were from the two residential appliance saturation studies that were prepared by RLW Analytics (RLW); 1) "2006 Missouri Statewide Residential Lighting And Appliance Efficiency Saturation Study, Final Report", dated Sept 15, 2006 and 2) "2007

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Kansas City Power & Light Single-Family Residential Potential Analysis, Final Report" dated March 13, 2007.

Morgan Marketing Partners (MMP), a consulting firm specializing in the development, marketing, and implementation of demand-side energy programs reviewed these measures and expanded the list.

The major categories of residential end-use measures included:

- Lighting
- Space cooling
- Space heating
- Residential refrigeration
- Water heating
- Residential building structure improvements
- Energy Star residential appliances, including dish washers, and clothes washers.

The measures identified in the RLW studies are listed as measure R1 through R31 in Table 4 below. The measures identified by MMP are listed as R32 through R41 in Table 4 also.

Table 4 Residential End-Use Measures

Residential ID	Baseline measure	End-Use Improvement	End-Use Category
R1	AC Refrigerant under charged	Add refrigerant	Space Cooling
R2	AC Refrigerant over charged	Remove refrigerant	Space Cooling
R3	Low evaporator airflow A	Increase duct sizes or add new ducts	Space Cooling
R4	Low evaporator airflow B	Increase blower speed	Space Cooling
R5	High duct leakage (25%)	Reduce duct leakage to 5%	Space Heating & Cooling
R6	Oversized AC units A	Size AC units to 100% of Manual J	Space Cooling
R7	Oversized AC units B	Size AC units to 100% of Manual J	Space Cooling
R8	One inch insul. on ducts in attic	Add two more inches of insulation	Space Heating & Cooling
R9	Gas heat and 13 SEER AC	Install AC SEER = 16	Space Cooling
R10	Home has 13 SEER heat pump	Install Heat Pump SEER = 16	Space Heating & Cooling
R11	Home has electric strip heat	Install Heat Pump SEER = 16	Space Heating & Cooling
R12	Attic insulation = R-7	Add another R-23 attic insulation	Space Heating & Cooling
R13	Attic insulation = R-11	Add another R-19 attic insulation	Space Heating & Cooling
R14	Exposed walls not insulated	Add R-11 wall insulation	Space Heating & Cooling
R15	Floor over basement not insulated	Add R-19 Insulation to floor	Space Heating & Cooling
R16	House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	Space Heating & Cooling
R17	Single pane windows A	Add storm windows	Space Heating & Cooling
R18	Single pane windows B	Install Low E double pane window 2904	Space Heating & Cooling
R19	Standard double pane windows	Install Low E double pane window 2904	Space Heating & Cooling
R20	No E & W window shading A	Add solar screens to E & W glass	Space Heating & Cooling
R21	No E & W window shading B	Plant deciduous trees on E & W sides	Space Heating & Cooling
R22	No Compact Fluorescent Lamps	Use 10 more CFLs throughout house	LIGHTING
R23	Refrigerator needs to be replaced	Purchase Energy Star refrigerator	REFRIGERATION
R24	Refrigerator early retirement	Removed unit uses no energy	REFRIGERATION
R25	Dishwasher to be replaced	Purchase Energy Star dishwasher	HOME APPLIANCE
R26	Clothes washer to be replaced	Purchase Energy Star clothes washer	HOME APPLIANCE
R27	No prgrammable thermostat	Install programmable thermostat	Space Heating & Cooling
R28	No faucet aerators	Install faucet aerators	Water Heating
R29	No low flow shower heads	Install low fow shower heads	Water Heating
R30	Hot water pipes not insulated	Insulate hot water pipes	Water Heating
R31	Electric water heater not wrapped	Wrap electric water heater	Water Heating
R32	Electric Meter	Energy Usage and Display Monitor	Usage Device
R33	Early Retirement of HVAC system, if SEER< 8.5	Install Heat Pump SEER = 16	Space Heating & Cooling
R34	Early Retirement of HVAC system, if SEER< 8.5	Install Heat Pump SEER = 14	Space Heating & Cooling
R35	Early Retirement of HVAC system, if SEER< 8.5	Install Heat Pump SEER = 15	Space Heating & Cooling
R36	De-humidifier early retirement	Removed unit uses no energy	HVAC
R37	Room A/C Unit early retirement	Removed unit uses no energy	HVAC
R38	Freezer early retirement	Removed unit uses no energy	REFRIGERATION
R39	Failure of HVAC system, Replace with 13 SEER	Replace with 14 SEER Unit	Space Cooling
R40	Failure of HVAC system, Replace with 13 SEER	Replace with 15 SEER Unit	Space Cooling
R41	Failure of HVAC system, Replace with 13 SEER	Replace with 16 SEER Unit	Space Cooling

The following are descriptions of each listed measure and improvement option, explanations of the assumptions made, and the technical approach to estimating impacts:

ID R1: Undercharged AC Systems

Published accounts from several other studies, including a New England HVAC study conducted by RLW in 2002, were used to estimate the technical potential percentages for AC systems. From these studies, about 36% of the measured systems are probably undercharged with refrigerant, which would be enough to exhibit recognizable symptoms. The average undercharged condition was modeled as a 20% reduction in both cooling capacity and efficiency. This 20% reduction represents a general consensus of the other studies.

In the baseline DOE2 models, the refrigerant charge factor was adjusted to 0.8 to reflect this 20% loss. In the retrofit models this factor was set to 1.00 to reflect a properly charged system. At this point the operating capacities and efficiencies were still slightly below rated values due to the fact that evaporator airflow is still a little low. This refrigerant charge correction resulted in an estimated annual savings of 689 kWh, and a peak demand reduction of 0.18 kW per application.

ID R2: Overcharged AC Systems

About 31% of the measured AC systems found in other studies were found to be overcharged with refrigerant. The average effect of this situation, however, is not nearly as dramatic, with only a 5% reduction in both cooling capacity and efficiency. This was represented in the models by a refrigerant charge factor of 0.95, which is in fact the average operating condition. The frequency, degree, and impact of overcharging are not as great as undercharging.

In the retrofit models the refrigerant charge factor was set to 1.00. This resulted in an estimated annual savings of 176 kWh, and a peak demand reduction of 0.12 kW.

IDs R3 and R4: AC Systems with Low Evaporator Air Flow

According to recent studies, about 70% of residential AC systems have a problem of significantly low evaporator airflow. The threshold for this performance characteristic is considered 350 CFM per ton, which is generally used as the lowest acceptable flow rate before capacity and efficiency are appreciably reduced. The average airflow for all those below the threshold was about 300 CFM per ton.

In the baseline DOE2 models the system airflow rate was set at 300 CFM per ton. In the retrofit models this was increased to 400 CFM per ton.

Two different approaches to the correction of a low airflow problem were examined because the associated costs and impacts of each are significantly different. The easiest, and least expensive, solution is to increase the blower speed whenever practical. In many cases, however, this will not be practical due to the presence of single speed blowers or a limited remaining blower capacity.

The other approach is to reduce airside system operating pressures by locating and removing restrictions or by increasing duct capacities. In an existing system the only practical ways to increase supply duct capacity are to replace existing ductwork with larger runouts to several rooms, or add more runouts at or near the supply plenum to new supply grilles.

In past studies, it was found that many return duct systems are simple but undersized. Return duct undersizing often occurs with systems in the attic that have one central return air filter grille in the ceiling of a corridor with one large flexible duct to a return plenum. In most, if not all, cases these can be replaced with larger ducts and return grilles, or new ducts and grilles can be added in parallel.

Any reliable and practical correction to the problem of low airflow would have to be determined by a careful on-site analysis of each problematic system. Often it may be necessary to combine fan speed corrections with increased supply and return duct capacities to obtain proper airflow at a reasonable cost.

The retrofit DOE2 model for increased duct capacity, ID 3, assumed that the total static pressure of the air distribution system could be reduced enough to allow the existing blower to deliver the required air flow without increasing the blower speed. The blower power was increased linearly with the increased airflow rate, and the system capacities and efficiencies were increased to rated conditions. This resulted in an estimated annual savings of 981 kWh, and a peak demand reduction of 0.82 kW.

The retrofit model for increasing blower speed, ID 4, required an increase in motor power equal to the square of the ratio of the flow rates. The increased fan power offset some of the energy savings due to increases in system capacity and efficiency. This resulted in an estimated annual savings of 807 kWh, and a peak demand reduction of 0.67 kW.

ID R5: AC Systems with High Duct Leakage

In the recent New England study that RLW conducted, it was found that about 73% of the AC systems had a problem of significantly high supply duct leakage to the outside. The threshold for supply air leakage was 15% of actual system airflow. The average leakage for all those above the threshold was 25 percent. The systems with high duct leakage do not seem to correlate at all with duct location or plenum static pressure. Based on field observation, however, these systems were characterized by poor installation workmanship, and they tended to be older than others.

The DOE2 model treats duct leakage as primary air delivered to and returning from unconditioned spaces such as attics and basements. About one third of the leakage was assigned to the unconditioned portion of the basement, and the remainder went to the first and second floor attic spaces. This leakage air actually tends to cool these spaces slightly, and they are modeled as buffer zones so that return leakage from them approximates the actual zone conditions. In this way, the primary effects of both supply and return air leakage to these spaces are captured in the model.

The baseline model used 25% duct leakage, and this was reduced to 5% in the retrofit case. This resulted in an estimated annual savings of 606 kWh, and a peak demand reduction of 0.45 kW.

In this analysis the inherent but small reduction in evaporator airflow was not modeled because an average value was not known. Many systems with leaky ductwork also suffer from insufficient airflow. In the New England study RLW found that about 79% of those with high duct leakage also had low airflow below 350 CFM per ton. Additionally, it was observed that 29% had a high blower motor power over 150 Watts per ton. The sealing of leaky ducts will tend to reduce air flow through the evaporator coil. In practice, therefore, it is necessary to measure the existing system airflow and blower motor power to determine if these other two potential problems need to be corrected before duct sealing is attempted.

IDs R6 and R7 Proper Sizing of AC Systems

An oversized system in this study is defined as having a rated cooling capacity greater than 100% of a valid Manual J cooling load estimate . Based on an average Manual J estimate of capacity in terms of square feet per ton and the individually observed home sizes and installed capacities, about 80% of the AC systems of this study are oversized relative to this criterion. It was found in the 2002 study by RLW that those that qualified as oversized averaged about 50% above the Manual J estimate.

The DOE2 models estimate the cooling system efficiency each hour as a function of a part load ratio. This is the ratio of system load and cooling capacity, and the function is empirically designed to approximate the efficiency penalty due to system cycling.

In the baseline model for ID 6 the systems were oversized by about 1.6 tons, and the retrofit was sized to 100% of Manual J, while the airflow and duct sizing was maintained at 360 CFM per ton. The rationale for maintaining this airflow rate is the probability that the same duct sizing practice will be applied by the contractor based on system size. This would be applicable to new AC systems that are installed where there is no existing ductwork. The estimated annual savings is 333 kWh, with a peak demand reduction of 0.27 kW.

On the other hand, if a new system is to be installed to replace an old system or with an existing forced air furnace that already has supply and return ductwork, the contractor may not install new ductwork. In this scenario, ID 7,

there is even more to gain by keeping the system size to a minimum. This is due to the fact that the existing ductwork would be able to deliver the same airflow in CFM as before with the same fan power (which would become a higher CFM per ton as the tons are reduced), thus reducing the system losses due to low airflow and excessive system cycling.

The retrofit DOE2 models for this case assume that the duct sizes, airflow rates, and fan static pressures remain unchanged. Even though the fan power is not increased, the annual fan energy consumption increases due to the fact that the system operates for longer periods of time, and this is accounted for in the models. The estimated annual savings for this scenario is 1046 kWh, with a peak demand reduction of 0.83 kW.

The advantages of reducing system size are all positive as long as the system capacity is sufficient to maintain acceptable comfort conditions about 97.5% of the time (which are all but a few hours of the typical cooling season). The smaller system will typically maintain better humidity control, last longer, make less noise, use less energy and cost less to install.

Most of the problems of low evaporator airflow in houses with evaporator coils added to existing forced air furnaces could be greatly reduced or avoided if the AC system is properly sized for the application. In recent studies, about 70% of the systems that are oversized also have evaporator airflow below 350 CFM per ton.

Unfortunately, downsizing is not a viable option after the system has been installed. Therefore, as an effective conservation program component, information and incentives will need to be presented to prospective homeowner participants before they even contact a contractor. Information and incentives should also be directed toward the contractors.

ID R8 Addition of Duct Insulation

It was observed that most ducts in the basements were not insulated, whereas nearly all ducts in the attics had at least one inch of insulation. The only appreciable savings available would be due to the addition of another inch or two of insulation to exposed ducts in the attic. Exact modeling of this was not within the scope of this project, but some assumptions were made regarding the duct heat gains due to conduction from a hot attic.

In the baseline DOE2 models it was assumed that 90% of the ducts were located in the attic and the product of U*A (i.e. thermal conduction coefficient times duct surface area) would be about 49.7, yielding an approximate peak air temperature rise of 1.0 degree Fahrenheit during the cooling cycle. In the retrofit case this U*A value was reduced to about 20.5. The estimated annual savings for this measure is 242 kWh, with a peak demand reduction of 0.24 kW.

ID R9 High Efficiency SEER 16 AC in Gas Heated Homes

Significant savings are potentially available for the installation of high efficiency AC systems instead of standard efficiency SEER 13 units. In the existing home retrofit market this might be applied to homes with old existing systems that are at the end of their useful operating lifetimes and need to be replaced. This might also apply to an existing home in which air conditioning was never before installed and the homeowner wants to install a new central AC system. Modeling the unit savings for this measure was straightforward. The baseline DOE2 model was assigned a rated efficiency of SEER 13, and the retrofit model used SEER 16. Additionally, the expansion device for both was changed from a capillary tube to a thermal expansion valve (TXV). All other conditions remained unchanged. The estimated annual savings for this measure is 921 kWh, with a peak demand reduction of -0.11 kW. The peak demand reduction is negative because a practical SEER 16 AC unit is achieved by applying a dual-speed compressor to an otherwise lower efficiency system. RLW found that a combination of an SEER 11 system and a dual speed compressor would yield a system that would be ARI rated at about SEER 16. The retrofit peak efficiency, however, is actually lower than the baseline peak efficiency.

IDs R10 and R11 High Efficiency SEER 16 Heat Pump

The installation of a high efficiency heat pump might be an option as a retrofit measure for existing homes with old heat pumps or with electric resistance heat.

The base case model for an old heat pump replacement, ID 10, assumed the baseline replacement heat pump would have been an SEER 13 heat pump. The retrofit model was similar to the SEER 16 AC, except it was equipped for reverse cycle operation. Potential savings for this option are about 1258 kWh and -0.52 kW for the average home.

The base case models for an electric resistance heat system replacement, ID 11, assumed the replacement equipment would be same as above. Potential savings calculated for this option were 3109 kWh and -0.48 kW. Average savings for electric strip heated homes is a little lower than anticipated due to the fact that the average electric strip heated home is slightly better insulated, and the occupants are more frugal in their energy usage practices (due to naturally reoccurring high heating costs). Additionally, there may be some significant "takeback" behavior involved. After upgrades are done, a homeowner would perceive heating bills are lower, and take some of the potential savings back in terms of increased comfort

IDs R12 and R13 Add Attic Insulation

Savings achievable for increasing attic insulation vary greatly with the amount of insulation already in place, as well as the amount of extra insulation added. Whether this is cost effective depends more on the amount of existing insulation. Two different baseline insulation values of R-7 and R-11 were assumed. In both retrofit scenarios the final R-value was R-30. Addition of any more than this is typically not cost-effective.

In the first scenario, ID R12, the baseline models were given an attic insulation value of R-7 with a retrofit to R-30. The calculated savings are 879 kWh and 0.54 kW. In the second scenario, ID R13, the base case was R-11 and the retrofit was R-30. Savings were estimated to be 541 kWh and 0.35 kW.

ID R14 Add Wall Insulation

Similar to attic insulation, achievable savings by increasing wall insulation vary greatly with the amount of insulation already in place, as well as the amount of extra insulation added. Whether this is cost effective depends more on the amount of existing insulation. RLW evaluated this measure with a baseline of no wall insulation, and added R-11 insulation to represent a realistic best-case scenario.

The calculated savings are 2634 kWh and 0.69 kW. Due to the high cost of adding insulation to existing walls, however, the simple payback for this measure based on kWh savings alone is relatively long at about 9.7 years. But this measure achieves some significant gas savings on average of about 360 Therms, and the simple payback to the average homeowner is only 2.8 years after rebate.

Although the potential savings are high, the long payback suggests that it would not be cost-effective to insulate existing walls with some insulation already in place. In fact, the existence of any batt insulation in existing walls renders it impractical to add more insulation by the normal method of blowing it through holes drilled into the stud cavities, because the batts would tend to block the flow of new insulation in many places.

ID R15 Add Insulation to Floor over Unheated Basement

Most basements are enclosed by thick masonry foundation walls and have direct contact with the earth. As such, they are naturally cooled by relatively low ground temperatures typical of Kansas City, where the averages are about 67 degrees Fahrenheit during the summer and about 43 during the winter.

As a result of the low ground temperatures, the savings are negative for most of the cooling season. The base case for this measure assumed no insulation and the retrofit provided for the addition of R-19 to the floors over the unconditioned basement areas. Calculated savings are -223 kWh and -0.12 kW. Due to differences in the costs of electricity and gas, the monetary savings from gas offset the increase in electricity usage, and the simple payback is about 7.5 years.

ID R16 Reduce Infiltration by Caulking and Weather Stripping

For this measure RLW assumed a baseline infiltration value of 0.8 ACH (Air Changes per Hour) and a retrofit of 0.35 ACH. RLW learned from several studies in different parts of the country that the average home infiltration rate is about 0.5 ACH. Calculated savings for weatherization measures are 1046 kWh, most of which (about 90%) is due to reduced heating requirements in electric heated homes, and 0.43 kW.

ID R17 Add Storm Windows to Standard Single Pane Windows

The average house in this study has about 240 square feet of window area. Less than 6% of the windows in this study were single pane, about 68% were double pane and 26%, were triple pane, counting those with storm windows. The overall average number of glass panes is 2.2, based on the study sample.

RLW used a typical single pane window with a U0 (thermal transmission coefficient) value of 1.09 and a SHGC (Solar Heat Gain Coefficient) of 0.81 for the base case, and applied storm windows in the retrofit case. The retrofit window structure had a U0 of 0.46 and a SHGC of 0.76, and the estimated savings were 908 kWh and 0.28 kW.

ID R18 Replace Standard Single Pane Windows

RLW used a typical single pane window with a U0 value of 1.09 and a SHGC of 0.81 for the base case, and applied a typical high performance double pane window in the retrofit case. The retrofit window had a U0 of 0.40 and a SHGC of 0.55, and the estimated savings were 1428 kWh and 0.54 kW.

ID R19 Replace Standard Double Pane Windows

RLW used a typical double pane window with a U0 (thermal transmission coefficient) value of 0.46 and a SHGC (Solar Heat Gain Coefficient) of 0.76 for the base case, and applied a typical high performance double pane window in the retrofit case. The retrofit window had a U0 of 0.40 and a SHGC of 0.55, and the estimated savings were 520 kWh and 0.26 kW.

IDs R20 and R21 Add Shading to East and West Facing Windows

Although external window shading might be added to all four faces of a house, the east and west faces offer the greatest potential savings. Also, to obtain maximum energy savings, the shade would have to be applied during the cooling season and removed during the heating season to avoid increasing the heating loads during the winter.

RLW considered and analyzed two different ways of shading east and west facing windows for this study, because one method will apply to some, while the other method is better for others. Neither alternative will be applicable to homes with significant east and west shading from existing trees or other things. To model these measures RLW removed all but about 5% of the external shading from the calibration models.

One practical method, ID R20, of shading windows from the exterior is the addition of solar screens that can be removed during the heating season. To model this retrofit, RLW increased the calibrated model east and west building shade transmissivities from about 0.7 to about 0.95 for the base case and the U0 value from 0.8 to 0.7 for the period of June 1 to October 31. To simulate the addition of solar screens, RLW reduced the SC of the east and west windows by half and the U0 value from 0.9 to 0.8 for July 1 through August 31. Estimated savings for this scenario are 172 kWh and 0.22 kW.

The other (and more desirable from both an aesthetic and practical perspective) method is the planting of deciduous trees in strategic locations to the east and west of the house. In this scenario, (ID R21) RLW assumed that three deciduous trees had been planted at about 20 feet from each side of the house (a total of six trees) to shade the windows as much as possible, and that they had grown to an effective height of 20 feet. Their solar transmissivities were changed from 0.1 during the summer (June 1 through October 31) to 0.9 during the winter. Resultant savings are 627 kWh, 0.18 kW. As these trees continue to grow, the savings will increase.

ID R22 Install Compact Fluorescent Lamps

Field data from the site visits indicated that the average home had about 9.7% CFL's (Compact Fluorescent Lamps) by bulb count. Hence, there is a high technical market potential for this measure. In the impact analysis RLW assumed that each program participant would install and use an average of ten 15-watt CFL's to replace ten 60-watt incandescent lamps, for a connected load reduction of about 450 Watts.

Lighting hourly usage patterns utilized in the models are based on actual measured hourly residential lighting usage patterns from a large number of long-term and short-term end-use studies RLW has performed or examined. Calculated savings amounted to 504 kWh and 0.05 kW. The peak heating load was not measurably affected because it occurred during the night when the lights are not being used.

One may note that the peak kW savings was 0.05 kW, or 50 Watts, whereas the reduction in connected load was 450 Watts. This is due to natural diversity in the lighting usage patterns so that all ten of these lamps are never on at the same time. These electric savings include both direct and indirect savings due to the reduction in internal heat gains that reduce the need for cooling.

IDs R23 and R24 Purchase Energy Star Labeled Refrigerator

Two options for replacing an existing refrigerator with an Energy Star certified unit were examined in this study. The first option assumes that an existing refrigerator is at the end of its functional life and the homeowner has already decided to replace it. The other option examines the potential of enticing a homeowner to retire an existing refrigerator before the end of its functional life.

For the firs option, ID R23, it was assumed that a standard new refrigerator on the market today uses about 564 kWh per year, and an Energy Star refrigerator will use about 432 kWh per year (10% below the 2001 federal standard average of about 480). The difference is 132 kWh per year. This direct energy reduction was modeled into the retrofit DOE2 models, and the resultant total interactive net savings are 152 kWh and 0.02 kW. Some secondary impacts are seen due to the fact that the refrigerator is in the conditioned spaces. Gas heated homes realize the full operating reduction of 132 kWh, but electrically heated homes pay a heating penalty due to the fact that savings inside the house increase the need for heat in the winter.

The baseline for the second option, ID R24, was 850 kWh per year. The resultant total interactive savings due to removal of this unit are 954 kWh and 0.12 kW. In addition to interactive effects, it was assumed that the primary refrigerator will be used more, thus adding slightly to its annual kWh usage.

ID R25 Purchase Energy Star Labeled Dishwasher

An average new dishwasher uses about 121 kWh per year directly, and an equivalent Energy Star dishwasher will use about only about 78 kWh per year. Estimated savings for a house with a weighted combination of electric and gas water heaters are 107 kWh and 0.01 kW, most of which is due to savings in weighted average electric hot water usage.

On the other hand, more substantial electric savings are possible if the water heater is electric. In this scenario, the savings would be about 240 kWh per year and 0.02 kW peak demand.

ID R26 Purchase Energy Star Labeled Clothes Washer

Maximum electric savings for high efficiency clothes washers can be achieved if both the water heater and dryer are electric, although by far most of the savings is due to the dryer. The most common home, however, uses natural gas for hot water. A significant number of homes had electric dryers (76%) and about 19% had electric water heaters.

For the typical home, RLW estimated annual savings to be about 110 kWh and 0.02 kW. The Energy Star clothes washer actually uses slightly more electric energy during the spin cycle to wring more water out, consequently reducing the time required for drying.

For the all-electric scenario, RLW estimated annual savings to be about 400 kWh and 0.04 kW.

ID R27 Install Programmable Thermostat

More than half of the homes visited already had programmable thermostats. RLW modeled the potential impacts of programmable thermostats by increasing the cooling setpoints 3.75 degrees F and decreasing the heating setpoints by 3.75 degrees F daily from 8AM to 3PM.

For this scenario RLW estimated annual savings to be about 666 kWh and -0.22 kW. Demand savings may actually be negative, as they are in this case, depending upon the setback schedule, the building mass and a thermal flywheel effect that causes the system to run longer to "make up" for the hours during which it was set back.

ID R28 Install Faucet Aerators

It was assumed, based on RLW's previous study for Missouri, that about 63% of all single family detached homes in Kansas City do not have a faucet aerator. RLW estimated the impacts of these by assuming that one faucet aerator would be installed on the kitchen sink, and that the energy savings would occur through a reduction in the use of hot water. The homes with gas water heaters will see no electric savings, but many of the homes in this study had electric water heaters.

The estimated savings for the typical home are 31 kWh and no measurable demand savings. For the 19% of homes with electric water heaters, the annual electric savings would be about 120 kWh and no peak demand. Actual demand savings may exist in some homes, but the schedule of kitchen faucet usage is small during the peak demand window.

Some homeowners may be willing to install and keep a faucet aerator in the bathroom. Although savings for these are not well defined, RLW has previously estimated that they might achieve about one tenth to one third the savings of the kitchen aerator. The reduced savings are, of course, due to the fact that the average bathroom sink utilizes significantly less hot water.

ID R29 Install Low Flow Showerheads

Field results of the previous study for Missouri indicate that about 40% of all single-family detached homes in Kansas City already use a low flow showerhead. RLW estimated the impacts of these by assuming that two low flow showerheads would be installed, and that the energy savings would occur through a reduction in the use of hot water. Again, the most common water heater is gas fired.

The estimated savings for the typical home are 174 kWh per year, and demand savings are negligible. For the 19% with electric water heaters the annual savings would be about 725 kWh and negligible coincident peak demand.

If there are more than two showers in a home, the low flow showerheads should be installed on the two most frequently used showers. If more than two devices are installed in a single home, the savings for the third one will probably be significantly less than those of the first two, but it will depend on how much the showers are actually used. On the other hand, if only one showerhead is installed because there is only one shower present, the savings for the one will probably be more than half the savings for two.

ID R30 Insulate Hot Water Pipes

All the audited homes of this study have hot water piping, but only portions of the pipes are easily accessible. RLW estimated conservation impacts by assuming that the exposed pipes could be insulated, and that the energy savings would occur through a reduction in the hot water standby losses. Again, the typical water heater is gas fired.

The estimated savings for the typical home are 80 kWh per year and negligible coincident peak demand. For the 19% with electric water heaters the annual electric savings would be about 355 kWh and negligible kW peak demand. Actual savings will vary significantly, depending on the amount and locations of exposed piping and the hot water usage patterns.

ID R31 Insulate Electric Water Heater Storage Tanks

RLW found that about 90% of the homes had electric water heaters that were not externally wrapped. The estimated savings for the typical home are 58 kWh per year and negligible kW. Savings for this measure will vary with the ambient temperatures surrounding the hot water tank.

ID R32 Install Energy Usage and Display Monitor Device

The Energy Use Monitor Tool (EUM) will provide the customer with a energy usage monitoring device aimed at helping them better manage their energy costs through real time feedback. With rising energy costs in all aspects of daily life, customers are looking for information they can act upon which will impact their monthly energy bill.

IDs R33, R34, R35 Early Retirement of residential HVAC SYSTEM

Energy efficiency gains of up to 100% can be obtained by replacing older HVAC units with a unit rated at a 14 SEER (ID R33), a unit rated at a 15 SEER (ID R34),

or a unit rated at a 16 SEER (ID R35). The base case assumption was that the existing HVAC unit was rated an 8 SEER.

ID R36, R37, R38 De-humidifier, Room A/C units and Freezers, early retirement

This measures offers a financial incentive to retire older de-humidifier units, old room A/C units and old freezers. The unit would be decommissioned and removed from the home.

IDs R39, R40, R41 Upgrade failed HVAC System

The baseline measure was a failed HVAC unit being replaced with a 13 SEER rated unit. A financial incentive would be provided to install a higher efficiency 14 seer unit, (ID R39) , a 15 SEER unit (ID R40), or a 16 SEER Unit (ID R41).

The major categories of commercial end-use measures included:

- Lighting systems – indoor, outdoor and traffic control
- Refrigeration and Food Service Equipment
- Heating, Ventilation, and Air Conditioning (HVAC)
- Motive power
- Commercial Energy Star Washing Machines
- Office equipment, both PC & Non-PC
- Thermal Storage

The major categories of industrial end-use measures included:

Industrial

- Lighting systems – indoor, outdoor and traffic control
- Refrigeration and Food Service Equipment
- Heating, Ventilation, and Air Conditioning (HVAC)
- Motive power
- Industrial process equipment

Lighting systems – indoor, outdoor and traffic control are listed in Table 5 and are described below.

Table 5: C&I lighting measures

ID#	Potential Situation	Improvement	Quantity
C&I L1	T12 - 20W -2' 1 Lamp - Magnetic	T8 - 17W -2' 1 Lamp - Electronic	1 Fixture
C&I L2	T12 - 20W -2' 2 Lamp - Magnetic	T8 - 17W -2' 2 Lamp - Electronic	1 Fixture
C&I L3	T12 - 20W -2' 3 Lamp - Magnetic	T8 - 17W -2' 3 Lamp - Electronic	1 Fixture
C&I L4	T12 - 20W -2' 4 Lamp - Magnetic	T8 - 17W -2' 4 Lamp - Electronic	1 Fixture
C&I L5	T12 - 30W -3' 1 Lamp - Magnetic	T8 - 25W -3' 1 Lamp - Electronic	1 Fixture
C&I L6	T12 - 30W -3' 2 Lamp - Magnetic	T8 - 25W -3' 2 Lamp - Electronic	1 Fixture
C&I L7	T12 - 30W -3' 3 Lamp - Magnetic	T8 - 25W -3' 3 Lamp - Electronic	1 Fixture
C&I L8	T12 - 30W -3' 4 Lamp - Magnetic	T8 - 25W -3' 4 Lamp - Electronic	1 Fixture
C&I L9	T12- 34W - 4' 1 Lamp - Magnetic	T8 32W - 4' 1 Lamp - Electronic	1 Fixture
C&I L10	T12- 34W - 4' 2 Lamp - Magnetic	T8 32W - 4' 2 Lamp - Electronic	1 Fixture
C&I L11	T12- 34W - 4' 3 Lamp - Magnetic	T8 32W - 4' 3 Lamp - Electronic	1 Fixture
C&I L12	T12- 34W - 4' 4 Lamp - Magnetic	T8- 32W - 4' 4 Lamp - Electronic	1 Fixture
C&I L13	T12 - 60W - 8' 1 Lamp - Magnetic	T8 - 59W - 8' 1 Lamp - Electronic	1 Fixture
C&I L14	T12 - 60W - 8' 2 Lamp - Magnetic	T8 - 59W - 8' 2 Lamp - Electronic	1 Fixture
C&I L15	T12 - 95W - 8' 1 Lamp - Magnetic - HO	T8 - 86W - 8' 1 Lamp - HO - Electronic	1 Fixture
C&I L16	T12 - 95W - 8' 2 Lamp - Magnetic - HO	T8 - 86W - 8' 2 Lamp - HO - Electronic	1 Fixture
C&I L17	32 W T8 Lamp	Low Watt T8 Lamp	1 Lamp
C&I L18	T12- 34W - 4' 1 Lamp - Magnetic	T5 - 4' 1 Lamp - 28 watt	1 Fixture
C&I L19	T12- 34W - 4' 2 Lamp - Magnetic	T5 - 4' 2 Lamp - 28 watt	1 Fixture
C&I L20	T12- 34W - 4' 3 Lamp - Magnetic	T5 - 4' 3 Lamp - 28 watt	1 Fixture
C&I L21	T12- 34W - 4' 4 Lamp - Magnetic	T5 - 4' 4 Lamp - 28 watt	1 Fixture
C&I L22	T12- 34W - 4' 2 Lamp - Magnetic	T5 - 4' 1 Lamp HO - 54 watt	1 Fixture
C&I L23	T12 - 60W - 8' 2 Lamp - Magnetic	T5 - 4' 2 Lamp HO - 54 watt	1 Fixture
C&I L24	T12- 34W - 4' 4 Lamp - Magnetic	T5 - 4' 2 Lamp HO - 54 watt	1 Fixture
C&I L25	T12 - 8' and 4' Avg	T5 - 4' 2 Lamp HO - 54 watt	1 Fixture
C&I L26	T12 - 95W - 8' 2 Lamp - Magnetic - HO	T5 - 4' 3 Lamp HO - 54 watt	1 Fixture
C&I L27	T12 - 60W - 8' 4 Lamp - Magnetic	T5 - 4' 4 Lamp HO - 54 watt	1 Fixture
C&I L28	T12 - 95W - 8' 2 Lamp - Magnetic - HO	T5 - 4' 4 Lamp HO - 54 watt	1 Fixture
C&I L29	T12 - 95W - 8' 2 Lamp - Magnetic - VHO	T5 - 4' 4 Lamp HO - 54 watt	1 Fixture
C&I L30	T12 - 95W - 8' 2 Lamp - Magnetic - HO - VHO Avg	T5 - 4' 4 Lamp HO - 54 watt	1 Fixture
C&I L31	Hi-Bay 250 W Hi Intensity Discharge	Hi-Bay 3L T5 HO Fluorescents	1 Fixture
C&I L32	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 4L T5 HO Fluorescents	1 Fixture
C&I L33	Hi-Bay 400W Hi Intensity Discharge	Hi-Bay 6L T5 HO Fluorescents	1 Fixture
C&I L34	Hi-Bay 1000W Hi Intensity Discharge	Hi-Bay 2-6L T5 HO Fluorescents	1 Fixture
C&I L35	Hi-Bay 250 W Hi Intensity Discharge	Hi-Bay 4L F32 T8 Fluorescents	1 Fixture
C&I L36	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 6L F32 T8 Fluorescents	1 Fixture
C&I L37	Hi-Bay 400W Hi Intensity Discharge	Hi-Bay 8L F32 T8 Fluorescents	1 Fixture
C&I L38	Hi-Bay 1000W Hi Intensity Discharge	Hi-Bay 2-8L F32 T8 Fluorescents	1 Fixture
C&I L39	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 8L 42W CFL	1 Fixture
C&I L40	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 320 Watt Metal Halide - Pulse Start	1 Fixture
C&I L41	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 350 Watt Metal Halide - Pulse Start	1 Fixture
C&I L42	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 400 Watt Metal Halide - Pulse Start	1 Fixture
C&I L43	60W Inc	15W CFL	1 Lamp
C&I L44	2-60W Inc Fixture	2-13 W CFL Fixture	1 Fixture
C&I L45	Exit Signs have CFLs	Retrofit to LED EnergyStar Exit sign	1 Fixture
C&I L46	Standard lighting switch	Install Occupancy Sensor	1 switch
C&I L47	Traffic Signal, Incandescent	Install EnergyStar Rated LED Traffic Signal	1 Fixture
C&I L48	No Skylight or light tube	Install Light Tube Commercial Skylight	1 Fixture
C&I L49	No centralized lighting controls	Install centralized lighting controls	Per Sq. Ft
C&I L50	No lighting controls	Install Multilevel Lighting Controls	Per Sq. Ft
C&I L51	No lighting controls	Install Daylight Lighting Control Sensors	Per Sq. Ft

Description of C&I Lighting Measures

ID: C&I L1 to C&I L17 Replace T12 or T12HOs Fixtures with T8 or T8HO Fixtures

Technology Description

For this technology, we evaluated the replacement of energy efficient T12 lamps and T12 fixtures with magnetic ballasts with T8 lamps and T8 fixtures with electronic ballasts.

Methodology and Assumptions

A standard spreadsheet analysis was developed to evaluate the use of T8 lamps and fixtures with electronic ballasts versus the use of energy efficient T12 lamps and fixtures with magnetic ballasts. Also evaluated was the replacement of T12 HO lamps and fixtures with T8HO lamps and fixtures.

Key assumptions for both scenarios:

- Cost estimates include material costs only. Fixture replacement as well as fixture retrofit costs is provided. Installation costs and potential maintenance savings are not included.
- Secondary impacts for heating and cooling were not evaluated.
- Information regarding lamp and system wattages, lumens, and material pricing was developed from a combination of lighting suppliers and industrial supply houses.
- Potential lighting replacement scenarios were evaluated based on mean lumens. Lumen is the measure of the amount of light a lamp produces. Initial lumens are the lamps' approximate light output after 100 hours of operation, while mean lumens measures the light output at 40% of its rated life. A true measure of a lamps' efficacy is how well it maintains its' light output over time.

Results Summary

The results of the analysis are shown in CI – L1 T8 Replacement of T12s.

- Standard 2' T8 17 watt lamps with electronic ballasts can be used to replace standard 2' T12 20 watt lamps with magnetic ballasts on a one-for-one replacement schedule for 1, 2, 3 and 4 lamp configurations, with an average 10% increase in mean lumen output.

- Standard 3' T8 25 watt lamps with electronic ballasts can be used to replace standard 3' T12 30 watt lamps with magnetic ballasts on a one-for-one replacement schedule for 1, 2, 3 and 4 lamp configurations, with an average 3% increase in mean lumen output.

- Standard 4' T12 34 watt lamps with magnetic ballasts can be replaced by 4' T8 lamps with 28, 30, or 32 watt lamps with electronic ballasts on a one-for-one replacement schedule for 1, 2, 3 and 4 lamp configurations. Utilizing T8 28 watt lamps yield an average 13% increase in mean lumens output, the T8 30 watt lamps yield an average 16% increases in mean lumens output, while the T8 32 watt lamps yield an average 17% increase in mean lumens output.

- Standard 8' T8 59 watt lamps with electronic ballasts can be used to replace standard 8' T12 60 watt lamps with magnetic ballasts on a one-for-one replacement schedule for 1 and 2 lamp configurations, with an average 9% increase in mean lumen output. Although replacing T12 60W 8' 1 and 2 lamp configurations with respective T8 59W 8' 1 and 2 lamp configurations is an energy efficient solution, it isn't very cost effective. A more cost effective option would be to replace T12 60W 8' 1 lamp fixtures with T8 32 W 4'2 lamp fixtures and to replace T12 60W 8' 2 lamp fixtures with T8 32 W 4' 4 lamp fixtures. This option results in a 5% increase in mean lumen output.

- Standard 8' T8 86 watt HO lamps with electronic ballasts can be used to replace standard 8' T12 95 watt HO lamps with magnetic ballasts on a one-for-one replacement schedule for 1 and 2 lamp configurations, with an average 9% increase in mean lumen output.

- Standard 2' T8 32W watt U-Bend lamps with electronic ballasts can be used to replace standard 2' T12 34 watt U-Bend lamps with magnetic ballasts on a one-for-one replacement schedule for 1 and 2 lamp configurations, with an average 12% increase in mean lumen output.

Measure Life

Fixture and ballast life data range from 10 to 16 years, we recommend 10 years.

Initial One-Time Costs

A summary of costs are shown in CI – L1 T8 Replacement of T12s.

Existing Energy Standards

There are currently no standards for this technology.

Sources of Information

Center Point Energy lighting wattage table, manufacturers' data, and utility data.

Energy savings and cost information are listed in Table 6 and in Table 7.

Table 6: Energy savings, T12s to T8 fixtures

Assumptions	
Minimum Operating Hours	1,800
Demonstration Operating Hours*	3,680

* hours based on 16hrs/day, 5 days/week, 52 weeks/year

ID	Energy Efficient Installation T8 w/Electronic Ballast	Energy Efficient System Wattage	Standard Installation T12 w/Magnetic Ballast	Standard System Wattage	kW Savings	Demonstration Operating Hours	Energy Savings kWh/yr
C&I L1	T8 - 17W -2' 1 Lamp - Electronic	20	T12 - 20W -2' 1 Lamp - Magnetic	27.5	0.008	3,680	28
C&I L2	T8 - 17W -2' 2 Lamp - Electronic	33	T12 - 20W -2' 2 Lamp - Magnetic	43	0.010	3,680	35
C&I L3	T8 - 17W -2' 3 Lamp - Electronic	48	T12 - 20W -2' 3 Lamp - Magnetic	68	0.020	3,680	74
C&I L4	T8 - 17W -2' 4 Lamp - Electronic	63	T12 - 20W -2' 4 Lamp - Magnetic	85	0.022	3,680	81
C&I L5	T8 - 25W -3' 1 Lamp - Electronic	26	T12 - 30W -3' 1 Lamp - Magnetic	37	0.011	3,680	40
C&I L6	T8 - 25W -3' 2 Lamp - Electronic	43	T12 - 30W -3' 2 Lamp - Magnetic	53	0.010	3,680	37
C&I L7	T8 - 25W -3' 3 Lamp - Electronic	78	T12 - 30W -3' 3 Lamp - Magnetic	90	0.012	3,680	44
C&I L8	T8 - 25W -3' 4 Lamp - Electronic	86	T12 - 30W -3' 4 Lamp - Magnetic	106	0.020	3,680	74
C&I L9	T8 32W - 4' 1 Lamp - Electronic	30	T12- 34W - 4' 1 Lamp - Magnetic	44	0.014	3,680	52
C&I L10	T8 32W - 4' 2 Lamp - Electronic	60	T12- 34W - 4' 2 Lamp - Magnetic	77	0.017	3,680	63
C&I L11	T8 32W - 4' 3 Lamp - Electronic	88	T12- 34W - 4' 3 Lamp - Magnetic	120	0.032	3,680	118
C&I L12	T8- 32W - 4' 4 Lamp - Electronic	112	T12- 34W - 4' 4 Lamp - Magnetic	150	0.038	3,680	140
C&I L13	T8 - 59W - 8' 1 Lamp - Electronic	58	T12 - 60W - 8' 1 Lamp - Magnetic	69	0.011	3,680	40
C&I L14	T8 - 59W - 8' 2 Lamp - Electronic	112	T12 - 60W - 8' 2 Lamp - Magnetic	132	0.020	3,680	74
C&I L15	T8 - 86W - 8' 1 Lamp - HO - Electronic	80	T12 - 95W - 8' 1 Lamp - Magnetic - HO	105	0.025	3,680	92
C&I L16	T8 - 86W - 8' 2 Lamp - HO - Electronic	160	T12 - 95W - 8' 2 Lamp - Magnetic - HO	210	0.050	3,680	184
C&I L17	Low Watt T8	28	32 W T8	32	0.004	3,680	15

Table 7: Cost information, T12s to T8 fixtures

Product Description	Fixture Replacement Material Totals	Fixture Replacement Material Totals	Fixture Retrofit Material Totals
T8 - 17W -2' 1 Lamp - Electronic	$56.43	$56.43	$33.00
T8 - 17W -2' 2 Lamp - Electronic	$62.88	$62.88	$36.00
T8 - 17W -2' 3 Lamp - Electronic	$108.29	$108.29	$54.00
T8 - 17W -2' 4 Lamp - Electronic	$114.72	$114.72	$57.00
T8 - 25W -3' 1 Lamp - Electronic	$56.60	$56.60	$33.00
T8 - 25W -3' 2 Lamp - Electronic	$63.20	$63.20	$36.00
T8 - 25W -3' 3 Lamp - Electronic	$108.80	$108.80	$54.00
T8 - 25W -3' 4 Lamp - Electronic	$115.40	$115.40	$57.00
T8 32W - 4' 1 Lamp - Electronic	$63.10	$63.10	$33.00
T8 32W - 4' 2 Lamp - Electronic	$75.90	$75.90	$36.00
T8 32W - 4' 3 Lamp - Electronic	$80.15	$80.15	$54.00
T8- 32W - 4' 4 Lamp - Electronic	$144.55	$144.55	$57.00
T8 - 59W - 8' 1 Lamp - Electronic	$137.43	$137.43	$49.50
T8 - 59W - 8' 2 Lamp - Electronic	$146.56	$146.56	$54.00
T8 - 86W - 8' 1 Lamp - HO - Electronic	$146.55	$146.55	$66.00
T8 - 86W - 8' 2 Lamp - HO - Electronic	$164.80	$164.80	$72.00

ID: C&I L18 to C&I L30 Replace T12 or T12HOs fixtures with T5 or T5HO Fixtures

Technology Description

For this technology, we evaluated the replacement of energy efficient T12 lamps and T12 fixtures with magnetic ballasts with T5 lamps and T5 fixtures with electronic ballasts.

Methodology and Assumptions

A standard spreadsheet analysis was developed to evaluate the use of T5 lamps and fixtures with electronic ballasts versus the use of energy efficient T12 lamps and fixtures with magnetic ballasts. Also evaluated was the replacement of T12 HO lamps and fixtures with T5HO lamps and fixtures.

Key assumptions for both scenarios:

- Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.
- Secondary impacts for heating and cooling were not evaluated.
- Information regarding lamp and system wattages, lumens, and material pricing was developed from a combination of lighting suppliers and industrial supply houses.
- Potential lighting replacement scenarios were evaluated based on mean lumens. Lumen is the measure of the amount of light a lamp produces. Initial lumens are the lamps' approximate light output after 100 hours of operation, while mean lumens measures the light output at 40% of its rated life. A true measure of a lamps' efficacy is how well it maintains its' light output over time.

Results Summary

The results of the analysis are shown in CI – L2 T5s for T12s.

- Standard 4' T5 28 watt lamps with electronic ballasts can be used to replace standard 4' T12 34 watt lamps with magnetic ballasts on a one-for-one replacement schedule for 1, 2, 3 and 4 lamp configurations, with an average 20% increase in mean lumen output.

- T5 54W 4' 1 lamp HO fixture can be utilized to replace a T12 34W 4' 2 lamp fixture with a 3% increase in mean lumen output.

- T5 54W 4' 2 lamp HO fixture can be utilized to replace a T12 60W 8' 2 lamp fixture, but mean lumen output would decrease by 7%. The fixture can also be used to replace a T12 34W 4' 4 lamp fixture with a 32% decrease in mean lumen output. Savings were determined for this fixture assuming an equal mix of these two replacements.

- T5 54W 4' 3 lamp HO fixture can be utilized to replace a T12 95W 8' 2 lamp HO fixture, with a 1% increase in mean lumen output.

- T5 54W 4' 4 lamp HO fixture can be utilized to replace a T12 60W 8' 4 lamp fixture, but mean lumen output would decrease by 6%. The fixture can also be used to replace a T12 95W 8' 2 lamp HO or VHO fixture. Lumen output is 35% higher than the HO fixture and 28% lower than the VHO fixture. Savings were determined for this fixture assuming an equal mix of these three replacements.

Due to the high cost of the T5 fixtures, paybacks are generally not acceptable at lower operating hours. Some T5 options may be viable at higher operating hours, if substantial incentives are provided.

Due to the high lumen output, T5s may be too bright for low bay application and standard one-for-one T12 replacement. T5 technology may be better suited for high bay applications (ceiling heights > 15 feet) such as HID replacement.

Measure Life

Fixture and ballast life data range from 10 to 16 years, we recommend 10 years.

Initial One-Time Costs

A summary of costs are shown in CI – L2 T5s for T12s.

Suggested Incentives

T5 - 4' 1 Lamp - 28 watt	$5.00
T5 - 4' 2 Lamp - 28 watt	$8.00
T5 - 4' 3 Lamp - 28 watt	$10.00
T5 - 4' 4 Lamp - 28 watt	$12.00
T5 - 4' 1 Lamp HO - 54 watt	$6.00
T5 - 4' 2 Lamp HO - 54 watt	$9.00
T5 - 4' 3 Lamp HO - 54 watt	$11.00
T5 - 4' 4 Lamp HO - 54 watt	$13.00

Existing Energy Standards

There are currently no standards for this technology.

Sources of Information

Center Point Energy lighting wattage table, manufacturers' data, and utility data.

Energy savings and cost information are listed in Table 8 and Table 9 below:

Table 8: Energy savings, T12s to T5

	Assumptions							
	Demonstration Operating Hours	3,680						
Measure ID	Energy Efficient Installation T 5 w/Electronic Ballast	Energy Efficient System Wattage	Standard Installation	Standard System Wattage	Watts Savings	kW Savings	Operating Hours	Energy Savings kWh/yr
C&I L18	T5 - 4' 1 Lamp - 28 watt	32	T12- 34W - 4' 1 Lamp - Magnetic	44	12	0.012	3,680	44
C&I L19	T5 - 4' 2 Lamp - 28 watt	65	T12- 34W - 4' 2 Lamp - Magnetic	77	12	0.012	3,680	44
C&I L20	T5 - 4' 3 Lamp - 28 watt	93	T12- 34W - 4' 3 Lamp - Magnetic	120	27	0.027	3,680	99
C&I L21	T5 - 4' 4 Lamp - 28 watt	126	T12- 34W - 4' 4 Lamp - Magnetic	150	24	0.024	3,680	88
C&I L22	T5 - 4' 1 Lamp HO - 54 watt	62	T12- 34W - 4' 2 Lamp - Magnetic	77	15	0.015	3,680	55
C&I L23	*T5 - 4' 2 Lamp HO - 54 watt*	*122*	*T12 - 60W - 8' 2 Lamp - Magnetic*	*132*	*10*	*0.010*	*3,680*	*37*
C&I L24	*T5 - 4' 2 Lamp HO - 54 watt*	*122*	*T12- 34W - 4' 4 Lamp - Magnetic*	*150*	*28*	*0.028*	*3,680*	*103*
C&I L25	T5 - 4' 2 Lamp HO - 54 watt	122	T12 - 8' and 4' Avg	141	19	0.019	3,680	70
C&I L26	T5 - 4' 3 Lamp HO - 54 watt	185	T12 - 95W - 8' 2 Lamp - Magnetic - HO	210	25	0.025	3,680	92
C&I L27	*T5 - 4' 4 Lamp HO - 54 watt*	*243*	*T12 - 60W - 8' 4 Lamp - Magnetic*	*264*	*21*	*0.021*	*3,680*	*77*
C&I L28	*T5 - 4' 4 Lamp HO - 54 watt*	*243*	*T12 - 95W - 8' 2 Lamp - Magnetic - HO*	*210*	*(33)*	*(0.033)*	*3,680*	*(121)*
C&I L29	*T5 - 4' 4 Lamp HO - 54 watt*	*243*	*T12 - 95W - 8' 2 Lamp - Magnetic - VHO*	*380*	*137*	*0.137*	*3,680*	*504*
	T5 - 4' 4 Lamp HO - 54 watt	243	T12 - 95W - 8' 2 Lamp - Magnetic - HO - VHO Avg	295	52	0.052	3,680	191

Table 9: Cost, T5 Fixture

Product Description	Material Totals
T5 - 4' 1 Lamp - 28 watt	$59.30
T5 - 4' 2 Lamp - 28 watt	$74.12
T5 - 4'3 Lamp - 28 watt	$78.60
T5 - 4'4 Lamp - 28 watt	$87.56
T5 - 4'1 Lamp HO - 54 watt	$120.00
T5 - 4'2 Lamp HO - 54 watt	$140.00
T5 - 4'3 Lamp HO - 54 watt	$175.00
T5 - 4' 4 Lamp HO - 54 watt	$223.88

ID: C&I L31 to C&I L42 High Bay Fluorescents and Pulse-Start HIDs

Technology Description

In high bay lighting applications (ceiling heights > 15 feet), high intensity discharge (HID) fixtures are typically utilized due to their high lumen output. Although high pressure sodium fixtures are energy efficient, they do not provide good color rendering. Probe-start metal halide fixtures are typically installed for high bay lighting applications because they deliver crisp white light, even though they are not very energy efficient.

Traditional probe-start metal halide lamps have an internal starting electrode, or probe, powered by a high open circuit voltage (600v peak voltage) from the ballast to initiate an arc. The ballast starts the lamps as well as regulates the current through the lamp. The necessity of the probe-start mechanism and its' high open circuit voltage requirement contributes to shorter ballast and lamp life, poor lumen maintenance, and poor lamp efficacy.

Methodology and Assumptions

The analysis for this technology was performed to evaluate the use of high bay fluorescents and pulse-start metal halides versus traditional probe-start metal halides in high bay applications.

Ten high bay applications were evaluated:

1. T5 fixtures utilizing 3, 4, 6, and 12, high output lamps (T5HO), replacing, 250W, 400W, and 1000W metal halide fixtures.

2. T8 fixtures utilizing 4, 6, 8, and 16, 32 watt lamps (F32T8), replacing, 250W, 400W, and 1000W metal halide fixtures.

3. Compact fluorescent fixture utilizing eight (8) 42 watt c.f. lamps – 8L42WCF replacing a 400W metal halide fixture.

4. Pulse-Start metal halides at various wattages replacing 400W probe start metal halides. Pulse-start metal halide fixtures have an igniter incorporated in the pulse-start ballast which delivers a high voltage pulse to start the pulse-start lamp. The pulse-start ballast has a lower open circuit voltage requirement which contributes to lower ballast operating temperatures, resulting in longer ballast and lamp life, great lumen maintenance and lamp efficacy. Pulse-start metal halide fixtures have faster warm up times and quicker re-strike times compared to traditional probe-start metal halide fixtures.

Key assumptions:

a. Base case probe-start metal halide fixture as summarized above

b. Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

c. Information regarding lamp and system wattages, lumens, and material pricing was developed from a combination of lighting suppliers and industrial supply houses.

d. Secondary impacts for heating and cooling were not evaluated.

e. Potential lighting replacement scenarios were evaluated based on mean lumens. Lumen is the measure of the amount of light a lamp produces. Initial lumens are the lamps' approximate light output after 100 hours of operation, while mean lumens measures the light output at 40% of its rated life. A true measure of lamps' efficacy is how well it maintains its' light output over time.

Results Summary

The results of the analysis are shown in CI – L3 High Bay Fluorescents.

All T5HO fixtures are acceptable replacements for the metal halide fixtures they were compared to. Each result in a deviation in lumen output of 25% or less.

All F32T8 fixtures are acceptable replacements for the metal halide fixtures they were compared to. All but one result in a deviation in lumen output of 25% or less. The 2-8LT8 fixture replacement for a 1000W fixture results in a decrease in lumen output of 38%, but this is still a common fixture replacement.

The 8L42WCF fixtures may not be a cost effective option as cost is high compared to the above measures.

The 320WMH-PS fixtures deliver the same mean lumens as the standard system.

The 350WMH-PS fixtures result in a 12% increase in mean lumens, but have significantly lower savings.

The 400WMH-PS fixtures are not a cost effective option unless delamping scenarios are evaluated, as a one for one replacement results in savings.

Measure Life

Fixture and ballast life data range from 10 to 16 years, we recommend 10 years.

Initial One-Time Costs

A summary of costs are shown in CI – L3 High Bay Fluorescents.

Suggested Incentives

High Bay 3L T5HO	$	40.00
High Bay 4LT5HO	$	50.00
High Bay 6L T5HO (400W replacement)	$	40.00
High Bay 2 - 6L T5HO (1000W replacement)	$	120.00
High Bay Fluorescent 4LF32T8	$	40.00
High Bay Fluorescent 6LF32T8	$	50.00
High Bay Fluorescent 8LF32T8 (400 W replacement)	$	40.00
High Bay Fluorescent 8LF32T8 (1000 W replacement)	$	120.00
Pulse Start Metal Halide (retrofit only)	$	25.00
42W 8 Lamp Hi Bay CFL	$	50.00

Existing Energy Standards

There are currently no standards for this technology.

Sources of Information

Center Point Energy lighting wattage table, manufacturers' data, and utility data.

Energy savings and cost information is listed in Table 10 and Table 11 below:

Table 10: Energy savings, Hi-bay Fluorescent

	Assumptions								
	Operating Hours	4,160							
Measure ID	Energy Efficient Installation Hi Bay Fluorescents	Energy Efficient System Wattage	Standard Installation	Standard System Wattage	Watts Savings	kW Savings	Demonstration Operating Hours	Energy Savings kWh/yr
C&I L31	3L T5 HO	182	250 W HID	290	108	0.108	4,160	449
C&I L32	4L T5 HO	243	400 W HID	455	212	0.212	4,160	882
C&I L33	6L T5 HO	365	400W HID	455	90	0.09	4,160	374
C&I L34	2-6L T5 HO	730	1000W HID	1080	350	0.35	4,160	1,456
C&I L35	4L F32 T8	142	250 W HID	290	148	0.148	4,160	616
C&I L36	6L F32 T8	224	400 W HID	455	231	0.231	4,160	961
C&I L37	8L F32 T8	299	400W HID	455	156	0.156	4,160	649
C&I L38	2-8L F32 T8	598	1000W HID	1080	482	0.482	4,160	2,005
C&I L39	8L 42W CFL	372	400 W HID	455	83	0.083	4,160	345
C&I L40	320 Watt Metal Halide - Pulse Start	342	400 W HID	455	113	0.113	4,160	470
C&I L41	350 Watt Metal Halide - Pulse Start	375	400 W HID	455	80	0.08	4,160	333
C&I L42	400 Watt Metal Halide - Pulse Start	455	400 W HID	455	0	0	4,160	0

Table 11: Cost, Hi-bay Fluorescent

Fixture Installation	Material Cost
320 Watt Metal Halide - Pulse Start	$150.00
350 Watt Metal Halide - Pulse Start	$160.00
400 Watt Metal Halide - Pulse Start	$170.00
3L T5 HO	$180.00
4L T5 HO	$192.00
6L T5 HO	$350.00
4L F32 T8	$160.00
6L F32 T8	$160.00
8L F32 T8	$200.00
8L 42W CFL	$395.00

ID: C&I L43 to C&I L44 Compact Fluorescent Lamps and Fixtures

Technology Description

Compact fluorescent lamps were evaluated for the replacement of incandescent lamps. Hard-wired compact fluorescent fixtures were also evaluated in installations in lieu of incandescent fixtures.

Methodology and Assumptions

A spreadsheet calculation was performed with standard lighting wattages. Savings for typical conversions were calculated. Replacements were chosen to provide equivalent lumen output.

Key assumptions:

Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

Secondary impacts for heating and cooling were not evaluated.

Estimated Energy Savings – kWh

Screw based Compact Fluorescent Lamp annual savings 149 kWh/lamp. Assumes 1- 15W CFL replacing 60W incandescent lamp.

Compact Fluorescent Fixtures (hardwired) annual savings 308 kWh/fixture. Assumes 1 fixture with 2 -13W lamps (27W total) replacing 1 incandescent fixture with 2-60W lamps.

Assumptions include: 3,680 annual hours of operation (average of all commercial and industrial customers).

Summer Peak Savings

Screw based Compact Fluorescent Lamp – .0405 kW/lamp. Assumes 1- 15W CFL replacing 60W incandescent lamp.

Compact Fluorescent Fixtures (hardwired) - .0837 kW/fixture. Assumes 1 fixture with 2 -13W lamps (27W total) replacing 1 incandescent fixture with 2-60W lamps.

Assumes 90% of lighting is on during peak times.

Measure Life

Screw in Compact Fluorescent lamps 2 years (available with average rated life of 6,000 to 10,000 hours. Assumed mean life would be 8,000 hours for CFLs.)

Hardwired Compact Fluorescent fixtures: 12 years. Source: California Public Utilities Commission

Initial One-Time Cost

Screw in CFLs range in price from less than $3.00/lamp for shorter lifetime mainstream wattage lamps to over $20.00/lamp for specialty CFLs such as dimmable ballast reflector floods and other decorative styles.

Compact Fluorescent Fixtures are available for as little as $15.00/fixture for simple single lamp indoor or outdoor fixtures with magnetic ballasts, and over $200.00/fixture for commercial grade decorative fixtures with multiple lamps and electronic ballast. Median price range is $35.00-85.00/fixture for most common configurations.

Any Recurring Costs

Lamps will require replacement approximately every 2.5 years in a commercial building due to assumed average rated lamp life of 8,000 hours.

Suggested Incentives

CFL screw in lamps: $1.00 to $2.00 for standard units.

Hardwired new CFL fixtures: $10.00/fixture

Consideration of greater incentive for specialty items.

Requirements For Application

Compact fluorescent lamps must be replacing incandescent lamps. CFL fixtures should contain pin based lamps and be a hardwired installation. CFLs specified should be approximately ¼ of the wattage of the incandescent they are replacing.

Existing Energy Standards

Energy Star standards are available for both technologies for residential use. Considerations include rated lamp life, flicker free lamps, and descriptive information on packaging. Many commercial fixtures have not been evaluated for Energy Star residential list, but are appropriate replacements for incandescent and should not be excluded.

Sources of Information

Energy Star, Center Point Energy Lighting Wattage Table, lightsearch.com.

Energy savings information is listed in Table 12 below:

Table 12: Energy savings, CFLs

ID	C&I L43	C&I L44
EXISTING	*Test*	*Test*
Lighting Type	*60W Inc*	*2-60W Inc Fixture*
Number of Fixtures	*1*	*1*
Lamps per Fixture	*1*	*2*
Fixture Wattage	*60*	*120*
LF - Load Factor	*0.9*	*0.9*
Annual Operating Hours	*3,680*	*3,680*
Conversion Factor	*1,000*	*1,000*
kW	*0.054*	*0.108*
kWh/Yr Use	***199***	***397***
Average kWh Rate	*$0.070*	*$0.070*
Annual Energy Cost	***$14***	***$28***
PROPOSED		
Lighting Type	*15W CFL*	*2-13 W CFL Fixture*
Number of Fixtures	*1*	*1*
Lamps per Fixture	*1*	*2*
Fixture Wattage	15	27
Conversion Factor	*1,000*	*1,000*
kW	*0.014*	*0.024*
kWh/Yr Use	***50***	***89***
Gas Increase (th/yr)	*NA*	*NA*
Average therm Rate	*$0.070*	*$0.070*
Annual Energy Cost	*$3*	*$6*
SAVINGS		
kW	*0.0405*	*0.0837*
kWh/Yr Use	***149***	***308***
th/yr	*NA*	*NA*
Annual Energy Cost	***$10***	***$22***
Project cost Estimate	*$3*	*$45*
Simple Payback	0.3	2.1

ID: C&I L45 LED Exit Signs

Technology Description

Exit signs that have earned the ENERGY STAR label operate on five watts or less per sign, compared to standard signs, which use as much as 40 watts per sign.

Energy Savings – kWh and Summer Peak Savings

ENERGY STAR lists typical savings of 149 kWh and 31W. This assumes two CFL lamps in the base unit. As many existing fixtures have incandescent lamps these values are conservative.

Measure Life

15 years

Initial One-Time Cost

Material costs are found in the range of $20 - $40.

Suggested Incentive

A $10 incentive is recommended. Program incentives range from $5 to $35, or offer the fixtures at no cost.

Requirements

There are ENERGY STAR program requirements for LED Exit Signs. Signals must be less than 5W and have power factors above 0.7.

Existing Energy Standards, ENERGY STAR

Sources of Information

ENERGY STAR website

Manufacturers' website.

ID: C&I L46 Occupancy Sensors

Technology

Occupancy sensors represent an energy-efficient way to control lighting use in low occupancy areas such as halls, storage rooms, and restrooms. Instead of relying on people to remember to switch lights off when they leave a space, occupancy sensors perform this task. They measure the movement of people within a space. When movement is detected, the lights turn on automatically; they then shut off when they no longer sense movement. Each unit's shut-off time can be preset, given the needs of the space being controlled.

Estimated Energy Savings – kWh

Savings estimates vary by type of space and connected load. We are suggesting a two tier incentive based on square footage controlled. Larger square footages controlled will likely result in higher costs for multiple sensors, additional wiring, etc. We are not specifying savings or incentives by type of space assuming a natural mix in actual applications.

Industry Estimates of potential energy savings for occupancy sensors (%)

Space Type	CEC	Esource	EPRI	Novitas	Watt Stopper
Private office	25-50	13-50	30	40-55	15-70
Open office	20-25	20-28	15	30-35	5-25
Classroom	-	40-46	20-35	30-40	10-75
Conference	45-65	22-65	35	45-65	20-65
Restroom	30-75	30-90	40	45-65	30-75
Warehouses	50-75	-	55	70-90	50-75
Storage	45-65	45-80	-	-	45-65

Assumed 3,680 annual hours of operation (average of all commercial and industrial customers), a 30% reduction in operating hours and 1.2 watts/square foot of lighting controlled.

Under 500 ft2 $\quad$ 300 ft^2 average x 1.2 watt/ft^2 x 3680 hours x 30% = 397 kWh

1000 watts/kWh

Over 500 ft^2 750 ft^2 average x 1.2 watt/ft^2 x 3680 hours x 30% = 994 kWh

1000 watts/kWh

Summer Peak Savings

None – occupancy sensors may reduce load at peak but not for many applications. Average demand savings are 0.11 kW and 0.27 kW.

Measure Life

8-15 years listed in programs reviewed, DEER list 8 years, we recommend 8 years.

Initial One-Time Cost

Prices vary depending on sensor capability. Range from approximately $40 for low end or residential model to $200, not including installation. Assume $100 to $400/unit installed.

Any Recurring Costs

None.

Suggested Incentive

Under 500 ft^2 - $20/unit

Over 500 ft^2 - $40/unit

Incentive could be structured on wattage controlled or at a single incentive level for all installations.

Requirements For Application

Care should be taken when specifying occupancy sensors to ensure occupant satisfaction. Two main technologies used for occupancy sensors are passive infrared (PIR) and ultrasonic. PIR sensors react to body heat and sense occupancy by detecting the difference in heat from a body and the background. Ultrasonic sensors use volumetric detectors and broadcast sounds above the range of human hearing, then measure the time it takes the waves to return and can detect persons behind obstructions.

Both types of sensors feature a delay adjustment which sets the time that lights are on after no occupancy is detected and a sensitivity adjustment which makes the unit either more or less sensitive to motion. Delays should not be set for less than 10 minutes so that lamp life is not affected or make sure that programmed start ballasts are specified with fluorescent lamps.

Ultrasonic sensors are sensitive to air movement from HVAC diffusers and should be adjusted to a point at which they are not sensing air movement.

Existing Energy Standards

There are currently no Energy Star standards for this technology.

Sources of Information

FEMP, LRC; Green Seal Report, manufacturer's web sites Novitas, Leviton, Watt Stopper, Pass & Seymour Legrand

ID C&I L47 LED Traffic Lights

Technology Description

ENERGY STAR labeled signals perform better than incandescent models and are a better value. Compared to standard incandescents, ENERGY STAR labeled traffic signals use 80 - 90% less energy, and have lower maintenance costs because they need to be replaced less frequently.

Energy Savings – kWh

The energy savings varies for red, green and yellow signals. Savings also varies for round lamps, arrows and pedestrian signals. Reviewing details on California, Wisconsin and Texan programs, the savings below are typical.

In general savings are greater on car traffic signals and costs for the lamps are generally less than for pedestrian signals. The recommendations include a breakdown between the two types of signals.

Traffic signal (per lamp average) 275 kWh

Pedestrian signal 150 kWh

Summer Peak Savings

Traffic signal (per lamp average) 0.085 KW

Pedestrian signal 0.044 KW

Measure Life

Lamps rated for 30,000 to 40,000 hours which would provide for a 10 to 15 year life on traffic signal lights. We have seen municipalities plan for a 5 to 7 year change out schedule. Assume 6 to 8 years.

Initial One-Time Cost

Lamp costs vary significantly. Green generally cost 50% more than yellow or red. Pedestrian lamps generally 50% to 100% more expansive than traffic lamps.

Traffic Signals $50/lamp

Pedestrian $100/lamp

Suggested Incentive

Traffic Signals $12.50/lamp

Pedestrian $25/lamp

Incentives have been recently noted as high as $35/lamp (even higher when technology first became available) but feel lower incentives are adequate.

Requirements

There are Energy Star Program Requirements for LED Traffic Signals. Signals must be connected to a metered electric service. Some utilities charge municipalities per fixture or per intersection for traffic lights.

Existing Energy Standards

Energy Star

Sources of Information

LED Traffic signal programs from Texas, California and Wisconsin. Energy Star website. Manufacturers website.

<u>CI – L48 Light Tube Commercial Skylight</u>

Technology Description

This technology is essentially a 10" to 21" diameter skylight with a prismatic or translucent lens that reflects light captured from a roof opening through a highly specular reflective tube down to the mounted fixture height. When in use, a light tube fixture resembles a metal halide fixture. Uses include grocery, school, retail and other single story commercial buildings.

Estimated Energy Savings – kWh

As noted on the following table, the average savings is calculated to be 361 kWh. Please note, this assumes only 21" and 14" installations.

Brand/size	Lumen Output	Equivalent	KW	kWh
Solatube 21"	13,500-20,500	2-3LF32T8 172W	0.172	481.6
14"	6000-9100	1-3LF32T8	0.086	240.8
10"	3000-4600	3-18W quad	0.054	151.2
		AVERAGE	0.129	361.2

2800 hours per year used for savings calculations. Manufacturers maintain that light overcast conditions still allow for adequate output to offset electric light use.

Summer Peak Savings

There would be a fairly high correlation between sunlight available for the light tube and summer peak demand. Using 90% of the 0.129 KW average shown above results in a demand reduction estimate of 0.116 KW.

Measure Life

Warranty is 10 years. We have assumed a 14 year average life.

Initial One-Time Cost

Do it yourself kits range in price from approximately $300 to $500. Labor to install varies (approx. $200-$400) based on the type of roof deck. Average cost assumed to be on the low end, $500. Unless installations are easy and straightforward we don't feel many customers will utilize this technology. New construction installations are less expensive, and likely more viable.

Any Recurring Costs

Flashing may need occasional maintenance and lens many need cleaning.

Suggested Incentive

California Commercial Skylight program offers $56 for each installed 21" Solatube skylight. California incentives tend to be fairly high on a cost per kWh basis. This technology appears to have a relatively low savings level compared to the cost thus an extensive incentive is difficult to justify. We recommend using $75 for the analysis. We see this as most cost effective in the new construction market where installation costs are lower and planning and design can maximize savings.

Requirements

Commercial and Industrial interior spaces that would otherwise require electric lighting between 1-4PM on weekdays during the summer to reduce peak demand.

Existing Energy Standards

There are currently no standards for this technology.

Sources of Information

California Energy Commission website www.energy.ca.gov, www.evsolar.com/daylighting.htm, www.elitesolarsystems.com, www.Solatube.com/solamaster.htm , www.dayliteco.com, PG&E Daylighting McDonald's case study, manufacturer's web sites,

ID: C&I L49 Centralized Lighting Control

Technology Description

Allow automated control of lighting systems. Included in this technology are simple time clocks, package programmable relay panels, and complete building automation systems. This type of control is most often used with programming schedules to light only areas that are occupied based on typical occupant schedules and utilize wall switches or occupancy sensors to determine when occupants are in a space at a non-typical time and allow adjustments to the lighting accordingly. Increased savings are possible by incorporating photosensors with a centralized lighting control system to indicate when it is appropriate to decrease the lighting level in perimeter building areas. Energy savings are maximized by integrating other systems such as security systems that detect employee keycards and can turn on or off lighting in office areas accordingly. Limitations include high initial and maintenance costs and compatibility of components. This technology is easiest to implement in new construction, however retrofit is a possibility.

Estimated Energy Savings – kWh

Timers 10-20% of lighting energy, Building Automation systems with photoelectric controls 20-30%

Key assumptions:

Lights on for an average of 3,680 hours, even though 3,956 annual hours of operation (average of all commercial and industrial customers). 1.25 Watts per square foot, average lighting level in space to be controlled, 15% savings on simple timer systems and 25% on more sophisticated building automation and controls. Estimated savings averages 1.15 kWh per square foot per year.

$(1.25\ W/ft^2 / 1000W/kW) \times (25\%\ savings) \times 3{,}680\ hrs = 1.15\ kWh/ft^2/yr$

Summer Peak Savings

Assumes at least 90% of lighting on during peak times. Assume peak savings is negligible. Average demand savings is 3.12 kW/10,000 ft_2.

Measure Life

DEER lists 16 years, programs reviewed show 10-15 years, we recommend 12 years.

Initial One-Time Cost

Simple time clocks are available for as little as $49.00 for an electronic 20A programmable 7 day timer. Building automation systems can be in the hundred thousands of dollars. The simple timeclock installed for $100 in a 150 square foot office will only cost about $0.67/square foot. Large systems could cost several dollars per square foot. This analysis assumes can average cost of $0.90 per square foot.

Any Recurring Costs

Requires regular maintenance and adjustments in scheduling due to changes in usage by occupants.

Suggested Incentive

We recommend a $.10/square foot assumption be used. Could consider adding to incentives if systems create other opportunities for daylighting and/or multilevel lighting.

Requirements

System should be automated and must consider occupant schedules and override for safety.

Existing Energy Standards

There are currently no standards for this technology.

Sources of Information

Lighting Research Center –"Controlling lighting with building automation systems", ACEEE Guide to Energy Efficient Commercial Equipment, FEMP, DEER

ID: C&I L50 Multilevel Lighting Control

Technology Description

Systems allow occupants or building control systems the ability to vary the amount of lighting in a space using multilevel switching to create different lighting schemes based on the task illumination requirements. Examples are: Conference rooms, auditoriums, classrooms and other multipurpose rooms where lighting needs may be at different levels for meetings, presentations, etc. Fluorescent fixtures with 3 lamps may be contain 2 ballasts to control inboard and outboard lamps to vary the amount of illumination generated by the fixture. Occupants can operate fixtures at 3 levels – 1 lamp, 2 lamps or all 3 lamps. Other examples are multiple fixture types, such as in a conference or multimedia room where occupants may choose to operate perimeter lights, accent lights or task lights separately from ambient lighting for multiple levels of lighting.

Another area where multilevel lighting might be used is in warehouse areas that are frequently unoccupied or are illuminated by skylights. In this situation, lighting with multilevel (high/low) capability can be switched to low output based on input from an occupancy or daylight sensor. A consideration for multilevel HID is that in many cases, the lamp loses efficacy at reduced power – for example at the high setting a 400W MH is operating at 100% input wattage and 100% lamp lumens, but at 50% power the lamp lumens are at approximately 23-30%. An option to operate lamps at 50% light level is also available, but the energy savings are not as great (approx 30% energy reduction).

Estimated Energy Savings – kWh

Savings varies by application and user preferences. Classrooms can take advantage of available daylight and switch lighting rows next to windows off to achieve savings (approx. 20-30% at perimeter). Savings for HID bi-level can be estimated at approximately 24% compared to single level HID fixtures. These savings are likely optimistic compared to the universe of potential applications. Average savings is estimated at 15-20%. Based on 3,680 burn hours per year savings should be about 0.8 kWh per square foot.

(1.25 W/ft^2 / 1000W/kW) x (17.5% savings) x 3,680 hrs = 0.80 kWh/ft^2/yr

Summer Peak Savings

Assume peak demand impact is negligible. Average demand savings is 2.2 kW/10,000 ft^2.

Measure Life

DEER lists 16 years, programs reviewed show 10-15 years, we recommend 12 years.

Initial One-Time Cost

One time cost on new construction can be fairly minimal. Costs on retrofit will vary significantly with sophistication of the project. Assume $1/square foot for lack of substantial detail.

Any Recurring Costs

Commissioning to ensure proper performance of sensors if used.

Suggested Incentive

Minimal incentive based on savings potential and applications. Assumed to be $.05/square foot. Savings more reliable if multilevel lighting is part of a lighting automation or controlled daylighting strategy.

Requirements

Should be used with daylight or occupancy sensors to automate and maximize savings.

Existing Energy Standards

There are currently no Energy Star standards for this technology.

Sources of Information

PG&E, LRC, manufacturer websites.

ID: C&I L51 Daylight Sensor Lighting Control

Technology Description

Systems use photoelectric controls to take advantage of available daylight in perimeter building spaces (open spaces within 10' to 15' of windows) or other areas that have access to daylight infiltration. Photoelectric controls can be used to turn lights on or off, stepped dimming (high/low or inboard/outboard), or continuous dimming based on light level from available daylight. Especially useful in common spaces where task lighting is not critical (malls, warehouses, atriums, etc.).

Estimated Energy Savings – kWh

20-30+% for perimeter office and open spaces, up to 40% for sky lit common spaces.

Key assumptions:

Lighting on 3,680 hours per year. Assumes 1.3 watts per square foot, 30% savings in exterior (sun lit) spaces. Assume savings averages 1.43 kWh per square foot per year.

(1.3 W/ft^2 / 1000W/kW) x (30% savings) x 3,680 hrs = 1.43 kWh/ft^2/yr

Summer Peak Savings

The bulk of savings will occur during peak hours because this is exactly the time that maximum daylight is available.

1.3 watts/square foot x 1 square foot x .35 x 0.9 DF = 0.41 watts/ft^2

= .00041 KW/ft^2 or 4.1 KW/10,000ft^2

Measure Life

DEER lists 16 years, programs reviewed show 10-15 years, we recommend 12 years.

Initial One-Time Cost

Estimate $1/ft^2. Less expensive, and less refined, with multilevel lighting versus dimmable ballasts.

Any Recurring Costs

Occasional re-commissioning & adjustments, service calls due to occupant complaints.

Suggested Incentive

Suggest $.12/ft^2 of controlled space. Not entire facility square footage.

Requirements

Requires commissioning to calibrate sensors and ensure that energy savings and occupant comfort are realized. Incentive only for space with reasonable sun light exposure.

Existing Energy Standards

There are currently no standards for this technology.

Sources of Information

FEMP, ACEEE, Heschong Mahone Group, manufacturer websites, DEER.

Refrigeration and Food Service end-use measures are listed in Table 13 and described below.

Table 13: Refrigeration and food service measures

ID#	Potential Situation	Improvement	Quanti
C&I Refrig 1	No Controls on Vending Machine	Install Cold Beverage Vending Machine Controllers	1 each
C&I Refrig 2	No anti-sweat heater control	Install Anti-sweat heater controls	per doc
C&I Refrig 3	Standard condenser	Install Efficient Refrigeration Condenser	40 Ton cap
C&I Refrig 4	No covers on food cases	Install Night Covers for Food Cases	Per linea
C&I Refrig 5	No compressor head controls	Install compressor head controls	Per To
C&I Refrig 6	Standard Commercial Solid Door Refrigerators less than 20ft3	ENERGY STAR Commercial Solid Door Refrigerators less than 20ft3	per uni
C&I Refrig 7	Standard Commercial Solid Door Refrigerators 20-48 ft3	ENERGY STAR Commercial Solid Door Refrigerators 20-48 ft3	per uni
C&I Refrig 8	Standard Commercial Solid Door Refrigerators more than 48ft3	ENERGY STAR Commercial Solid Door Refrigerators more than 48ft3	per uni
C&I Refrig 9	Standard Commercial Solid Door Freezers less than 20ft3	ENERGY STAR Commercial Solid Door Freezers less than 20ft3	per uni
C&I Refrig 10	Standard Commercial Solid Door Freezers 20-48 ft3	ENERGY STAR Commercial Solid Door Freezers 20-48 ft3	per uni
C&I Refrig 11	Standard Commercial Solid Door Freezers more than 48ft3	ENERGY STAR Commercial Solid Door Freezers more than 48ft3	per uni
C&I Refrig 12	Standard Ice Machines less than 500 lbs	Energy Efficient Ice Machines less than 500 lbs	per uni
C&I Refrig 13	Standard Ice Machines 500-1000 lbs	Energy Efficient Ice Machines 500-1000 lbs	per uni
C&I Refrig 14	Standard Ice Machines more than 1000 lbs	Energy Efficient Ice Machines more than 1000 lbs	per uni

ID 52: C&I Refrigerator 1: Cold Beverage Vending Machine Controllers

Technology Description

Cold beverage vending machine controls reduce energy consumption between 30% and 50% on average by controlling the machine's lights and optimizing refrigeration to reduce energy while maintaining product quality. Additional yearly savings in maintenance can also be realized due to reduced running time of vendor components. The most prevalent and available control is Bayview Technologies' (owned by US Technologies, Inc) VendingMiser.

Methodology and Assumptions

Typical vending equipment consumes 7-14 kWh/day depending on size.

VendingMiser claims savings range is from 30%-50%. Potential annual energy saving calculate between 766.5 and 2,555 kWh per unit/year.

Tufts Climate initiative estimated 1752 kWh/year savings based on a very limited study. The Database for Energy Efficiency Resources (DEER) claims 1,612 kWh in annual savings.

Estimated Energy Savings – kWh

We have had experience with the installation of thousands of these units on programs over the last couple of years. We feel the units are effective in some applications but misapplications and persistency lead us to savings on the low end of expectations. We recommend a savings level of 800 kWh/year.

Summer Peak Savings

Typical peak use for a cold beverage machine: 700W – 1200 W. Assuming a 30% runtime reduction: 0.7 kW x 30% = 0.21 kW

Measure Life

Questions about persistence have been raised because the units are easily accessed and removed or unplugged. Position of sensor is also important for optimum performance. Although the quality of the product will allow for a longer life, we have assumed 5 years, as with other plug load technologies, analyzed, due to the persistency issue.

Initial One-Time Cost

Prices vary primarily due to institutional rates that are available to Utility and Government conservation programs. Identified costs vary from $140 to $180 per unit. Assume an average cost of $160/unit.

Any Recurring Costs

None.

Suggested Incentive

$50/unit

Requirements For Application

May need to move equipment away from the wall to access the outlet. Should follow placement of sensor directions closely

Existing Energy Standards

None for the controls. However, ENERGY STAR does have requirements for existing vending machines/rebuilt vending machines to be ENERGY STAR qualified. One of the methods of achieving the ENERGY STAR status is to install a vending machine controller to the existing machine.

Sources of Information

USA Technologies (usatech.com); EPA Energy Star; multiple utility/government program sites; Tufts University, E-Source, DEER database

ID 53: C&I Refrigerator 2: Anti-Sweat Heater Controls

Technology Description

Glass doors on refrigerator and freezer cases can have anti-sweat or anti-condensate heaters in the frames and mullions of the case. These heaters operate continuously in order to prevent condensation/frosting on the glass and frame that occurs when the surface temperature is below the dew point of the surrounding air. Anti-sweat heater controls control the operation of these heaters so that they do not run continuously when not needed (lower dew point in the air as typically occurs in winter). Anti-sweat heaters are only required to operate at full capacity when the space humidity is 55%. This results in energy savings due to reduce operation of the heater elements.

Methodology and Assumptions

Savings numbers were derived from a collection of supermarket studies identifying anti-sweat heaters as a potential energy efficiency measure. The study was completed by CDH Energy using the Supermarket Simulation Tool (SST) that they developed for the Electric Power Research Institute (EPRI).

The study simulated the potential impact of cycling anti-sweat heaters based on store humidity at eleven Wisconsin supermarkets. The control scheme assumes the heaters are on 100% of the time at store (indoor) relative humidity levels of 55%. The runtime drops linearly until the heaters are off at a store (indoor) humidity level of 22%. The savings determined is the average per door of the locations studied.

The savings at each store is driven by the hours at each humidity level – therefore the dryer the store the more savings. In addition, a reduction in refrigeration load due to less heat gain to the system from the heater operation is factored into the savings – therefore the less efficient the refrigeration system the more savings. Store humidity levels are dependent on outdoor humidity and the ventilation rate of the store.

Key assumptions:

Average power per door – 250 watts

3% savings in runtime of heater for a 1% drop in store (indoor) relative humidity.

Low temp rack efficiency of 1.8 kW/ton

75% of anti-sweat heater load contributes to total case load.

Estimated Energy Savings – kWh

1489 kWh savings per door.

Summer Peak Savings

No summer peak savings is claimed since the heaters typically must operate continuously through the summer in climates where summers are humid.

Measure Life

We recommend a 10 year life. This is consistent with what other programs use for other types of controls.

Initial One-Time Cost

The cost of controls can vary significantly per door depending on control type installed. One controller can operate as few as 1 door (when control is at the case) or an entire supermarket of doors when control is integrated into existing refrigeration control system. From our current observations of projects completed the average is $85 per door. A typical control is ~$250 to operate an average of 3 doors.

Suggested Incentive

$40 per door

Focus on Energy's incentive is $40 per door. Efficiency Vermont offers $15 for cooler doors and $30 for freezer doors.

Requirements For Application

Equipment must sense the relative humidity or dew point in the air outside of the display case and reduces or turns off the glass door (if applicable) and frame anti-sweat heaters at low humidity conditions. Measure not applicable for low or zero energy doors where there are no anti-sweat heaters. Incentive based on total number of doors and capped at 50% of project cost. New or retrofit applications are eligible.

Existing Energy Standards

None

Sources of Information

CDH Energy study, Other Efficiency Program Websites

ID 54: C&I Refrigerator 3: Efficient Refrigeration Condenser

Technology Description

This analysis evaluates the installation of oversized condensers for refrigeration systems. Increasing condenser size allows for reduced system head pressures. Reducing head pressure reduces the power consumption at the compressor.

Typical condenser designs provide for approaches (difference between entering air dry bulb temperature and refrigerant condensing temperature) as below:

Medium Temperature System = 15□F design approach

Low Temperature System = 10□F design approach

Reducing the approach lowers the head pressure and conserves compressor horsepower. Previous new construction programs in California offered prescriptive incentives that were based on the improvement in approach temperatures over those listed above.

Methodology and Assumptions

Averages of load and operating efficiency from an outside computer model are used in the calculation for energy savings.

- System capacity: 40 tons with full load kW/ton of 2.3 at 105°F saturated condensing temp.

- For the base, extrapolated from a computer model completed by an outside engineering firm, a system without efficient (oversized) condensers (10°F condenser approach) operating based on 82F ambient had an average load of 82% and average kW/ton of 1.92 and a similar system operating based on 70F ambient had an average load of 79% and average kW/ton of 1.85.

- For the proposed, extrapolated from the same computer model, a system with efficient (oversized) condensers (7°F condenser approach) operating based on 82F ambient had an average load of 83% and average kW/ton of 1.86 and a similar system operating based on 70F ambient had an average load of 80% and average kW/ton of 1.78. Peak kW/ton of the proposed in the model was 2.18 kW/ton.

Due to savings for this measure occurring only in the warmer months, 4380 hours was used (1/2 a year).

Estimated Energy Savings – kWh

120 kWh per ton of refrigeration capacity

Summer Peak Savings

0.118 kW per ton of refrigeration capacity

Measure Life

Connecticut Light & Power uses a 15 year life. The DEER database indicates between 10 and 16 years.

Initial One-Time Cost

Per internet research, more recent analysis from projects completed in Oregon and California indicate $35 per ton of refrigeration cost for incremental. A new condenser when existing not failed would result in $350 per ton cost.

Suggested Incentive

$12 per ton of refrigeration capacity

Requirements For Application

Oversized Condenser Approach Requirements: Air cooled low temp 8°F, air cooled medium temp 13°F, evaporative-cooled 18°F. Condenser design temperature approach must be at or below the following parameters: Air-cooled condensers (exiting refrigerant vs. ambient dry bulb temperature): low temperature systems (8°F) and medium temperature systems (13°F). Evaporative-cooled condensers (exiting refrigerant vs. ambient wet bulb temperature: 18°F. Incentive is based on tons of refrigeration capacity of the system being affected. Capacity calculated at customer specific design conditions.

Existing Energy Standards

None

Sources of Information

California DSM programs, Connecticut Power & Light programs, Oregon Energy Smart Grocer project report.

Energy saving information is listed in Table 14 below:

Table 14: Energy savings, Efficient Condensers

EXISTING	82 Cond	70 Cond
Tons Capacity	40	40
Average Annual Load	82%	79%
Average kW/Ton	1.92	1.85
peak kW/ton	2.30	2.30
Hours	4,380	4,380
kW	92.000	92.000
kWh/Yr Use	**274,489**	**255,731**
PROPOSED		
Lighting Type	40	40
Average Annual Load	83%	80%
Ave kW/ton	1.86	1.78
peak kW/ton	2.18	2.18
Equiv Full Load Hours	4380	4380
kW	87.200	87.200
kWh/Yr Use	**271,126**	**249,485**
SAVINGS		
kW	4.8000	4.8000
kWh/Yr Use	**3,364**	**6,246**
kWh/Yr/Ton	84	156
kW/yr/ton	0.12	0.12
Project cost Estimate per Ton	$35	$35

Assumptions

System capacity: 40 tons with full load kW/ton of 2.3 at 105°F saturated condensing temp.

From a computer model completed by an outside engineering firm, a system without efficient (oversized) condensers (10°F condenser approach) operating based on 82F ambient had an average load of 82% and average kW/ton of 1.92 and a similar system operating based on 70F ambient had an average load of 79% and average kW/ton of 1.85.

From the same computer model, a system with efficient (oversized) condensers (7°F condenser approach) operating based on 82F ambient had an average load of 83% and average kW/ton of 1.86 and a similar system operating based on 70F ambient had an average load of 80% and average kW/ton of 1.78. Peak kW/ton of the proposed in the model was 2.18 kW/ton.

Due to savings for this measure occuring only in the warmer months,4380 hours was used (1/2 a year).

ID 55: C&I Refrigerator 4: Night Covers

Technology Description

Open refrigerated display cases in supermarkets have a continuous heat load due to losses to the surrounding environment. When store operations are not 24 hours per day, night covers (a film type perforated cover) can be utilized on the cases to minimize the losses to the ambient space during periods when the store is closed. The analysis is based on information extracted from documents describing past California utilities refrigeration efficiency improvement programs. This analysis relies on the assumptions from the California programs.

Thermal radiation and infiltration of warm air into cold, open display cases account for most of the refrigeration load for the displays. For supermarkets that do not operate for 24 hours, there is an energy reduction opportunity to cover the opening. The literature restricts its analysis to a case with a minimum of 6 hours per day of non-operating hours. It is recommended that the covers be perforated to decrease moisture buildup.

Test results reported by the SDG&E indicate a 9% reduction is compressor power during a 6 hour period with night covers in place. The uncovered usage reported by the California programs is 1168 kWh per linear foot.

Methodology and Assumptions

The analysis for this technology consists of simply clarifying the results of the test reports from the California utilities. Inherent in the acceptance of their energy estimates is acceptance of their testing and assumptions..

Estimated Energy Savings – kWh

KWh Savings = 1168 kWh/lineal foot x 9% = 105 per lineal foot

Summer Peak Savings

No summer peak savings due to covers installed at night. Average night demand savings based on 3500 hours of night application would be 0.03 kW.

Measure Life

The DEER database indicates a 5 year life for night covers. It does indicate a 16-year life for night shields – the savings would be the same for these but the likelihood of installation is low due to the covers being easier to use.

Initial One-Time Cost

Per internet research, more recent analysis from projects completed in Oregon indicate $35 per lineal foot cost.

Suggested Incentive

$10 per lineal foot

Requirements For Application

Store operation must allow covers to be covering cases at least 6 hours per 24 hour period.

Existing Energy Standards

None

Sources of Information

California DSM programs

<u>ID 56 C&I Refrigerator 5: Head Pressure Control</u>

Technology Description

Reducing the compressor discharge pressure reduces the pressure ratio across the compressor and improves the operating efficiency. Many systems have controls that maintain a minimum condensing pressure to ensure proper operation of all components. By letting the condensing pressure drop down at lower ambient temperatures with head pressure controls, energy savings can be achieved. The typical design target for refrigeration systems for head pressure is the equivalent of 100F to 105F saturated condensing temperature.

Previous programs in California offered prescriptive incentives that were based on ambient temperatures for the estimated savings as listed below:

82□F = Base – No incentive

70□F = 6% Savings

60□F = 9.5% Savings

50□F = 13% Savings

Methodology and Assumptions

Averages of load and operating efficiency from an outside computer model are used in the calculation for energy savings. The analysis is based on the estimated energy consumption of a low temperature system (-25□F) operating 8760 hours per year. The base system is assumed to limit the condensing pressure to that corresponding to 82□F ambient. The floating head pressure system is assumed to allow the equivalent condensing pressure to drop to a pressure corresponding 60□F ambient. The average base load extrapolated from the model to be 82% with an average of 1.92 kW/ton operation. The proposed operation as extrapolated from the model is 78% with an average of 1.83 kW/ton.

Estimated Energy Savings – kWh

1264 per ton of refrigeration (based on original model output).

The calculation based on extrapolated data results in 1288 kWh/ton. A program simulation completed in Wisconsin of eleven stores demonstrated an average of 1226 kWh per ton.

Summer Peak Savings

Because the savings opportunity is based on colder ambient temperatures, there is no predictable demand savings for this technology.

Measure Life

The DEER database 2005 indicates a 16 year life

Initial One-Time Cost

Per internet research, more recent analysis from projects completed in Oregon indicated $80 per ton (mostly labor). The DEER database from California indicates between $30 & $50 per ton (mostly labor).

Suggested Incentive

$60 per ton of refrigeration

Requirements For Application

Controls must be installed that vary head pressure based on outdoor air temperature. At least a 20° minimum variance below design head pressure should be achieved during milder weather conditions. Qualifying systems use variable set-point floating head controls to adjust condensing temperatures in relation to outdoor air temperature. Incentive only available to assist with the purchase of hardware needed to achieve lowered head pressure (70F is a typical value). . Incentive is based on tons of refrigeration capacity that the control is applied to and is capped at 50% of project cost. Capacity calculated at customer specific design conditions.

Existing Energy Standards

None

Sources of Information

California DSM programs, CDH Energy Simulation report on Floating Head Pressure for 11 Wisconsin supermarkets

Energy savings information is listed in Table 15 below:

Table 15: Head Pressure Controls

EXISTING	*Test*
Tons Capacity	*40*
Average Annual Load	*82%*
kW/Ton	*1.92*
Hours	*8,760*
kW	*0.000*
kWh/Yr Use	***551,670***
PROPOSED	
Tons Capacity	*40*
Average Annual Load	*78%*
Ave kW/ton	*1.83*
Equiv Full Load Hours	*8760*
kW	*0.000*
kWh/Yr Use	***500,161***
SAVINGS	
kW	*0.0000*
kWh/Yr Use	***51,509***
kWh/Yr/Ton	*1,288*
kW/yr/ton	*0.00*
Project cost Estimate per Ton	*$80*

Assumptions

System Capacity: 40 Tons with full load kW per ton at 105°F Saturated Condensing temp of 2.3 kW/Ton.

From a computer model completed by an outside engineering firm, a system without head pressure control down to 82F ambient had an average load of 82% in a year with an average kW/ton performance of 1.92.

From a computer model completed by an outside engineering firm, a system with head pressure control down to 60F ambient had an average load of 78% with an average kW/ton performance of 1.83.

ID 57 C&I Refrigerator 6 to C&I Refrigerator 11: ENERGY STAR Commercial Solid Door Refrigerators and Freezers

Technology Description

ENERGY STAR Commercial Solid Door Refrigerators and Freezers were evaluated in comparison to base models of comparable units.

Methodology and Assumptions

A spreadsheet calculation was performed comparing an equation for the base equipment energy usage (dependent on unit volume) to the ENERGY STAR specification (dependent on unit volume). Average sizes in three different size ranges were evaluated.

Key assumptions:

- Sizes Used for each range of unit is the average size of all units qualifying for ENERGY STAR in the size range.
- The energy per day for the existing unit is based on the equation 0.125*Volume+2.76 for refrigerators and 0.398*Volume+2.28 for freezers. (per Food Service Technology Center - pre-1996 standard)
- The energy per day for ENERGY STAR units is based on the qualifying specification 0.1*Volume+2.04 for refrigerators and 0.4*Volume+1.38 for freezers.
- The demand is assumed to be the average demand. (per Food Service Technology Center)
- Unit run continuously year round = 8760 hours/year
- Cost estimates are incremental based on data provided by the Food Service Technology Center.
- Secondary impacts for heating and cooling were not evaluated.

Estimated Energy Savings – kWh

(Based on using Food Service Technology Center Life Cycle Cost Calculator)

Refrigerators <20 ft^3 - 371 kWh/unit. Assumes 12 ft^3 average.

Refrigerators 20-48 ft^3 - 544 kWh/unit. Assumes 30 ft^3 average.

Refrigerators >48 ft^3 - 832 kWh/unit. Assumes 62 ft^3 average.

Freezers <20 ft^3 - 320 kWh/unit. Assumes 12 ft^3 average.

Freezers 20-48 ft^3 - 307 kWh/unit. Assumes 30 ft^3 average.

Freezers >48 ft^3 - 282 kWh/unit. Assumes 63 ft^3 average.

Summer Peak Savings

(Based on using Food Service Technology Center Life Cycle Cost Calculator)

Refrigerators <20 ft^3 - 0.042 kW/unit. Assumes 12 ft^3 average.

Refrigerators 20-48 ft^3 - 0.062 kW/unit. Assumes 30 ft^3 average.

Refrigerators >48 ft^3 - 0.095 kW/unit. Assumes 62 ft^3 average.

Freezers <20 ft^3 - 0.037 kW/unit. Assumes 12 ft^3 average.

Freezers 20-48 ft^3 - 0.035 kW/unit. Assumes 30 ft^3 average.

Freezers >48 ft^3 - 0.032 kW/unit. Assumes 63 ft^3 average.

Measure Life

The DEER database from California indicates a 12 year useful life.

Initial One-Time Cost

For qualifying refrigerators, research from the Food Service Technology Center indicates incremental costs of $250, $500 and $900 corresponding to the size ranges recommended from smallest to largest.

For qualifying freezers, research from the Food Service Technology Center indicates incremental costs of $150, $400 and $700 corresponding to the size ranges recommended from smallest to largest.

Suggested Incentive

$50 - $75 for <48 ft^3 and $90 - $150 for >48 ft^3.

Focus on Energy provides $75 and $150 respectively for these same groupings.

Efficiency Vermont's program incentive ranges from $75-$125 based on size and Rochester Public Utilities provides incentives ranging from $100 to $125 depending on size.

Requirements For Application

New units must be ENERGY STAR.

Existing Energy Standards

ENERGY STAR is the energy standard applicable to these units. The Consortium for Energy Efficiency also has more efficient tiers included in their specification.

Sources of Information

ENERGY STAR, Food Service Technology Center, Program websites for Efficiency Vermont and Rochester Public Utilities

Table 16: Energy savings, ENERGY STAR Commercial Solid Door Refrigerators and Freezers

	Refrigerator <20 ft^3	Refrigerator 20-48 ft^3	Refrigerator >48 ft^3	Freezer <20 ft^3	Freezer 20-48 ft^3	Freezer >48 ft^3
EXISTING						
Internal Volume	12	30	62	12	30	63
Number of Fixtures	1	1	1	1	1	1
Energy Per Day	4.26	6.51	10.51	7.06	14.22	27.35
Days per Year	365	365	365	365	365	365
kW	0.178	0.271	0.438	0.294	0.593	1 140
kWh/Yr Use	**1,555**	**2,376**	**3,836**	**2,575**	**5,190**	**9,984**
PROPOSED						
Internal Volume	12	30	62	12	30	63
Number of Fixtures	1	1	1	1	1	1
Energy per Day	3.24	5.04	8.24	6.18	13.38	26.58
Days per Year	365	365	365	365	365	365
kW	0.135	0.210	0.343	0.258	0.558	1.108
kWh/Yr Use	**1,183**	**1,840**	**3,008**	**2,256**	**4,884**	**9,702**
SAVINGS						
kW	0.043	0.061	0.095	0.036	0.035	0.032
kWh/Yr Use	372	537	829	320	307	283
kW using FSTC Life Cycle Calculator	0.042	0.062	0.095	0.037	0.035	0.032
kWh/Yr using FSTC Life Cycle Calculator	371	544	832	320	307	282
Project cost Estimate	$250	$500	$900	$150	$400	$700

Assumptions

Sizes Used for each range of unit is the average size of all units qualifying for ENERGY STAR in the size range.

The energy per day for the existing unit is based on the equation 0.125*Volume+2.76 for refrigerators and .398*Volume+2.28 for freezers. (per Food Service Technology Center - pre-1996 standard)

The energy per day for ENERGY STAR units is based on the qualifying specification 0.1*Volume+2.04 for refrigerators and 0.4*Volume+1.38 for freezers.

The demand is assumed to be the average demand. (per Food Service Technology Center).

ID 58 C&I Refrigerator 12 to C&I Refrigerator 14: Ice Machines

Technology Description

Ice machines (both air- and water-cooled) that are cube making machines were evaluated. These machines may be either an ice making head, remote condensing (air-cooled only) or a self-contained unit.

Methodology and Assumptions

A spreadsheet analysis of all equipment in the Air-conditioning & Refrigeration Institute (ARI) directory (the regulating agency that provides the testing standard for ice machines) was completed.

Data from the ARI directory (Ice Harvest Rate – lbs/24 hrs; Energy Consumption Rate – kWh/100 lbs) was separated into the categories used by the Consortium for Energy Efficiency (CEE) for their specification: air-cooled ice making head, air-cooled remote condensing unit, air-cooled self-contained unit, water-cooled ice making head and water-cooled self-contained unit.

Within each of these categories, an X-Y scatter diagram of energy vs harvest rate was created and a trend line was determined for the equipment that did not meet the CEE Tier 1 specification in order to set the base line for savings. (Note: the ARI directory only includes equipment currently available for sale) Savings (kWh/year) for each piece of qualifying equipment was calculated as compared to the base line determined for its category & size.

Calculation for kWh/year:

Annual kWh Savings per Unit =

$$\left(\frac{\text{kWh base}}{\text{100 lbs}} - \frac{\text{kWh prop}}{\text{100 lbs}}\right) \times \frac{\text{lbs/24 hrs}}{\text{100 lbs}} \times \text{365 days} \times \text{Load Factor}$$

Demand Savings = Annual kWh Savings per Unit / 3000 Equiv. Full Load Hours

All qualifying equipment was then grouped back together and sorted by size. This list was separated by size category (increments of 100 lbs of ice production per day). Total savings per year with a load factor was calculated as well as an estimated demand for each piece of equipment and the average in each size range was determined. After analyzing the different size categories it was determined that the equipment could be put into the larger groupings of <500 lbs, 500-1000 lbs and >1000 lbs.

Key assumptions:

75% load factor

Estimated 3000 hours per year equivalent full load.

Estimated Energy Savings – kWh

Ice Production <500 lbs/24 hrs - 1200 kWh/unit.

Ice Production 500-1000 lbs/24 hrs - 1750 kWh/unit.

Ice Production >1000 lbs/24 hrs - 4870 kWh/unit.

Summer Peak Savings

Ice Production <500 lbs/24 hrs – 0.32 kW/unit.

Ice Production 500-1000 lbs/24 hrs – 0.48 kW/unit.

Ice Production >1000 lbs/24 hrs – 1.28 kW/unit.

Measure Life

California's Southern California Edison program indicates a 12 year useful life for ice machines.

Initial One-Time Cost

The incremental cost was found in research completed by the Food Service Technology Center. Ice Production <500 lbs/24 hrs - $600; Ice Production 500-1000 lbs/24 hrs - $1500; Ice Production >1000 lbs/24 hrs - $2000

Suggested Incentive

Ice Production <500 lbs/24 hrs -- $100.

Ice Production 500-1000 lbs/24 hrs – $150 - $200.

Ice Production >1000 lbs/24 hrs – $300 - $500

Focus on Energy's Incentives are $100, $200, and $500 for these categories.

California's Program's Incentives are $300, $400, and $500 for these categories.

Requirements For Application

New units must meet Consortium for Energy Efficiency's Tier 1 ice machine specification. Flake and nugget machines are not included.

Existing Energy Standards

Consortium for Energy Efficiency (CEE) Tier 1 is the standard. CEE also has more efficient tiers included in their specification.

Sources of Information

ARI, Consortium for Energy Efficiency, Food Service Technology Center working with the California DSM Programs, ASHRAE

Space heating, ventilation, and cooling end-use (HVAC) measures and descriptions are listed in **Error! Reference source not found.** below.

Table 17: HVAC Measures

ID	Potential Situation	Improvement	Quantity
C&I HVAC 1	AC 65,000 1 Ph, 66 kWh/ton	AC 65,000 1 Ph, 59 kWh/ton	per Ton
C&I HVAC 2	AC 65,000 3 Ph, 49 kWh/ton	AC 65,000 3 Ph, 44 kWh/ton	per Ton
C&I HVAC 3	AC 65,000 - 135,000, 77 kWh/ton	AC 65,000 - 135,000, 60 kWh/ton	per Ton
C&I HVAC 4	AC 135,000 - 240,000, 120 kWh/ton	AC 135,000 - 240,000, 107 kWh/ton	per Ton
C&I HVAC 5	AC 240,000 - 760,000, 63 kWh/ton	AC 240,000 - 760,000, 56 kWh/ton	per Ton
C&I HVAC 6	AC >760,000, 93 kWh/ton	AC >760,000, 83 kWh/ton	per Ton
C&I HVAC 7	HP 65,000 1 Ph, 96 kWh/ton	HP 65,000 1 Ph, 99 kWh/ton	per Ton
C&I HVAC 8	HP 65,000 3 Ph, 58 kWh/ton	HP 65,000 3 Ph, 57 kWh/ton	per Ton
C&I HVAC 9	HP 65,000 - 135,000, 108 kWh/ton	HP 65,000 - 135,000, 108 kWh/ton	per Ton
C&I HVAC 10	HP 135,000 - 240,000, 119 kWh/ton	HP 135,000 - 240,000, 124 kWh/ton	per Ton
C&I HVAC 11	HP >240,000, 150 kWh/ton	HP >240,000, 153 kWh/ton	per Ton
C&I HVAC 12	Ground Source HP Closed Loop <135,000, 9 kWh/ton	Ground Source HP Closed Loop <135,000, 7 kWh/ton	per Ton
C&I HVAC 13	WLHP <17,000, 24 kWh/ton	WLHP <17,000, 22 kWh/ton	per Ton
C&I HVAC 14	WLHP 17,000-65,000, 21 kWh/ton	WLHP 17,000-65,000, 19 kWh/ton	per Ton
C&I HVAC 15	WLHP 65,000-135,000, 21 kWh/ton	WLHP 65,000-135,000, 19 kWh/ton	per Ton
C&I HVAC 16	PTAC, 28 kWh/ton	PTAC, 24 kWh/ton	per Ton
C&I HVAC 17	PTAC-HP, 45 kWh/ton	PTAC-HP, 48 kWh/ton	per Ton
C&I HVAC 18	Economizer, 159 kWh/ton	Economizer, 109 kWh/ton	per Ton
C&I HVAC 19	Tuneup - Refrigerant Charge, 145 kWh/ton	Tuneup - Refrigerant Charge, kWh/ton	per Ton
C&I HVAC 20	No ES Sleeve AC over 14,000 Btu hr	Install ES Sleeve AC over 14,000 Btu hr	1 Each
C&I HVAC 21	No ES Sleeve AC under 14,000 Btu hr	Install ES Sleeve AC under 14,000 Btu hr	1 Each
C&I HVAC 22	No Setback_Programmable Thermostat	Install Setback_Programmable Thermostat	1 Each
C&I HVAC 23	Chilled Water Reset Air Cooled 0-100 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 24	Chilled Water Reset Air Cooled 100-200 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 25	Chilled Water Reset Air Cooled 200-300 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 26	Chilled Water Reset Air Cooled 300-400 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 27	Chilled Water Reset Air Cooled 400-500 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 28	Chilled Water Reset Water Cooled 0-1000 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 29	Chilled Water Reset Water Cooled 1000-2000 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 30	Chilled Water Reset Water Cooled 2000-3000 tons	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 31	Air Cooled Chillers	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 32	Water Cooled Chillers less than 150 ton	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 33	Water Cooled Chillers 150 - 300 ton	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 34	Water Cooled Chillers more than 300 ton	Replace with Min ARI rated Efficiency	per Ton
C&I HVAC 35	No Window Film	Install Window Film	per Sq. Ft.
C&I HVAC 36	Electric Water heater	HP Water Heater 500 gal_day	Gal per day
C&I HVAC 37	*Electric Water heater*	*HP Water Heater 1000 gal_day*	*Gal per day*
C&I HVAC 38	Electric Water heater	HP Water Heater 1500 gal_day	Gal per day

Description of HVAC measures

Weather Sensitive/ HVAC Measures

Study Methodology

HVAC measure energy and demand savings were established by using a set of prototypical building models developed for the DOE-2.2 building energy simulation program. DOE-2 is a widely used and accepted freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, operating schedules, conditioning systems (lighting, HVAC, etc.) and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills. Prototype models were developed for small retail, big-box retail, small office, large office, fast food restaurant, full service restaurant, school, assembly and light industrial buildings. These buildings represent the types of customers that are expected to participate in the program. The prototypes are based on the models used in the California DEER study, with appropriate modifications to adapt these models to local design practices and climate. Energy savings estimates were developed from the prototype models for entry into the DSMore cost-effectiveness tool.

The HVAC measures for small commercial buildings include single package rooftop air conditioners and heat pumps, split system air conditioners and heat pumps, packaged terminal air conditioners and heat pumps, and ground source and water loop heat pumps. The HVAC measures for the large office building include air cooled chillers, water cooled chillers, variable frequency drives (VFD) applied to fans and pumps, and chilled water temperature reset controls. The program baseline is defined by the National Appliance Energy Conservation Act (NAECA) minimum efficiency for single phase equipment and ASHRAE 90.1 – 2004 minimum efficiency for three phase equipment. HVAC measures cover the upgrade of standard efficiency packaged HVAC systems with high efficiency versions of the same equipment. The calculations do not address HVAC system type changes (e.g. the energy savings from changing from a rooftop AC system to a ground-source heat pump system).

Measure Efficiency Assumptions

The equipment covered, the size ranges, and the program baseline and measure efficiency assumptions are shown in **Error! Reference source not found.** below:

Table 18: HVAC Efficiency Assumptions

Equipment Category	Capacity Range Btu/hr	Baseline Efficiency Value	Baseline Efficiency Units	Source	Measure Efficiency Value	Measure Efficiency Units
Packaged Terminal A/C	All	8.9	EER	ASHRAE 90.1-2004	9.2	EER
Packaged Terminal HP	All	8.7	EER	ASHRAE 90.1-2004	9	EER
Rooftop A/C (1) phase	<65,000 1 Ph	13	SEER	NAECA	14	SEER
Rooftop A/C (3) phase	<65,000 3 Ph	12	SEER	ASHRAE 90.1-2004	13	SEER
Rooftop A/C (3) phase	65,000 - 135,000	10.1	EER	ASHRAE 90.1-2004	11	EER
Rooftop A/C (3) phase	135,000 - 240,000	9.5	EER	ASHRAE 90.1-2004	11	EER
Rooftop A/C (3) phase	240,000 - 760,000	9.3	EER	ASHRAE 90.1-2004	10	EER
Rooftop A/C (3) phase	>760,000	9	EER	ASHRAE 90.1-2004	10	EER
Rooftop HP (1) phase	<65,000 1 Ph	13	SEER	NAECA	14	SEER
Rooftop HP (3) phase	<65,000 3 Ph	12	SEER	ASHRAE 90.1-2004	13	SEER
Rooftop HP (3) phase	65,000 - 135,000	9.9	EER	ASHRAE 90.1-2004	11	EER
Rooftop HP (3) phase	135,000 - 240,000	9.1	EER	ASHRAE 90.1-2004	10	EER
Rooftop HP (3) phase	>240,000	8.8	EER	ASHRAE 90.1-2004	10	EER
Ground Source HP Closed Loop	<135,000 & 59 F EWT	16.2	EER	ASHRAE 90.1-2004	16.5	EER
Ground Source HP Closed Loop	<135,000 & 77 F EWT	13.4	EER	ASHRAE 90.1-2004	13.7	EER
Water Source Heat Pump	<17,000	11.2	EER	ASHRAE 90.1-2004	11.5	EER
Water Source Heat Pump	17,000 - 65,000	12	EER	ASHRAE 90.1-2004	12.3	EER
Water Source Heat Pump	65,000 - 135,000	12	EER	ASHRAE 90.1-2004	12.3	EER
Air Cooled Chillers	All	1.33	kW/ton	ASHRAE 90.1-2004	1.16	kW/ton
Water Cooled Chillers	< 150 ton	0.835	kW/ton	ASHRAE 90.1-2004	0.78	kW/ton
Water Cooled Chillers	150 - 300 ton	0.74	kW/ton	ASHRAE 90.1-2004	0.56	kW/ton
Water Cooled Chillers	> 300 ton	0.69	kW/ton	ASHRAE 90.1-2004	0.54	kW/ton

Additional measure modeling assumptions are summarized in Table 19.

Table 19: Measure Assumptions for Controls,Tune-up and Economizer Measures

Measure	Baseline Assumption	Measure Assumption	Comments
Economizer	Fixed outdoor air.	Dual sensor enthalpy economizer	Maximum efficiency economizer control strategy assumed.
AC tuneup	14% degradation in efficiency for un-tuned unit	Unit runs at rated efficiency (EER=8)	Tuneup applied to existing equipment only
VFD fan motor	Central VAV system with inlet vane air volume control	Central VAV system with VFD air volume control	Applied to large office prototype only
VFD pump control	Constant volume chilled water system with 3-way control valves at cooling coils	Variable volume chilled water system with 2 way control valves at cooling coils	Applied to chilled water pumps in large office prototype only
Chilled water reset control	Constant chilled water temperature setpoint control	Chilled water temperature controlled by coil demanding the most cooling	Applied to large office prototype only

SECONDARY RESEARCH REVIEW

Secondary research review was conducted to obtain estimates of engineering parameters used to develop the simulation models. The review incorporated research conducted in support of the California Database for Energy Efficiency Resources (DEER) study and the US Energy Information Agency (EIA) Commercial Building Energy Consumption Sudy (CBECS). Building characterstics data from the CBECS study for the West North Central census region were used to update the DEER prototype model. Insulation levels and glazing properties for existing buildings were set according the provisions of ASHRAE Standard 90A-1980. Insulation levels, glazing properties and lighting power densities for new construction were set according to ASHRAE Standard 90.1-2004. A description of each prototype simulation model follows.

Small Retail

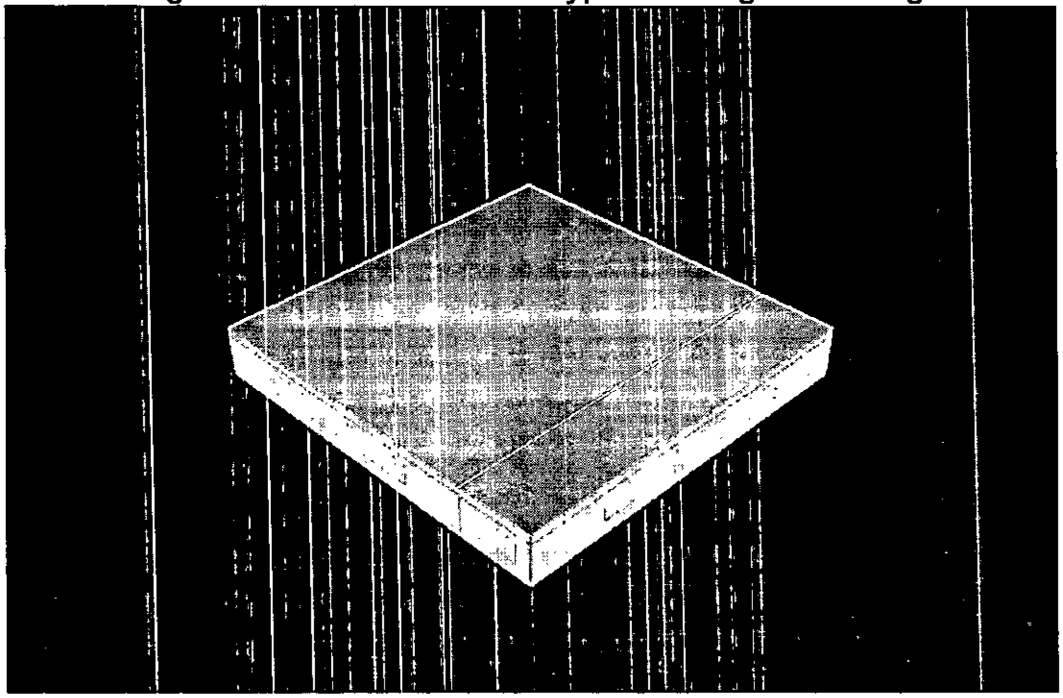
A prototypical building energy simulation model for a small retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the small retail building prototype are summarized in Table 20 below:

Table 20: Small Retail Prototype Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
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. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Sales area: 3.4 W/SF Storage area: 0.9 W/SF New construction: Sales area: 1.7 W/SF Storage area: 0.9 W/SF
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	Existing building: Sales floor: 221 SF/ton Storage area: 349 SF/ton New building Sales floor: 275 SF/ton Storage area: 460 SF/ton
Thermostat setpoints	Occupied hours: 76 cooling, 72 heating Unoccupied hours: 81 cooling, 67 heating

A computer-generated sketch of the small retail building prototype is shown in Figure 1 below:

Figure 1: Small Retail Prototype Building Rendering



Full-service Restaurant

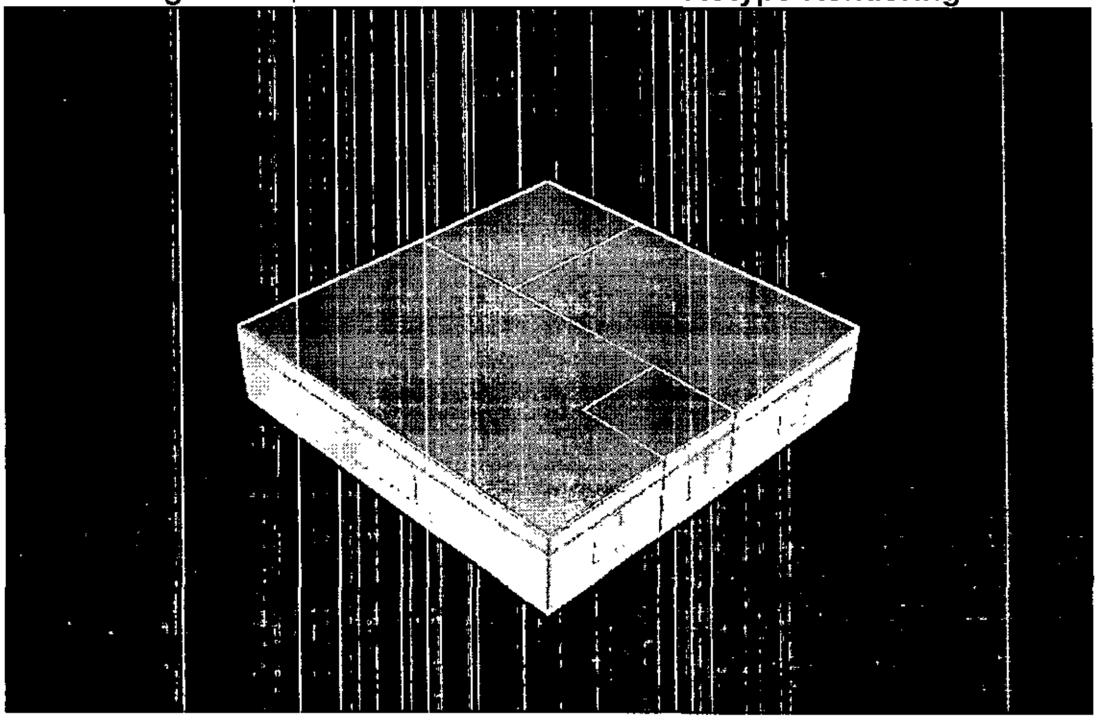
A prototypical building energy simulation model for a full-service restaurant was developed using the DOE-2.2 building energy simulation program. The characteristics of the full service restaurant prototype are summarized in Table 21 below:

Table 21: Full Service Restaurant Prototype Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
Size	2000 square foot dining area 600 square foot entry/reception area 1200 square foot kitchen 200 square foot restrooms
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Dining area: 1.7 W/SF Entry area: 2.5 W/SF Kitchen: 4.3 W/SF Restrooms: 1.0 W/SF New construction: Dining area: 2.1 W/SF Entry area: 1.1 W/SF Kitchen: 1.2 W/SF Restrooms: 0.9 W/SF
Plug load density	Dining area: 0.6 W/SF Entry area: 0.6 W/SF Kitchen: 3.1 W/SF Restrooms: 0.2 W/SF
Operating hours	9am – 12am
HVAC system type	Packaged single zone, no economizer
HVAC system size	Existing building: Dining area: 136 SF/ton Entry area: 76 SF/ton Kitchen: 189 SF/ton Restrooms: 159 SF/ton New construction: Dining area: 144 SF/ton Entry area: 84 SF/ton Kitchen: 239 SF/ton Restrooms: 173 SF/ton
Thermostat setpoints	Occupied hours: 77 cooling, 72 heating Unoccupied hours: 82 cooling, 67 heating

A computer-generated sketch of the full-service restaurant prototype is shown in Figure 2 below:

Figure 2: Full Service Restaurant Prototype Rendering



Small Office

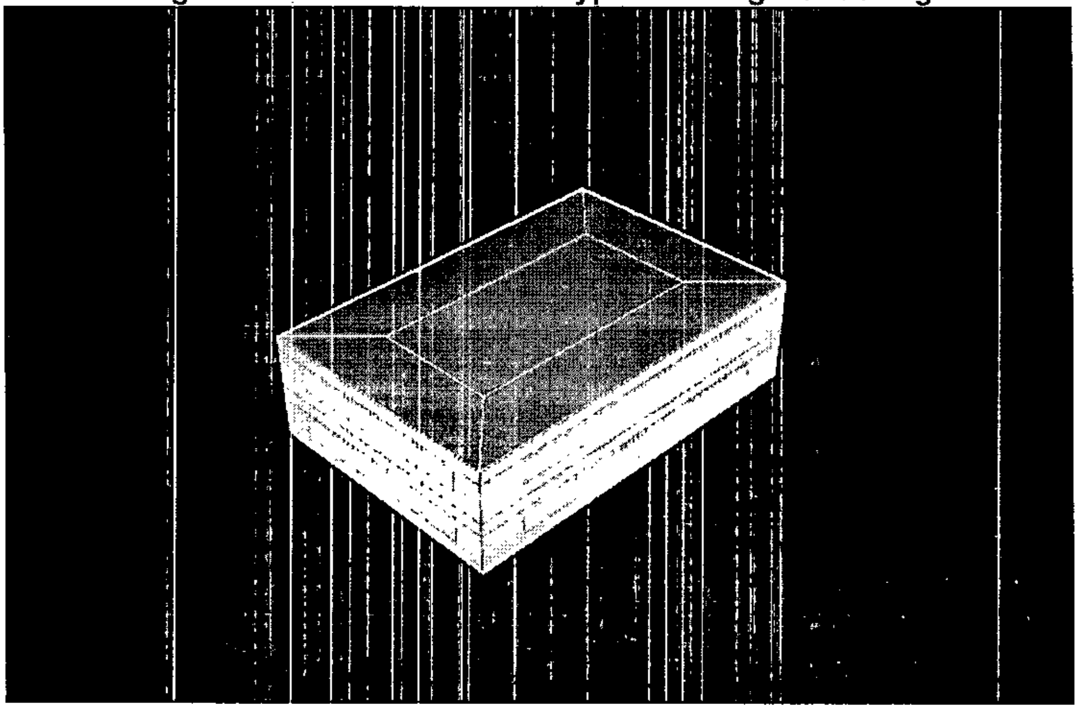
A prototypical building energy simulation model for a small office was developed using the DOE-2.2 building energy simulation program. The characteristics of the small office prototype are summarized in Table 22 below:

Table 22: Small Office Prototype Building Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
Size	10,000 square feet
Number of floors	2
Wall construction and R-value	Concrete block with brick veneer. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Perimeter offices: 2.2 W/SF Core offices: 1.5 W/SF New construction: Perimeter offices: 1.1 W/SF Core offices: 1.1 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	Existing building: 171 SF/ton New construction: 236 SF/ton
Thermostat setpoints	Occupied hours: 76 cooling, 72 heating Unoccupied hours: 81 cooling, 67 heating

A computer-generated sketch of the small office prototype is shown in Figure 3 below:

Figure 3: Small Office Prototype Building Rendering



Light Industrial

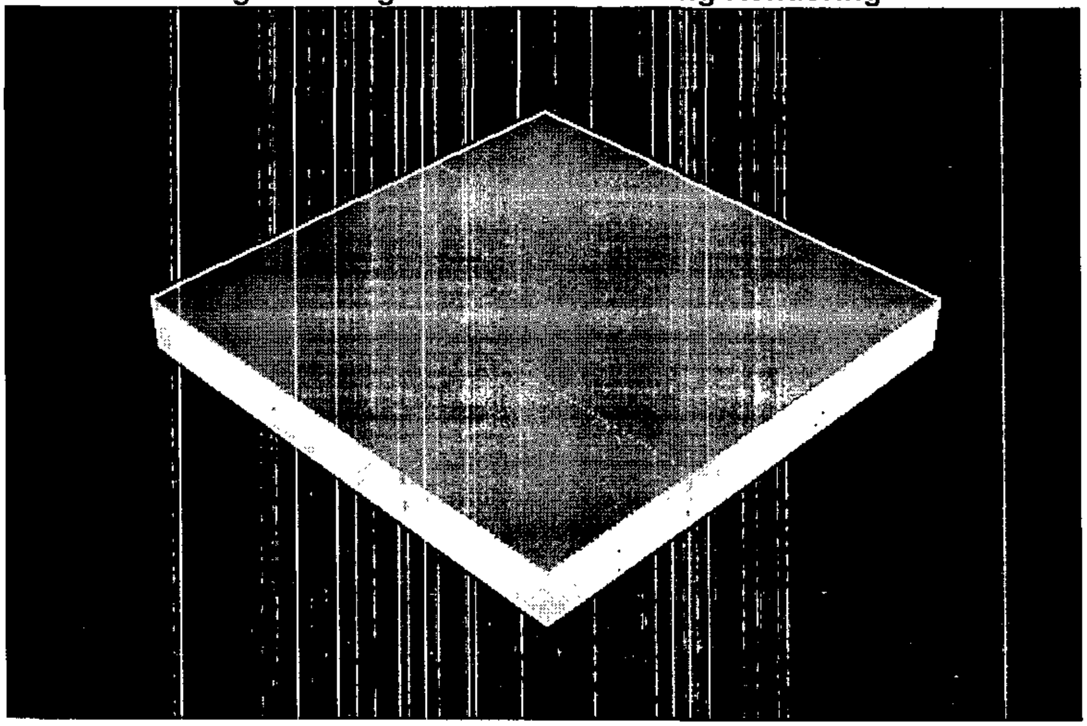
A prototypical building energy simulation model for a light industrial building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 23 below:

Table 23: Light Industrial Prototype Building Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
Size	100,000 square feet total 80,000 SF factory 20,000 SF warehouse
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Factory – 2.1 W/SF Warehouse – 0.9 W/SF New construction: Factory – 1.7 W/SF Warehouse – 0.9 W/SF
Plug load density	Factory – 1.2 W/SF Warehouse – 0.2 W/SF
Operating hours	Mon-Fri: 6am – 6pm Sat Sun: Unoccupied
HVAC system type	Packaged single zone, no economizer
HVAC system size	Existing building: 478 SF/ton New construction: 523 SF/ton
Thermostat setpoints	Occupied hours: 78 cooling, 70 heating Unoccupied hours: 83 cooling, 65 heating

A computer-generated sketch of the prototype is shown in Figure 4 below:

Figure 4: Light Industrial Building Rendering



Big Box Retail

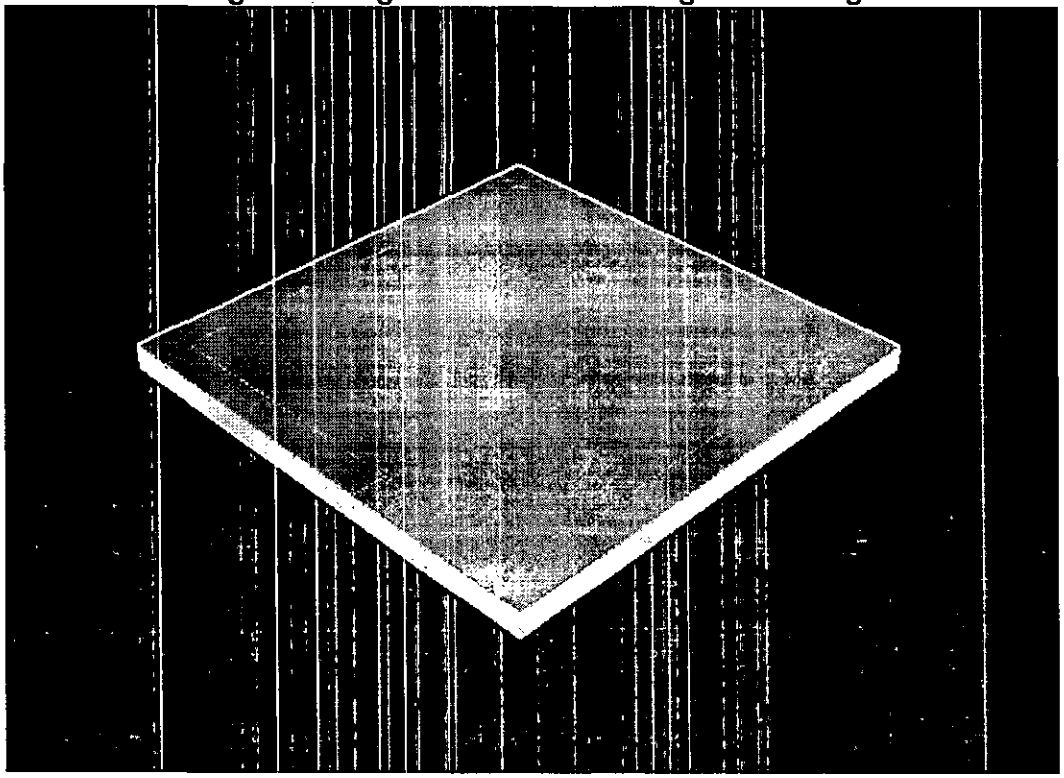
A prototypical building energy simulation model for a big box retail building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 24 below:

Table 24: Big Box Retail Prototype Building Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
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 brick veneer. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Sales: 3.36 W/SF Storage: 0.88 W/SF Office: 2.2 W/SF Auto repair: 2.15 W/SF Kitchen: 4.3 W/SF New construction: Sales: 1.7 W/SF Storage: 0.9 W/SF Office: 1.1 W/SF Auto repair: 0.7 W/SF Kitchen: 1.2 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	Existing building: 256 SF/ton New construction: 309 SF/ton
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 5 below:

Figure 5: Big Box Retail Building Rendering



FAST FOOD RESTAURANT

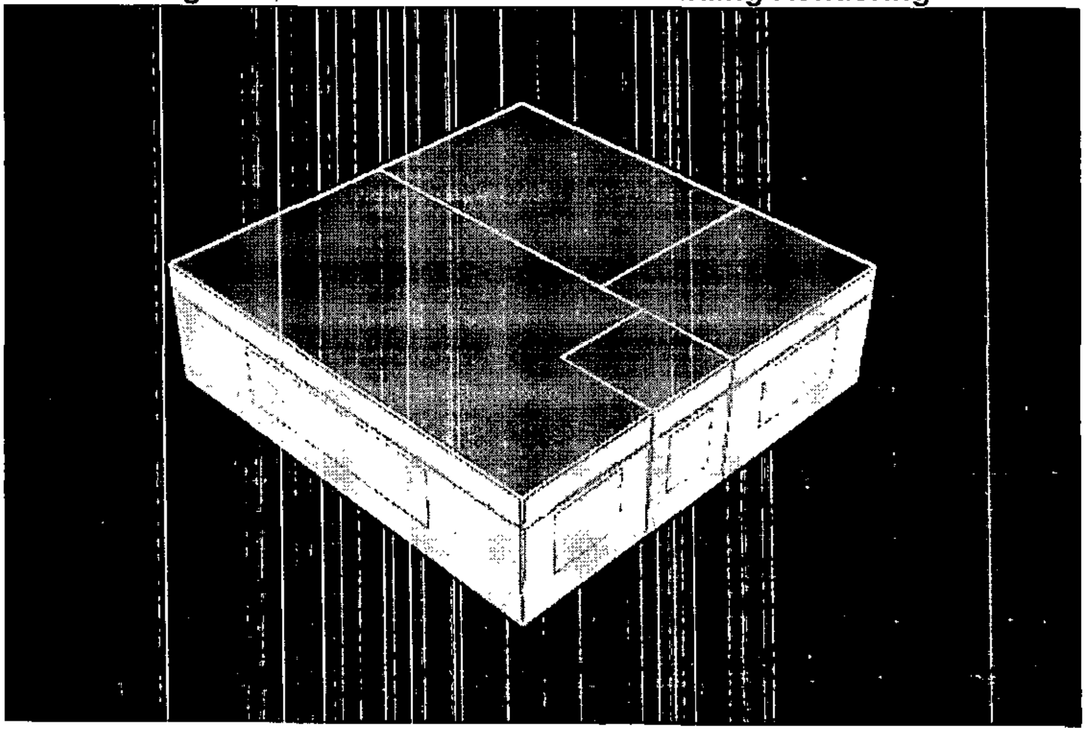
A prototypical building energy simulation model for a fast food restaurant was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 25 below:

Table 25: Fast Food Restaurant Prototype Building Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
Size	2000 square feet 1000 SF dining 600 SF entry/lobby 300 SF kitchen 100 SF restroom
Number of floors	Concrete block with brick veneer. Insulation R-value = 5.7
Wall construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Roof construction and R-value	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Glazing type	Single pane clear
Lighting power density	Existing building: 1.7 W/SF dining 2.5 W/SF entry/lobby 4.3 W/SF kitchen 1.0 W/SF restroom New construction: 0.9 W/SF dining 1.1 W/SF entry/lobby 1.2 W/SF kitchen 0.9 W/SF restroom
Plug load density	0.6 W/SF dining 0.6 W/SF entry/lobby 4.3 W/SF kitchen 0.2 W/SF restroom
Operating hours	Mon-Sun: 6am – 11pm
HVAC system type	Packaged single zone, no economizer
HVAC system size	Existing building: 89 SF/ton New construction: 105 SF/ton
Thermostat setpoints	Occupied hours: 77 cooling, 72 heating Unoccupied hours: 82 cooling, 67 heating

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

Figure 6: Fast Food Restaurant Building Rendering



School

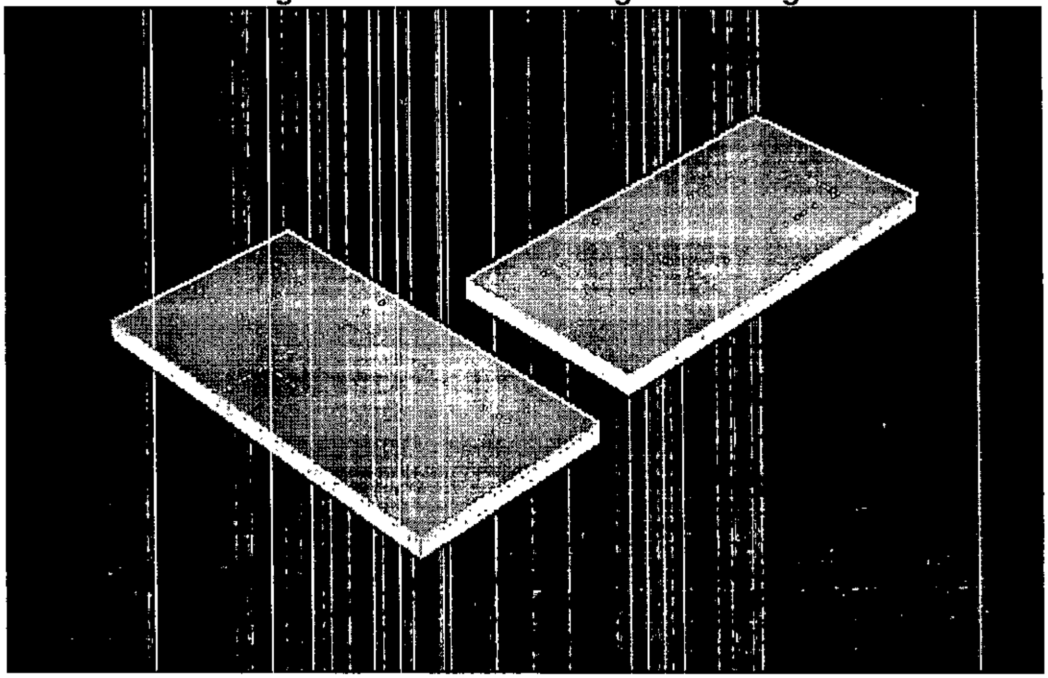
A prototypical building energy simulation model for an elementary school was developed using the DOE-2.2 building energy simulation program. The model is really of two identical buildings oriented in two different directions. The characteristics of the prototype are summarized in Table 26 below:

Table 26: Elementary School Prototype Building Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
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 block with brick veneer. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Classroom: 4.4 W/SF Cafeteria: 1.7 W/SF Gymnasium: 2.1 W/SF Kitchen: 4.3 W/SF New construction: Classroom: 1.4 W/SF Cafeteria: 0.9 W/SF Gymnasium: 1.4 W/SF Kitchen: 1.2 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	Existing building: 195 SF/ton average New construction: 235 SF/ton average
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 below:

Figure 7: School Building Rendering



Assembly

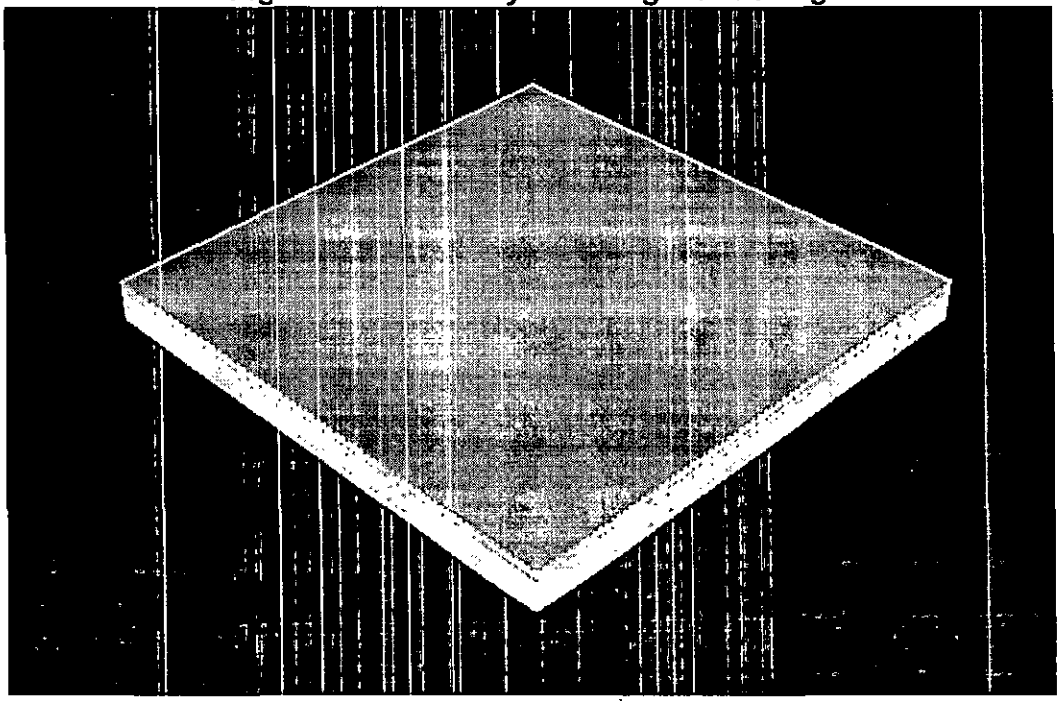
A prototypical building energy simulation model for an assembly building was developed using the DOE-2.2 building energy simulation program. The characteristics of the prototype are summarized in Table 27 below:

Table 27: Assembly Prototype Building Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
Size	34,000 square feet Auditorium: 33,240 SF Office: 760 SF
Number of floors	1
Wall construction and R-value	Concrete block with brick veneer. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Auditorium: 3.4 W/SF Office: 2.2 W/SF New construction: Auditorium: 1.7 W/SF Office: 1.1 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	Existing building: 91 SF/ton New construction: 98 SF/ton
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 8 below:

Figure 8: Assembly Building Rendering



Large 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 large office prototype are summarized in Table 28 below:

Table 28: Large Office Prototype Building Description

Characteristic	Value
Vintage	Existing (1980s) vintage and new construction
Size	175,000 square feet
Number of floors	10
Wall construction and R-value	Concrete block with brick veneer. Insulation R-value = 5.7
Roof construction and R-value	Wood frame with built-up roof Existing building insulation: R- 8.4 New construction insulation R-15
Glazing type	Existing building: Double pane clear (SC=0.84, U-value=0.72) New construction: Double low-e tint (SC=0.45, U-value=0.57)
Lighting power density	Existing building: Perimeter offices: 2.2 W/SF Core offices: 1.5 W/SF New construction: Perimeter offices: 1.1 W/SF Core offices: 1.1 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	Central built-up VAV system with water cooled centrifugal chiller and boiler.
HVAC system size	Existing building: 235 SF/ton New construction: 284 SF/ton
Thermostat setpoints	Occupied hours: 76 cooling, 72 heating Unoccupied hours: 81 cooling, 67 heating

Energy and Peak Demand Savings Estimates

Energy and peak demand savings estimates were developed based on difference the simulated HVAC energy consumption and peak demand at the baseline and the measure efficiency levels. Energy and demand savings were normalized per ton of cooling capacity. The simulations used TMY2 long-term average weather data for Kansas City, Missouri. The results for each of the prototype building and HVAC system type and size combinations are shown in Table 29 through Table 37 below:

Table 29: Assembly Building HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.079	74	0.079	71
AC <65,000 3 Ph	0.059	56	0.059	53
AC 65,000 - 135,000	0.081	77	0.082	74
AC 135,000 - 240,000	0.144	136	0.144	130
AC 240,000 - 760,000	0.076	71	0.076	68
AC >760,000	0.112	105	0.112	101
HP <65,000 1 Ph	0.085	138	0.085	140
HP <65,000 3 Ph	0.059	77	0.059	77
HP 65,000 - 135,000	0.103	149	0.103	150
HP 135,000 - 240,000	0.101	175	0.101	179
HP >240,000	0.139	211	0.139	213
GSHP <135,000	0.009	7	0.009	6
WLHP <17,000	0.024	32	0.024	31
WLHP 17,000-65,000	0.021	28	0.021	27
WLHP 65,000-135,000	0.021	28	0.021	27
Economizer	0.081	96	0.000	13
AC Tuneup	0.175	165		

Table 30: . Big Box Retail HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.077	83	0.077	76
AC <65,000 3 Ph	0.058	62	0.058	56
AC 65,000 - 135,000	0.171	184	0.079	76
AC 135,000 - 240,000	0.141	152	0.140	135
AC 240,000 - 760,000	0.074	80	0.074	71
AC >760,000	0.109	117	0.109	105
HP <65,000 1 Ph	0.082	113	0.082	116
HP <65,000 3 Ph	0.058	71	0.058	69
HP 65,000 - 135,000	0.100	130	0.100	129
HP 135,000 - 240,000	0.098	140	0.098	145
HP >240,000	0.135	180	0.135	181
Economizer	0.080	166	0.079	118
Tuneup	0.171	184		

Table 31: Fast Food Restaurant HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.077	67	0.073	57
AC <65,000 3 Ph	0.058	50	0.058	44
AC 65,000 - 135,000	0.080	69	0.080	60
AC 135,000 - 240,000	0.141	122	0.141	106
AC 240,000 - 760,000	0.074	64	0.074	56
AC >760,000	0.109	94	0.109	82
HP <65,000 1 Ph	0.083	116	0.083	119
HP <65,000 3 Ph	0.058	66	0.058	64
HP 65,000 - 135,000	0.101	126	0.101	126
HP 135,000 - 240,000	0.098	146	0.099	151
HP >240,000	0.136	178	0.136	179
GSHP <135,000	0.009	10	0.008	8
Economizer	0.080	95	0.080	67
AC tuneup	0.171	148		

Table 32: Light Industrial HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.077	49	0.076	50
AC <65,000 3 Ph	0.058	37	0.057	37
AC 65,000 - 135,000	0.079	51	0.079	51
AC 135,000 - 240,000	0.140	90	0.140	91
AC 240,000 - 760,000	0.073	47	0.073	48
AC >760,000	0.108	69	0.108	70
HP <65,000 1 Ph	0.081	90	0.081	89
HP <65,000 3 Ph	0.057	51	0.057	50
HP 65,000 - 135,000	0.099	97	0.099	96
HP 135,000 - 240,000	0.097	114	0.097	113
HP >240,000	0.134	138	0.133	137
Economizer	0.079	75	0.079	77
AC tuneup	0.170	109		

Table 33: Nursing Home HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.077	67	0.076	59
AC <65,000 3 Ph	0.057	50	0.057	44
AC 65,000 - 135,000	0.079	69	0.079	60
AC 135,000 - 240,000	0.140	123	0.139	107
AC 240,000 - 760,000	0.073	64	0.073	56
AC >760,000	0.108	95	0.108	83
HP <65,000 1 Ph	0.082	121	0.082	129
HP <65,000 3 Ph	0.058	69	0.057	68
HP 65,000 - 135,000	0.100	131	0.100	135
HP 135,000 - 240,000	0.098	153	0.098	166
HP >240,000	0.135	186	0.135	194
Economizer	0.079	88	0.079	62
Tuneup	0.170	149		

Table 34: School HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.075	25	0.075	21
AC <65,000 3 Ph	0.056	18	0.056	16
AC 65,000 - 135,000	0.078	25	0.077	21
AC 135,000 - 240,000	0.138	45	0.137	38
AC 240,000 - 760,000	0.072	24	0.072	20
AC >760,000	0.106	35	0.106	29
HP <65,000 1 Ph	0.080	50	0.080	53
HP <65,000 3 Ph	0.056	27	0.056	27
HP 65,000 - 135,000	0.098	53	0.098	54
HP 135,000 - 240,000	0.096	64	0.096	68
HP >240,000	0.132	76	0.132	78
GSHP <135,000	0.009	3	0.009	2
WLHP <17,000	0.024	11	0.024	10
WLHP 17,000-65,000	0.021	10	0.021	9
WLHP 65,000-135,000	0.021	10	0.021	9
PTAC	0.006	13	0.006	11
PTAC-HP	0.007	28	0.007	30
Economizer	0.078	55	0.077	36
Tuneup	0.167	54		

Table 35: Full Service Restaurant HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.077	62	0.077	58
AC <65,000 3 Ph	0.058	46	0.058	43
AC 65,000 - 135,000	0.080	64	0.079	60
AC 135,000 - 240,000	0.141	113	0.140	105
AC 240,000 - 760,000	0.074	59	0.074	55
AC >760,000	0.109	88	0.109	82
HP <65,000 1 Ph	0.082	117	0.082	118
HP <65,000 3 Ph	0.058	65	0.058	64
HP 65,000 - 135,000	0.100	125	0.100	125
HP 135,000 - 240,000	0.098	148	0.098	151
HP >240,000	0.135	178	0.135	179
GSHP <135,000	0.009	9	0.009	8
Economizer	0.080	82	0.079	66
AC tuneup	0.171	137		

Table 36: Small Retail Building HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.078	82	0.077	71
AC <65,000 3 Ph	0.058	61	0.057	53
AC 65,000 - 135,000	0.080	84	0.079	73
AC 135,000 - 240,000	0.142	149	0.140	129
AC 240,000 - 760,000	0.075	78	0.073	68
AC >760,000	0.110	115	0.108	100
HP <65,000 1 Ph	0.083	120	0.082	123
HP <65,000 3 Ph	0.058	73	0.057	70
HP 65,000 - 135,000	0.101	135	0.100	134
HP 135,000 - 240,000	0.099	149	0.097	155
HP >240,000	0.136	188	0.134	189
GSHP <135,000	0.011	13	0.009	10
PTAC	0.006	40	0.006	35
PTAC-HP	0.006	63	0.007	67
Economizer	0.080	149	0.079	99
Tuneup	0.172	181		

Table 37: Small Office Building HVAC Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.072	62	0.072	55
AC <65,000 3 Ph	0.054	47	0.054	41
AC 65,000 - 135,000	0.074	64	0.074	57
AC 135,000 - 240,000	0.131	114	0.132	101
AC 240,000 - 760,000	0.069	60	0.069	53
AC >760,000	0.101	88	0.102	78
HP <65,000 1 Ph	0.076	83	0.076	86
HP <65,000 3 Ph	0.053	52	0.053	51
HP 65,000 - 135,000	0.092	95	0.093	96
HP 135,000 - 240,000	0.091	102	0.091	108
HP >240,000	0.125	131	0.125	134
GSHP <135,000	0.011	11	0.010	9
WLHP <17,000	0.025	29	0.024	25
WLHP 17,000-65,000	0.022	25	0.021	22
WLHP 65,000-135,000	0.022	25	0.021	22
PTAC	0.005	31	0.005	27
PTAC-HP	0.005	44	0.006	48
Economizer	0.074	189	0.074	134
Tuneup	0.159	138		

Weights were developed for each of the buildings above that utilize packaged HVAC systems from GMO customer data. The GMO data show number of accounts by building type. Weights for the buildings addressed by this study were derived from the GMO customer account data and are shown in

.

Table 38: Weights for Buildings with Packaged HVAC Systems

Building Type	Weight
Assembly	7.5%
Big Box Retail	10.5%
Fast Food	3.9%
Light Industrial	16.6%
Nursing Home	5.3%
School	14.6%
Full Service Restaurant	3.9%
Small Retail	17.7%
Small Office	19.9%

The weights were applied to the results for each of the prototypes to estimate the average savings for each packaged HVAC system measure. The average savings are shown in Table 39 below:

Table 39: Weighted Packaged HVAC System Measure Savings

	Existing		New	
	kW/ton	kWh/ton	kW/ton	kWh/ton
AC <65,000 1 Ph	0.076	62	0.075	56
AC <65,000 3 Ph	0.057	46	0.057	42
AC 65,000 - 135,000	0.088	74	0.078	57
AC 135,000 - 240,000	0.139	113	0.138	102
AC 240,000 - 760,000	0.073	59	0.072	53
AC >760,000	0.107	87	0.107	79
HP <65,000 1 Ph	0.081	98	0.081	100
HP <65,000 3 Ph	0.057	58	0.056	56
HP 65,000 - 135,000	0.098	108	0.098	108
HP 135,000 - 240,000	0.097	122	0.096	127
HP >240,000	0.133	152	0.132	154
GSHP <135,000	0.010	9	0.009	7
WLHP <17,000	0.024	23	0.024	21
WLHP 17,000-65,000	0.021	20	0.021	18
WLHP 65,000-135,000	0.021	20	0.021	18
PTAC	0.006	29	0.006	25
PTAC-HP	0.006	46	0.007	49
Economizer	0.079	104	0.071	72
Tuneup	0.171	136		

Energy and demand savings for built up HVAC system measures calculated from the large office building prototype are shown in Table 40.

Table 40: Large Office Building HVAC Measure Savings

	Existing		New	
Chillers and controls	kW/ton	kWh/ton	kW/ton	kWh/ton
Air-cooled Chiller	0.150	154	0.143	136
Water-Cooled Chiller < 150 ton	0.049	56	0.049	53
Water-Cooled Chiller 150-300 ton	0.158	187	0.159	177
Water-Cooled Chiller >300 ton	0.131	156	0.133	148
Chilled water reset	0.030	87	0.040	86
VFDs on HVAC motors	kW/hp	kWh/hp	kW/hp	kWh/hp
VFD Fan Motor (per hp)	0.001	868	0.005	969
VFD chilled water pump (per hp)	0.496	1430	0.615	1398

TYPICAL HVAC UNIT SIZES

For the DSMore runs, typical HVAC unit sizes were chosen from each of the unit size categories above to estimate a "per unit" savings. The typical unit size assumed in the DSMore runs is summarized in Table 41 below:

Table 41: Typical HVAC Unit Sizes by Type and Size

HVAC Measure Type and Size Category	Typical Unit Size
AC <65,000 1 Ph	5 ton
AC <65,000 3 Ph	5 ton
AC 65,000 - 135,000	10 ton
AC 135,000 - 240,000	20 ton
AC 240,000 - 760,000	25 ton
AC >760,000	65 ton
HP <65,000 1 Ph	5 ton
HP <65,000 3 Ph	5 ton
HP 65,000 - 135,000	10 ton
HP 135,000 - 240,000	20 ton
HP >240,000	65 ton
GSHP <135,000	10 ton
WLHP <17,000	1 ton
WLHP 17,000-65,000	3 ton
WLHP 65,000-135,000	7.5 ton
PTAC	1 ton
PTAC-HP	1 ton
Economizer	10 ton
Tuneup	10 ton
Air-cooled Chiller	200 ton
Water-Cooled Chiller < 150 ton	80 ton
Water-Cooled Chiller 150-300 ton	230 ton
Water-Cooled Chiller >300 ton	1000 ton

Motive power ~ Motors, Pumps and Variable Frequency Drive (VFD) end-use measures are listed in Table 42.

Table 42: Pumps and Variable Frequency Drive (VFD) measures

ID3	Potential Situation	Improvement	Quantity
CI Motive Power 1	Std. EPACT Motors 1-5 HP	NEMA Premium Motors 1-5 HP	per HP
CI Motive Power 2	Std. EPACT Motors 7.5-20 HP	NEMA Premium Motors 7.5-20 HP	per HP
CI Motive Power 3	Std. EPACT Motors 25-100 HP	NEMA Premium Motors 25-100 HP	per HP
CI Motive Power 4	Std. EPACT Motors 125-250 HP	NEMA Premium Motors 125-250 HP	per HP
CI Motive Power 5	Std. Pump HP 1.5	Hi Efficiency Pump HP 1.5	per HP
CI Motive Power 6	Std. Pump HP 2	Hi Efficiency Pump HP 2	per HP
CI Motive Power 7	Std. Pump HP 3	Hi Efficiency Pump HP 3	per HP
CI Motive Power 8	Std. Pump HP 5	Hi Efficiency Pump HP 5	per HP
CI Motive Power 9	Std. Pump HP 7.5	Hi Efficiency Pump HP 7.5	per HP
CI Motive Power 10	Std. Pump HP 10	Hi Efficiency Pump HP 10	per HP
CI Motive Power 11	Std. Pump HP 15	Hi Efficiency Pump HP 15	per HP
CI Motive Power 12	Std. Pump HP 20	Hi Efficiency Pump HP 20	per HP
CI Motive Power 13	No Variable Frequency Drive HP 1.5	Install Variable Frequency Drive HP 1.5	per HP
CI Motive Power 14	No Variable Frequency Drive HP 2	Install Variable Frequency Drive HP 2	per HP
CI Motive Power 15	No Variable Frequency Drive HP 3	Install Variable Frequency Drive HP 3	per HP
CI Motive Power 16	No Variable Frequency Drive HP 5	Install Variable Frequency Drive HP 5	per HP
CI Motive Power 17	No Variable Frequency Drive HP 7.5	Install Variable Frequency Drive HP 7.5	per HP
CI Motive Power 18	No Variable Frequency Drive HP 10	Install Variable Frequency Drive HP 10	per HP
CI Motive Power 19	No Variable Frequency Drive HP 15	Install Variable Frequency Drive HP 15	per HP
CI Motive Power 20	No Variable Frequency Drive HP 20	Install Variable Frequency Drive HP 20	per HP
CI Motive Power 21	No Variable Frequency Drive HP 25	Install Variable Frequency Drive HP 25	per HP
CI Motive Power 22	No Variable Frequency Drive HP 30	Install Variable Frequency Drive HP 30	per HP
CI Motive Power 23	No Variable Frequency Drive HP 40	Install Variable Frequency Drive HP 40	per HP
CI Motive Power 24	No Variable Frequency Drive HP 50	Install Variable Frequency Drive HP 50	per HP

ID: CI Motive Power 1 – 4 Premium Efficiency Motors

Technology Description

Considerable efficiency gains can be made by selecting NEMA Premium Efficiency motors over standard EPACT efficiency motors.

Methodology and Assumptions

The attached spreadsheet compares the efficiency gains from EPACT to NEMA Premium Efficiency for 6 of the more common motors from 1 to 300 HP. The motor types selected were ODP and TEFC in 1200, 1800, and 3600 RPM. (60 Hz 1, 2, and 3 poles)

Key assumptions:

Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

Energy savings are for new motors

Estimated Energy Savings

Size Category	kW	kWh
1-5 HP	0.03	110
7.5-20 HP	0.08	294
25-100 HP	0.29	1,067
125-250 HP	0.66	2,429

Assumptions include: 3,680 annual hours of operation (average of all commercial and industrial customers).

Measure Life

NEMA premium efficiency motors have a life of 15 years.

Suggested Incentive

Size Category	$/HP
1-5 HP	$ 10.00
7.5-20 HP	$ 8.00
25-100 HP	$ 5.00
125-250 HP	$ 4.00

Requirements For Application

Copies of invoices that clearly show that the new motor is NEMA premium efficiency and the motor's size.

Cross Reference for Energy Calculations

Estimated Savings for Motors are within 8.5% of deemed savings by the Focus On Energy program.

Existing Energy Standards

NEMA Premium Efficiency, Epact 1992, Pre 1997

Sources of Information

EERE Industrial Technologies Program

Energy savings and cost information are listed in Table 43 and Table 44 below:.

Table 43: Energy savings, Premium Efficiency Motors

	1200 TEFC		1800 TEFC		3600 TEFC		1200 ODP		1800 ODP		3600 ODP		Overall		
Motor HP	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Delta kW	Delta kWh/yr	Average 6 Categories Delta kW	Average 6 Categories Delta kWh/yr	Average per Size Category
1	0.02	67.59	0.02	75.89	0.01	46.04	0.02	67.59	0.02	75.89	NA	NA	0.02	67	0.03079
1.5	0.02	71.56	0.03	92.09	0.02	57.94	0.03	92.09	0.03	92.09	0.02	57.94	0.02	77	
2	0.03	93.24	0.03	122.79	0.02	74.54	0.03	95.41	0.03	122.79	0.02	74.54	0.03	97	
3	0.04	136.72	0.04	136.72	0.02	72.38	0.04	139.86	0.06	207.45	0.03	111.81	0.04	134	
5	0.06	227.86	0.06	227.86	0.03	115.22	0.06	227.86	0.06	227.86	0.03	120.64	0.05	191	
7.5	0.07	246.48	0.10	358.75	0.05	168.96	0.08	285.01	0.11	415.45	0.05	172.83	0.07	275	0.11099
10	0.09	328.64	0.13	478.33	0.04	154.73	0.09	323.61	0.13	478.33	0.06	225.29	0.09	331	
15	0.13	485.41	0.12	445.66	0.07	260.88	0.13	485.41	0.17	632.55	0.06	232.09	0.12	424	
20	0.18	647.21	0.23	843.40	0.09	347.83	0.16	594.22	0.23	843.40	0.09	347.83	0.16	604	
25	0.18	680.03	0.17	618.98	0.10	374.22	0.18	680.03	0.27	987.53	0.10	374.22	0.17	619	0.28697
30	0.22	816.04	0.20	742.77	0.12	449.06	0.20	742.77	0.28	1046.67	0.12	449.06	0.19	708	
40	0.24	897.18	0.24	897.18	0.16	589.68	0.24	897.18	0.24	897.18	0.16	598.04	0.22	796	
50	0.30	1121.48	0.41	1522.81	0.17	622.97	0.30	1121.48	0.41	1522.81	0.17	622.97	0.30	1,089	
60	0.30	1089.40	0.46	1685.70	0.20	737.90	0.30	1089.40	0.46	1685.70	0.20	737.98	0.32	1,171	
75	0.37	1361.75	0.53	1938.06	0.25	922.47	0.37	1361.75	0.37	1347.38	0.25	922.47	0.36	1,309	
100	0.49	1796.51	0.48	1781.40	0.28	1012.99	0.49	1796.51	0.70	2584.08	0.33	1229.96	0.46	1,700	
125	0.61	2245.64	0.61	2226.75	0.34	1242.29	0.61	2245.64	0.61	2226.75	0.34	1266.24	0.52	1,909	0.67817
150	0.64	2352.84	0.64	2352.84	0.41	1490.75	0.73	2672.11	0.64	2352.84	0.41	1519.48	0.58	2,123	
200	0.85	3137.12	1.27	4686.11	0.43	1575.14	0.97	3562.81	0.85	3137.12	0.54	1987.67	0.82	3,014	
250	1.07	3921.40	1.59	5857.64	0.53	1952.48	0.00	0.00	0.53	1952.48	0.68	2484.59	0.73	2,695	
300	1.28	4705.68	1.27	4666.46	0.64	2342.97	0.00	0.00	0.64	2342.97	0.64	2362.70	0.74	2,737	

Table 44: Cost, Premium Efficiency Motors

	1200 TEFC Added Cost	1800 TEFC Added Cost	3600 TEFC Added Cost	1200 ODP Added Cost	1800 ODP Added Cost	3600 ODP Added Cost	Avg Added Cost	Ac/hp Added Cost
1	40.3	84.5	58.5	37.7	66.3	22.75	51.68	51.68
1.5	81.9	91.65	33.15	43.55	66.95	32.5	58.28	38.86
2	61.75	86.45	9.1	55.9	70.2	51.35	55.79	27.90
3	50.05	43.55	33.8	99.45	73.45	41.6	56.98	18.99
5	87.75	37.7	39	169.65	78.65	59.8	78.76	15.75
7.5	250.25	50.05	54.6	141.05	127.4	148.2	128.59	17.15
10	306.8	81.25	48.75	187.85	150.15	130	150.80	15.08
15	193.05	130	114.4	281.45	233.35	167.7	186.66	12.44
20	419.9	160.55	125.45	334.1	200.2	130.65	228.48	11.42
25	355.55	276.9	194.35	183.95	249.6	150.15	235.08	9.40
30	299.65	335.4	204.75	174.85	198.9	295.1	251.44	8.38
40	696.15	412.1	285.35	178.75	293.15	257.4	353.82	8.85
50	684.45	555.1	596.7	232.7	220.35	357.5	441.13	8.82
60	657.8	624.65	605.8	516.75	320.45	253.5	496.49	8.27
75	914.55	889.2	556.4	346.45	393.9	583.05	613.93	8.19
100	1506.05	1201.85	1170.65	37.7	576.55	468	826.80	8.27
125	820.95	685.1	551.2	540.15	926.9	828.1	725.40	5.80
150	530.4	803.4	554.45	1085.5	427.7	644.8	674.38	4.50
200	1728.35	784.55	1365.65	1635.4	886.6	861.9	1,210.41	6.05
250	4026.75	1530.1	1556.75	0	1323	1326	1,627.10	6.51
300	5135	980.2	1686.1	0	1369.5	1547.25	1,786.34	5.95

ID: CI Motive Power 5 – 12 High Efficiency Pumps

Technology Description

Choosing the correct pump for the process can have a large impact on energy consumption. System efficiencies can be increased by 20% or more depending on pump selection. High efficiency pumps reach efficiencies of 75% or greater on the pump curve at the dominant operating conditions.

Methodology and Assumptions

A spreadsheet analysis was performed for the operation of a set of pumps from Bell-Gosset. For five flow increments and five pressure increments, pumps that could meet the operating conditions were compared. The savings listed are the average savings on a kilowatt per horsepower basis of high efficiency pumps over other pumps that could meet the load.

Key assumptions:

Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

New installations such that motor speed and impeller size could vary

Estimated Energy Savings – kWh

The high efficiency pumps are shown to save 236 kWh per year per horsepower of the pump.

Assumptions include: 3,680 annual hours of operation (average of all commercial and industrial customers).

Summer Peak Savings

The high efficiency pumps are shown to save .064 kW per horsepower of the pump.

Assumptions include: The average loading of the pumps analyzed was 76%. Pumps with varying loads should also be equipped a variable speed drive to ensure optimal performance.

Measure Life

Pumping systems are common listed with life spans of 15 years.

Suggested Incentive

Pumps HP 1.5	$	210.00
Pumps HP 2	$	220.00
Pumps HP 3	$	230.00
Pumps HP 5	$	240.00
Pumps HP 7.5	$	250.00
Pumps HP 10	$	260.00
Pumps HP 15	$	300.00
Pumps HP 20	$	400.00

Requirements For Application

Submittals for incentive should include a pump performance curve demonstrating that a pump efficiency of 75% or greater for the dominant operating conditions.

Existing Energy Standards

A premium quality pump can have a poor efficiency if it is not matched with the proper load. The best indicator of pump performance is the pump curve.

Sources of Information

EERE Industrial Technologies Program

Table 45: High Efficiency Pumps

Pump No	HP	Increase	Savings	Savings	Cost Index	Cost $	hp
1	1.5	5.66	0.55	1,991	1.47	$ 319	0.365
3	2.0	7.48	0.14	513	1.31	$ 467	0.070
8	3.0	7.19	0.16	573	1.28	$ 461	0.052
2	5.0	2.86	0.18	664	1.07	$ 75	0.036
4	5.0	21.3	2.54	9,232	1.29	$ 304	0.507
5	5.0	12.9	1.21	4,405	1.72	$ 754	0.242
11	5.0	13.75	0.43	1,569	1.19	$ 341	0.086
14	5.0	24.54	1.17	4,254	1.34	$ 610	0.234
6	7.5	7.48	0.51	1,840	1.38	$ 657	0.067
9	7.5	6.05	0.47	1,720	1.26	$ 498	0.063
7	10.0	2.96	0.28	1,026	1.06	$ 131	0.028
10	10.0	4.6	0.45	1,629	1.14	$ 332	0.045
12	10.0	12.25	1.11	4,043	1.06	$ 150	0.111
15	15.0	16.09	2.01	7,332	1.21	$ 585	0.134
13	20.0	2.45	0.35	1,267	1.32	$ 1,029	0.017
16	20.0	9.24	1.47	5,340	1.17	$ 498	0.073
17	20.0	4	0.94	3,409	1.29	$ 850	0.047

ID: CI Motive Power 13 – 24 VFD's on Pumps

Technology Description

Variable frequency drives physically slow the motors driving pumps in order to achieve reduced flow rates at considerable energy savings. Traditionally flow rates have been reduced by increasing the head and riding the pump curve back to a new flow rate (throttling control). Alternately some systems have bypasses that divert a portion of the flow back to the pump inlet to reduce system flow (bypass control).

Methodology and Assumptions

The attached spreadsheet analyzes three common load profiles utilizing data collected from simple VFD models. Since throttling valve control is more efficient than bypass control it was selected as the base case.

Key assumptions:

Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

Typical load profiles were assumed.

Estimated Energy Savings

0.26 kW/HP

957 kWh/HP

Assumptions include: 3,680 annual hours of operation (average of all commercial and industrial customers).

Measure Life

Variable Speed Drives have a life of 10 years.

Suggested Incentive

We recommend an incentive of $40 - $50/HP.

Requirements for Application

Copies of invoices that clearly show that the new motor is NEMA premium efficiency and the motor's size.

Cross Reference for Energy Calculations

Focus on Energy offers a hybrid rebate a prescriptive incentive of $50/hp that needs custom calculations to determine savings

Existing Energy Standards

None

Sources of Information

EERE Industrial Technologies Program

Table 46: Energy savings estimate VFDs

Profile 1

Design Data & Flow Profile				Constant Speed Pump					Variable Speed Pump						
				(Rides the pump curve)									Curve Fit	1.1356800	
Design Head			80	Generic curve fits					Calculation	-1.212121	-0.464286		from EPRI	-3.189767	
Design GPM			500	-0.16832	-0.46429	Motor Eff			of Static	2.187879	1.032857			3.035644	
Min. Static Head			16	-0.14027	1.03286	is almost			Pressure	0.013333	0.220000			-0.029156	
Nominal BHP			17.1	1.35963	0.22000	constant			on the						
Estimated Motor HP			20						Modulation						
% Motor Load at Design			85%						Curve			Motor Eff	90%		
				Correction Factors			Motor Eff.				Corr. Fact	VFD Eff	98%		
				95.2%	75.0%		90%				75%	Corr Fact	1.05		
% Hours	Hrs/yr	GPM	% flow	Head	Pump. Eff.	BHP	Cur. kW	kWh	Head	Eq. Flow	Pump Eff.	BHP	Comb. Eff.	Pro. kW	kWh
5%	184	500	100%	80	59%	17.1	14.2	2,605	80.0	99%	59%	17.1	88%	14.5	2,662
15%	552	450	90%	84	58%	16.4	13.6	7,484	67.8	100%	59%	13.0	88%	11.1	6,119
20%	736	400	80%	87	56%	15.6	12.9	9,515	57.0	99%	59%	9.7	87%	8.4	6,150
25%	920	350	70%	90	54%	14.8	12.3	11,272	47.4	95%	59%	7.1	85%	6.2	5,732
18%	662	300	60%	92	50%	13.9	11.5	7,626	39.0	89%	58%	5.1	82%	4.6	3,067
8%	294	250	50%	95	47%	12.9	10.7	3,144	32.0	80%	56%	3.6	77%	3.5	1,022
6%	221	200	40%	97	42%	11.7	9.7	2,143	26.2	69%	54%	2.5	69%	2.7	589
3%	110	150	30%	99	37%	10.3	8.5	939	21.8	56%	49%	1.7	58%	2.2	239
0%	-	100	20%	101	31%	8.3	6.9	-	18.6	40%	42%	1.1	43%	2.0	-
0%	-	50	10%	102	24%	5.4	4.5	-	16.6	22%	32%	0.7	23%	2.2	-
0%	3,680							44,727							25,581
70%	Avg Flow														

Profile 2

Design Data & Flow Profile				Constant Speed Pump					Variable Speed Pump						
				(Rides the pump curve)									Curve Fit	1.1356800	
Design Head			80	Generic curve fits					Calculation	-1.212121	-0.464286		from EPRI	-3.189767	
Design GPM			500	-0.16832	-0.46429	Motor Eff.			of Static	2.187879	1.032857			3.035644	
Min. Static Head			16	-0.14027	1.03286	is almost			Pressure	0.013333	0.220000			-0.029156	
Nominal BHP			17.1	1.35963	0.22000	constant			on the						
Estimated Motor HP			20						Modulation						
% Motor Load at Design			85%						Curve			Motor Eff	90%		
				Correction Factors			Motor Eff				Corr. Fact	VFD Eff	98%		
				95.2%	75.0%		90%				75%	Corr Fact	1.05		
% Hours	Hrs/yr	GPM	% flow	Head	Pump. Eff.	BHP	Cur. kW	kWh	Head	Eq. Flow	Pump Eff.	BHP	Comb. Eff.	Pro. kW	kWh
0%	-	500	100%	80	59%	17.1	14.2	-	80.0	99%	59%	17.1	88%	14.5	-
2%	74	450	90%	84	58%	16.4	13.6	998	67.8	100%	59%	13.0	88%	11.1	816
10%	368	400	80%	87	56%	15.6	12.9	4,757	57.0	99%	59%	9.7	87%	8.4	3,075
20%	736	350	70%	90	54%	14.8	12.3	9,017	47.4	95%	59%	7.1	85%	6.2	4,586
35%	1,288	300	60%	92	50%	13.9	11.5	14,827	39.0	89%	58%	5.1	82%	4.6	5,964
20%	736	250	50%	95	47%	12.9	10.7	7,860	32.0	80%	56%	3.6	77%	3.5	2,554
10%	368	200	40%	97	42%	11.7	9.7	3,572	26.2	69%	54%	2.5	69%	2.7	982
3%	110	150	30%	99	37%	10.3	8.5	939	21.8	56%	49%	1.7	58%	2.2	239
0%	-	100	20%	101	31%	8.3	6.9	-	18.6	40%	42%	1.1	43%	2.0	-
0%	-	50	10%	102	24%	5.4	4.5	-	16.6	22%	32%	0.7	23%	2.2	-
0%	3,680							41,970							18,217
60%	Avg Flow														

Profile 3

Design Data & Flow Profile				Constant Speed Pump					Variable Speed Pump						
				(Rides the pump curve)									Curve Fit	1.1356800	
Design Head			80	Generic curve fits					Calculation	-1.212121	-0.464286		from EPRI	-3.189767	
Design GPM			500	-0.16832	-0.46429	Motor Eff			of Static	2.187879	1.032857			3.035644	
Min. Static Head			16	-0.14027	1.03286	is almost			Pressure	0.013333	0.220000			-0.029156	
Nominal BHP			17.1	1.35963	0.22000	constant			on the						
Estimated Motor HP			20						Modulation						
% Motor Load at Design			85%						Curve			Motor Eff	90%		
				Correction Factors			Motor Eff				Corr. Fact.	VFD Eff	98%		
				95.2%	75.0%		90%				75%	Corr Fact	1.05		
% Hours	Hrs/yr	GPM	% flow	Head	Pump. Eff.	BHP	Cur. kW	kWh	Head	Eq. Flow	Pump Eff.	BHP	Comb. Eff.	Pro. kW	kWh
5%	184	500	100%	80	59%	17.1	14.2	2,605	80.0	99%	59%	17.1	88%	14.5	2,662
29%	1,067	450	90%	84	58%	16.4	13.6	14,470	67.8	100%	59%	13.0	88%	11.1	11,830
40%	1,472	400	80%	87	56%	15.6	12.9	19,030	57.0	99%	59%	9.7	87%	8.4	12,300
15%	552	350	70%	90	54%	14.8	12.3	6,763	47.4	95%	59%	7.1	85%	6.2	3,439
7%	*258*	*300*	*60%*	*92*	*50%*	*13.9*	*11.5*	*2,965*	*39.0*	*89%*	*58%*	*5.1*	*82%*	*4.6*	*1,193*
4%	147	250	50%	95	47%	12.9	10.7	1,572	32.0	80%	56%	3.6	77%	3.5	511
0%	-	200	40%	97	42%	11.7	9.7	-	26.2	69%	54%	2.5	69%	2.7	-
0%	-	150	30%	99	37%	10.3	8.5	-	21.8	56%	49%	1.7	58%	2.2	-
0%	-	100	20%	101	31%	8.3	6.9	-	18.6	40%	42%	1.1	43%	2.0	-
0%	-	50	10%	102	24%	5.4	4.5	-	16.6	22%	32%	0.7	23%	2.2	-
0%	3,680							47,405							31,935
80%	Avg Flow														

Table 47: Cost VFDs

Drive HP	VFD Installed Installed	VFD Installation Cost Estimate: Feeder unit $	30 Feeder Total $	P/I Transducer	Press Sensor	Control Cable	Totals
1	$ 3,170	$ 6.35	$ 191	$ 200	$ 200	$ 100	$ 3,861
2	$ 3,280	$ 6.35	$ 191	$ 200	$ 200	$ 100	$ 3,971
3	$ 3,400	$ 6.51	$ 195	$ 200	$ 200	$ 100	$ 4,095
5	$ 3,650	$ 6.77	$ 203	$ 200	$ 200	$ 100	$ 4,353
7.5	$ 4,800	$ 6.77	$ 203	$ 200	$ 200	$ 100	$ 5,503
10	$ 5,025	$ 6.77	$ 203	$ 200	$ 200	$ 100	$ 5,728
15	$ 6,450	$ 7.04	$ 211	$ 200	$ 200	$ 100	$ 7,161
20	$ 7,350	$ 7.04	$ 211	$ 200	$ 200	$ 100	$ 8,061
25	$ 8,700	$ 7.04	$ 211	$ 200	$ 200	$ 100	$ 9,411
30	$ 10,100	$ 7.59	$ 228	$ 200	$ 200	$ 100	$ 10,828
40	$ 10,600	$ 8.99	$ 270	$ 200	$ 200	$ 100	$ 11,370
50	$ 13,400	$ 11.85	$ 356	$ 200	$ 200	$ 100	$ 14,256

Commercial Energy Star Washing Machines end-use measures are listed in Table 48.

Table 48: Description of Energy Star Washing Machines

Potential Situation	Improvement	Quantity
Std Commercial Clothes Washers	Energy Star Commercial Clothes Washers	Per Unit

FES-C1 – Energy Star Commercial Clothes Washers, (Washers Only)

Technology Description

ENERGY STAR qualified commercial clothes washers wash more clothes per load than standard clothes washers and use less water and energy to do so. This calculation is comparing the annual energy savings resulting from purchasing an ENERGY STAR qualified clothes washer over a standard clothes washer that is DOE 2007 compliant. This calculation is for the clothes washer only and does not take into account the dryer savings resulting from lower moisture levels per load. The hot water energy savings are assuming the water is heated with an electric water heater.

Methodology and Assumptions

A spreadsheet calculation was performed using industry data put together by the US Department of Energy and Energy Star.

Key assumptions:

Annual cycles per washer per year = 950 cycles

- Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.
- Dryer energy savings as a result of lower moisture levels were not included.

Estimated Energy Savings – kWh

Energy Star qualified Commercial Clothes Washer: 380 kWh/yr

Summer Peak Savings

Energy Star qualified Commercial Clothes Washer: 0.019 kW

(only accounts for machine energy savings)

Measure Life

10-12 years

Initial One-Time Cost

US Department of Energy quoted the average retail price of a conventional clothes washer at $750, not including installation/labor costs. It quoted the average retail price of an ENERGY STAR qualified clothes washer at $1,077, not including installation/labor costs. These numbers were based on 2006 industry data gathered from across the country. ENERGY STAR's savings calculator had a conventional unit at $350, while it had an average ENERGY STAR qualified clothes washer at $500. The average incremental cost between these two comparisons is roughly $240.

Any Recurring Costs

None

Suggested Incentive

$50-$100/qualifying unit.

Requirements For Application

ENERGY STAR qualified commercial clothes washers must have a Modified Energy Factor (MEF) of 1.72 or higher.

Existing Energy Standards

US Department of Energy standard for commercial clothes washers is an MEF of 1.26 or better.

Sources of Information

Energy Star, US Department of Energy, Multi-housing Laundry Assn

Additional Information:

Assumptions:

DOE Standard 2007	1.26	MEF (requirement)
Energy Star 2007	1.72	MEF (requirement)
	950	cycles/year; Multihousing Laundry Assn (cited by Energy Star)
	3.0	cycles/day for Multifamily applications; cited by CEE
	6.0	cycles/day for Laundry Applications; cited by CEE
	4.5	cycles/day; weighted average
	0.114	kWh; machine energy per cycle, Energy Star 2007 (DOE 2006)
	0.133	kWh; machine energy per cycle, DOE Standard 2007 (DOE 2006)
	0.409	kWh; electric water heating energy per cycle, Energy Star 2007 (DOE 2006)
	0.790	kWh; electric water heating energy per cycle, DOE Standard 2007 (DOE 2006)
	0.400	kWh; energy savings per cycle
	$750.00	average retail price for DOE Standard clothes washer, DOE 2006
	$1,077.31	average retail price for Energy Star qualified clothes washer, DOE 2006
	$327.31	incremental cost difference to purchase Energy Star qualified clothes washer

Average Number of Washer Cycles per year:

			kWh savings/cycle		kWh saved per
950	cycles X	0.400	=	380	year
				0.019	kW; peak summer demand savings

Annual Cost Savings:

380 kWh/yr X /kWh = $0.00 per year savings

Recommended incentive per washer:

$50

Other End-use measures

Office equipment, both PC & Non-PC end-use measures are listed in Table 49.

Table 49: Other office equipment

Potential Situation	Improvement	Quantity
No Plug Load Occupancy Sensors Document Stations	Plug Load Occupancy Sensors Document Stations	Per Unit
Std. Power Supply Desktop Unit	80Plus Power Supply Desktop Unit	Per Unit
Std. Power Supply Server Unit	80Plus Power Supply Server Unit	Per Unit
No Computer Power Manager	Computer Power Manager	Per Unit

Description of Office equipment measures:

Plug Load Occupancy Sensors for Document Stations

Technology Description

Occupancy sensors that control 'document stations', i.e., fax machines, copiers, scanners, etc reduce the idling runtime of these machines when no one is using them or is around them.

Methodology and Assumptions

A spreadsheet calculation was performed with standard equipment wattages, both idle wattages and continuous use wattages. Savings for typical conversions were calculated. A 25% savings factor was assumed.

Key assumptions:

Savings factor during a typical 10 hour business day = 25%

Idle wattage of laser printer = 50W

Idle wattage of fax machine, scanner, etc = 50W

Idle wattage of copier = 120W

Estimated Energy Savings – kWh

Plug Load Occupancy Sensor for Document Station = 803 kWh

Summer Peak Savings

Plug Load Occupancy Sensor for Document Station = 0.055 kW

Measure Life, 5 years

Initial One-Time Cost

Cost estimates are variable and can range from $80 to $400+.

Assume average cost of $150.

Any Recurring Costs

None

Suggested Incentive

$25/central document station (Multi user area with fax, copier, printer, etc.)

It's possible that document station can be controlled by a single power strip with sensor at a cost of $80 to $100 which would result in a high percentage incentive.

Requirements For Application

Must control at least 3 devices in central document station

Existing Energy Standards

None

Sources of Information

June 2000 ASHRAE Journal Study, 2001 ASHRAE Fundamentals, manufacturers websites

Table 50: Estimated Energy savings:

Laser Printers	Continuous Use	130 to 550 watts	
	Idle Use	10 to 125 watts	Avg. Est. = 50 watts
Copiers	Continuous Use	400 to 1100 watts	
	Idle Use	20 to 300 watts	Avg. Est. = 120 watts
Fax, stamp machine, scanner etc.	Idle Use or Energy Saver Mode		Avg. Est. = 50 watts

Savings per document station

$$\frac{(50 + 120 + 50) \text{ x } 10 \text{ hours/day x } 365 \text{ days/year x } .25}{1000 \text{ watts/kWh}} = 803 \text{ kWh}$$

Summer Peak Demand Savings: Studied for a 15 minute increment

0.22 kW	X	0.25 hr	=	0.055 kWh
0.22 kW	X	0.1875 hr	=	0.04125 kWh
				0.01375 kWh savings

0.01375 kWh / 0.25 hr = 0.055 kW saved during 15 min increments

1.4 RENEWABLE ENERGY

(D) Renewable energy sources and energy technologies that substitute for electricity at the point of use.

GMO has engaged a consultant, Bob Solger, who is a principal with The Energy Savings Store (TESS) , to update a 2008 benefit / cost study of the following small scale renewable technologies:

- 2.0 kW PV Solar System
- 3.20 kW PV Solar System
- 2.4 kW Wind Turbine
- 6 kW Wind Turbine
- Solar Hot Water System
- Solar Air Heating System

The PV solar and wind technology will be evaluated at four geographic locations; Northeast Kansas City, Southwest Kansas City, Sedalia, MO, and St. Joseph, MO.

The solar hot water and air heating technology will be evaluated as the Kansas City region as defined in the RETscreen software, a computer software tool for analyzing renewable energy projects. RETscreen is available at no cost from Natural Resources Canada, a public agency.

Recent changes in tax codes, and current material costs will be incorporated into the analysis.

The Energy Savings Store has been providing complete solar and wind solutions for homes, business, and governments for more than six years in the Kansas City and St. Louis areas.

The timeline for analysis and screening of these renewable energy project is

June 22, 2009 TESS final report completed and delivered to GMO

Sept. 30, 2009 Measure screening analysis completed.

SECTION 2: CALCULATION OF AVOIDED COSTS

(2) Calculation of Avoided Costs. The utility shall develop estimates of the cost savings that can be obtained by substituting demand-side resources for existing and new supply-side resources. These avoided cost estimates, expressed in nominal dollars, shall be used for cost-effectiveness screening and ranking of end-use measures and demand-side programs.

The DSMore "Demand Side Management Option/Risk Evaluator" (DSMore) software package, which is available from Integral Analytics, LLC, was used to calculate the benefits and costs of the end-use measures. DSMore is an analytical tool to evaluate the economic benefits and cost of demand side end-use measures and programs. DSMore also calculates utility total avoided costs and all the avoided cost parameters required under rule 22.050 (2)

2.1 SUPPLY RESOURCE COST ESTIMATES

(A) Supply Resource Cost Estimates. The utility shall use the cost estimates developed pursuant to 4 CSR 240-22.040(2) to calculate the following two (2) estimates of avoided cost: avoided utility costs and avoided utility costs plus avoided probable environmental costs.

DSMore calculates total avoided utility costs plus avoided probable environmental costs.

2.1.1 NEW GENERATION OPTIONS

1. The choice of new generation options used to calculate avoided costs shall be limited to those which will meet the need for capacity under the base-case load forecast at approximately the lowest present value of utility revenue requirements over the planning horizon. The utility shall document the basis on which the timing and choice of the new generation options were determined to be approximately least cost.

GMO utilized the levelized cost of a Combustion Turbine (CT) for the avoided supply-side resource cost values.

2.1.2 <u>ANNUAL CAPACITY COST</u>

2. The utility shall calculate the annual capacity cost of each new generation option and new transmission and distribution facilities as the sum of the levelized capital cost per kilowatt-year and the fixed operation and maintenance cost per kilowatt-year.

GMO was granted a waiver to utilize the cost of a Combustion Turbine (CT) for the avoided supply-side resource cost values. This value was utilized in the DSM end-use measure screening. The levelized capital cost per kilowatt-year of a new combustion turbine (CT) generator is provided in Figure 9. The cost estimate is based on estimated capital and operating costs available in 2009, when the DSMore model was being developed for GMO specific applications.

2.1.3 <u>DIRECT RUNNING COST</u>

3. The utility shall calculate the direct running cost of each generation option as the sum of fuel costs, sulfur dioxide emission allowance costs, and variable operation and maintenance costs per kilowatt-hour (kWh). The probable environmental costs calculated pursuant to 4 CSR 240-22.040(2)(B) shall also be expressed on a per-kilowatt hour basis for both existing and new generation resources.

DSMore calculates hourly avoided running costs and returns an annualized summary table including: 1) total avoided production cost, both capacity and energy costs, 2) avoided transmission & distribution cost, 3) avoided ancillary service costs, 4) total avoided costs in nominal dollars for the life-time of the end-use measure, and 5) emission costs or avoided probable environmental costs on a per-kilowatt hour basis.

The avoided running costs are modeled as the avoided market price of energy, plus ancillary services and emission allowance costs on a per kWh basis. Market prices of energy would include the marginal fuel costs and variable operation and maintenance costs. Market prices were obtained from MIDAS price forecasts supplied by the Energy Resource Management department.

Avoided environmental costs were included as the projected cost of mercury emissions and future potential CO_2 regulation. Although SO_2 and NO_x emission values would increase the avoided environmental costs, these values were not originally modeled in the DSMore software. Because nearly all end-use measures were passed on to Integrated Analysis, GMO did not re-apply the SO_2 and NO_x values in the DSMore program. The end-use measures not passed on to Integrated Analysis were end-use renewable generation, and Residential end-uses of a) adding two more inches of attic duct insulation, b) add insulation to floor, c) purchase an Energy Star® dishwasher or d) clothes washer, e) insulate hot water pipes and f) replacing SEER 13 air conditioners with SEER 14, 15 or 16 SEER. All other end-use measures identified were passed to Integrated Analysis.

Utility avoided cost inputs into the DSMore model include:

- An avoided capacity value of ** [redacted] ** in levelized dollars per kilowatt-year. GMO used the levelized avoided cost of a combustion turbine (CT) generator as granted in the waiver request referred to in Section 2.3.1 below.

- An avoided T&D value of ** [redacted] ** in levelized dollars per kilowatt-year.

- Ancillary services avoided costs, which include load following and reserve margin costs.

- Environmental costs per kW-hr, which include emissions costs for CO_2 emissions.

HC

2.2 AVOIDED COST PERIODS

(B) Avoided Cost Periods. The utility shall determine avoided cost periods by grouping hours on a seasonal (for example, summer, winter and transition) and time-of-use basis (for example, on-peak, off-peak, super-peak or shoulder-peak) as required to adequately reflect significant differences in running costs and the type of capacity being utilized to maintain required reserve margins.

DSMore uses an hourly load profile specific to each end-use measure to evaluate the avoided costs over the life of the measure. Thus each hour is implicitly defined as belonging to a specific season and as belonging to a specific time of use period, such as on-peak or off-peak. The value of energy served for each hour reflects the differences in running costs hour by hour. The type of capacity being utilized is the levelized capital cost per kilowatt-year of a new combustion turbine generator. The hourly load profile described above meets the requirements of Rule 22.050 (2) (B).

2.3 CALCULATION OF AVOIDED CAPACITY AND RUNNING COSTS

(C) Calculation of Avoided Capacity and Running Costs. Avoided costs shall be calculated as the difference in costs associated with a specified decrement in load large enough to delay the on-line date of the new capacity additions by at least one (1) year.

DSMore uses an hourly load profile specific to each end-use measure to calculate the avoided running cost per kWh over the life of the measure. DSMore calculates the avoided direct running costs per kWh as the market value of energy for each hour. DSMore also calculates the avoided environmental cost on an hourly basis. The DSMore model was setup by Integral Analytics to model market prices that are specific to GMO. The market prices generated reflect price uncertainly through a probability distribution that provides more accurate valuations of DSM by including weather effects, and the covariance of hourly prices and loads. Avoided capacity cost was calculated as the levelized capital cost per kilowatt-year of a new combustion turbine generator.

2.3.1 AVOIDED RUNNING COST

1. Avoided running cost. For each year of the planning horizon and for each avoided cost period, the utility shall calculate the avoided direct running cost per kWh (including sulfur dioxide emission allowance costs) and the avoided probable environmental running cost per kWh due to the specified load decrement.

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 12" allows DSMore to use an hourly load profile specific to each end-use measure to calculate the avoided running cost per kWh over the life of the measure. The avoided running costs are modeled as the hourly avoided market price of energy, plus ancillary services and emission allowance costs.

2.3.2 AVOIDED CAPACITY COSTS

2. Avoided capacity costs. The utility shall calculate and document the avoided capacity costs per kilowatt-year for each year of the planning horizon. .

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 13" allows Therefore, avoided capacity cost was calculated as the levelized capital cost per kilowatt-year of a new combustion turbine generator as shown in Figure 9 below:

Figure 9: Avoided Capacity Cost ** Highly Confidential **

Avoided Cost Capacity Calculation		
Net Capacity (MW)		[redacted]
Capacity Factor		[redacted]
Fixed O&M ($/kW-Yr)	$	[redacted]
Var O&M ($/MWh)	$	[redacted]
Technology Cost ($/kW)	$	[redacted]
Technology Capital	$	[redacted]
Levelized FCR for construction projects		[redacted]
Annual Technology Carrying Cost	$	[redacted]
Transmission Cost ($/kW)	$	[redacted]
Transmission Capital	$	[redacted]
Transmission FCR		[redacted]
Annual Transmission Carrying Cost	$	[redacted]
Total Annual Cost	$	[redacted]
Total Fixed O&M	$	[redacted]
Total Variable O&M	$	[redacted]
Total Levelized Fixed Cost Per Year	$	[redacted]
Installed Cost $/kW	$	[redacted]

2.3.2.1 Delayed or Avoided Costs

A. This calculation shall include the costs of any new generation, transmission and distribution facilities that are delayed or avoided because of the specified load decrement.

Avoided capacity cost was calculated as the levelized capital cost per kilowatt-year of a new combustion turbine generator as shown in Figure 9 above. Avoided cost of transmission and distribution was calculated as a levelized capital cost per kilowatt-year as shown in Figure 10 below:

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Figure 10: Avoided Transmission and Distribution Cost ** Highly Confidential **

Potential Distribution Avoided Costs Due to DSM Program Penetrations										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	Avg
System Expansion Deferred by DSM	[redacted]									
2010 $'s @ 2.5% per year										
Year 1										
Year 2										
Year 3										
Year 4										
Year 5										
Totals										
System Exp Defer by DSM										
in 2009 $'s @ 2.5% per yea										
Year 1										
Year 2										
Year 3										
Year 4										
Year 5										
Totals										

2.3.2.2 Avoided Cost Periods

B. For each year of the planning horizon, the utility shall determine the avoided cost periods in which the avoided new generation, transmission and distribution capacity was utilized, and shall allocate a nonzero portion of the annualized avoided capacity costs to each of the periods in which that capacity was utilized. .

DSMore uses an hourly load profile specific to each end-use measure to evaluate the avoided costs over the life of the measure. Thus each hour is implicitly defined as belonging to a specific season and as belonging to a specific time of use period, such as on-peak or off-peak. The value of energy served for each hour reflects the differences in running costs hour by hour. The type of capacity being utilized is the levelized capital cost per kilowatt-year of a new combustion turbine generator as shown in Figure 9 above. DSMore also allows the user to specify the coincident peak demand month and hour for both summer and winter when the probability of a loss of load is significant and is used to calculate demand period demand costs.

The hourly load profile described above meets the requirements of Rule 22.050 (2) (B).

2.4 AVOIDED DEMAND AND ENERGY COSTS

(D) Avoided Demand and Energy Costs. The utility shall use the avoided capacity and running costs (appropriately adjusted to reflect reliability reserve margins, demand losses and energy losses) to calculate the avoided demand and energy costs for each avoided cost period. Demand periods shall be defined as the avoided cost periods in which there is a significant probability of a loss of load (for example, periods which require the use of peaking capacity to maintain power pool reserve margins). Nondemand periods are the avoided cost periods in which there is not a significant probability of a loss of load.

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 13" allows DSMore to calculate the avoided capacity and running cost adjusted to reflect the costs associated with a reliability reserve margin as a percentage, and demand and energy system losses as a percentage. The reserve margin requirement was set to 13.6% and the demand and energy system losses were set to 5.5%. These values are inputs into the DSMore model. The 13.6% reserve margin equates to SPP's 12% minimum required capacity margin. DSMore also allows the user to specify the coincident peak demand month and hour for both summer and winter when the probability of a loss of load is significant and is used to calculate demand period demand costs.

1. Demand period avoided demand costs include an avoided T&D demand cost of ** [redacted] ** and the avoided capacity cost of a new CT which was ** [redacted] **. HC

2. DSMore creates hourly end-use load savings associated with each end use measure and calculates the total avoided cost for each hour which includes, demand period demand costs for new generation and T&D, running energy costs, and ancillary services costs. DSMore also reports the total annual avoided cost as the sum of total annual avoided production costs, total annual avoided T&D costs and total annual avoided ancillary service cost over the life of each end-use measure. DSMore also calculates the net present value (NPV) of the total annual avoided cost which is discounted at the utility cost of capital.

More information about how DSMore calculates avoided cost can be found in the DSMore user manual, pages 28, 29.

The following is the avoided cost calculation description from the DSMore user manual:

Avoided Costs

One of the more versatile functions of DSMore is its ability to assess multiple cost-effectiveness assessments over many different avoided cost scenarios, at once. The most important, and varying, of these is the avoided electric production costs. Traditional DSManager analyses only analyzed one pricing scenario, usually marginal production costs or system lambda. With DSMore, many cost-effectiveness tests are calculated, including system lambda costs if you wish to include them.

For each of 30+ years of weather scenarios, 21 different electric market scenarios are assessed (the lowest of which typically represents the traditional DSManager-type avoided marginal production costs, if you wish to include them). Historically, DSMore has used 33 years of weather as a default number of scenarios, yielding 693 (= 33 X 21) cost-effectiveness tests to reflect a full spectrum of possible valuations of a particular program. The average value of these approximately tests represents an average, weather normal expectation across all possible market price scenarios.

Selecting one market price scenario (Today's value) provides test results for the current market across 30 or so weather scenarios. Using fewer than 30 years of weather jeopardizes the estimation of weather normal and extreme weather effects. Using less than 21 market price scenarios may result in too few market price scenarios near your current market price, and does not allow interpolations between 5th percentile levels. The 21 price scenarios are composed of nineteen 5th percentiles (i.e., 5th, 10th, 15th, etc.), a minimum, and a maximum. Test results can be linearly interpolated between two existing market price scenarios (each at approximately 5th percentile levels). Where market price scenarios are too far apart (as a result of having too few pricing scenarios), linear interpolation of results is more risky.

The weather scenarios are set arbitrarily at 33 in many cases for ease of processing, but purposefully above 30, the point at which the central limit theorem (and weather normal, average load estimates) are insured.

If you look at the forward prices in traded electric markets and see rising prices, then you will tend to value scenario results toward the upper end of the distribution of possible prices. If you feel that the electric market is overbuilt, and prices will be depressed for some time to come, then you may rely more on the lower end of the distribution. DSMore allows you to view all of these possible futures in any single analysis. Further, it allows you to specify an expected form for the distribution of future prices, so that a weighted average of all likely futures in electric prices can be reflected in a single weighted cost-effectiveness test (termed the Option Value in DSMore). You are free to insert any distribution of expected prices.

DSMore provides the means to calculate a Logistic Distribution (shown in the Utility Input sheet). This distribution adequately reflects the skewed expectations of high prices that have been observed across markets historically, including California, Alberta, PJM, and others. The average price values are typically centered around $35 per MWh, with small probabilities of larger skewed prices *upward of $50, $60, or even the observed $90 per MWh market observed in California one year. Market prices below $20 only occur off peak, and a $20 long term annual "around the clock" (ATC) price is not likely. If you insert your system lambda marginal production costs into Scenario 1 though, the average price may be less than $20, averaged over 8,760 hours of the year."*

Reference DSMore user manual version 6.8, pages 28 & 29

1. Demand period avoided demand costs. Avoided demand costs per kilowatt-year for the demand periods of each season shall include avoided transmission and distribution capacity costs, plus the smaller of the avoided generation capacity cost allocated to the demand period or the avoided capacity cost of peaking capacity.

DSMore also allows the user to specify the coincident peak demand month and hour for both summer and winter when the probability of a loss of load is significant and is used to calculate demand period demand costs.

Demand period avoided demand costs include an avoided T&D demand cost of ** [redacted] ** and the avoided capacity cost of a new CT which was ** [redacted] **.

2. Demand period avoided energy costs. Any capacity cost per kilowatt-year allocated to the demand periods but not included in the avoided demand cost shall be converted to an avoided energy cost by dividing the avoided capacity cost per kilowatt-year by the number of hours in the associated demand period. The utility shall add this converted avoided capacity cost to both of the running cost estimates developed pursuant to paragraph (2)(C)1. to calculate the demand period direct energy costs and the probable environmental energy costs.

DSMore also allows the user to specify the coincident peak demand month and hour for both summer and winter when the probability of a loss of load is significant. This specification defines the demand period and the avoided capacity cost is included in the avoided demand cost calculation..

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3. Nondemand period avoided demand cost. The avoided demand cost for the nondemand periods is zero (0).

DSMore allows the user to specify the specify the coincident peak demand month and hour for both summer and winter when the probability of a loss of load is significant. This specification will also define the non-demand period. The avoided demand cost for the non-demand periods is zero (0).

4. Nondemand period avoided energy costs. Avoided capacity cost per kilowatt-year allocated to the nondemand periods within each season shall be converted to a per-kilowatt-hour cost by dividing the avoided capacity cost per kilowatt-year by the number of hours in the associated nondemand period. The utility shall add this converted avoided capacity cost to both of the running cost estimates developed pursuant to paragraph (2)(C)1. to calculate the nondemand period direct energy costs and the probable environmental energy costs.

DSMore does not allocate avoided capacity cost to non-demand periods.

5. Annual avoided demand and energy costs. Annual avoided demand costs shall include avoided transmission and distribution capacity costs, plus the smaller of the annual avoided generation capacity costs or the avoided capacity cost of peaking capacity. Annual avoided energy costs shall include annual avoided running costs plus any avoided capacity costs not included in the annual demand cost.

DSMore calculates avoided demand cost which include both avoided generation capacity and avoided transmission capacity. Avoided capacity in kW includes transmission line losses as a percentage of delivered energy. Avoided generation capacity was modeled as the avoided cost of peaking capacity.

SECTION 3: COST-EFFECTIVE SCREENING OF END-USE MEASURES

(3) Cost-Effectiveness Screening of End-Use Measures. The utility shall evaluate the costeffectiveness of each end-use measure identified pursuant to section (1) using the probable environmental benefits test. All costs and benefits shall be expressed in nominal dollars.

(A) The utility shall develop estimates of the end-use measure demand reduction for each demand period and energy savings per installation for each avoided cost period on a normal-weather basis. If the utility can show that subannual load impact estimates are not required to capture the potential benefits of an end-use measure, annual estimates of demand and energy savings may be used for cost-effectiveness screening.

Energy savings estimates for residential end-use measures R1 through R31 were developed by RLW analytics using the DOE-2 building simulation software. DOE-2 is a widely used and accepted freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, operating schedules, conditioning systems (lighting, HVAC, etc.) and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills.

Energy savings estimates for residential measures R32 through R34 were developed by Morgan Marketing Partners. Measures R1 through R31 are weather normalized. Impacts were calculated using the DOE-2 building simulation software. Impacts in terms of energy savings and demand of the residential end-use measures are listed in Table 51 below.

Energy savings and demand for C&I measures are listed in Table 52 through Table 56 below.

Table 51: Energy Savings Impact of Residential Measures

ID	Potential Situation	Improvement	Total kWh	Jan kW Coincident Peak	Aug kW coincident Peak
R1	AC Refrigerant under charged	Add refrigerant	689	-	0.32
R2	AC Refrigerant over charged	Remove refrigerant	176	-	0.08
R3	Low evaporator airflow A	Increase duct sizes or add new ducts	981	0.82	0.19
R4	Low evaporator airflow B	Increase blower speed	807	0.67	0.16
R5	High duct leakage (25%)	Reduce duct leakage to 5%	606	0.45	0.12
R6	Oversized AC units A	Size AC units to 100% of Manual J	333	-	0.16
R7	Oversized AC units B	Size AC units to 100% of Manual J	1,046	-	0.49
R8	One inch insul. on ducts in attic	Add two more inches of insulation	242	0.24	0.05
R9	Gas heat and 13 SEER AC	Install AC SEER = 16	921	-	0.43
R10	Home has 13 SEER heat pump	Install Heat Pump SEER = 16	1,258	(0.52)	0.25
R11	Home has electric strip heat	Install Heat Pump SEER = 16	4,061	(0.48)	0.80
R12	Attic insulation = R-7	Add another R-23 attic insulation	879	0.54	0.17
R13	Attic insulation = R-11	Add another R-19 attic insulation	541	0.35	0.11
R14	Exposed walls not insulated	Add R-11 wall insulation	2,634	0.69	0.52
R15	Floor over basement not insulated	Add R-19 Insulation to floor	(223)	(0.12)	(0.04)
R16	House infiltration = 0.8 ACH	Reduce infiltration to 0.35 ACH	1,046	0.43	0.21
R17	Single pane windows A	Add storm windows	908	0.28	0.18
R18	Single pane windows B	Install Low E double pane window 2904	1,428	0.54	0.28
R19	Standard double pane windows	Install Low E double pane window 2904	520	0.26	0.10
R20	No E & W window shading A	Add solar screens to E & W glass	172	-	0.08
R21	No E & W window shading B	Plant deciduous trees on E & W sides	627	-	0.30
R22	No Compact Fluorescent Lamps	Use 10 more CFLs throughout house	543	0.05	-
R23	Refrigerator needs to be replaced	Purchase Energy Star refrigerator	152	0.02	0.02
R24	Refrigerator early retirement	Removed unit uses no energy	954	0.12	0.12
R25	Dishwasher to be replaced	Purchase Energy Star dishwasher	107	0.01	0.02
R26	Clothes washer to be replaced	Purchase Energy Star clothes washer	110	0.02	0.02
R27	No prgrammable thermostat	Install programmable thermostat	666	(0.22)	0.13
R28	No faucet aerators	Install faucet aerators	31	0.01	0.01
R29	No low flow shower heads	Install low fow shower heads	174	0.04	0.03
R30	Hot water pipes not insulated	Insulate hot water pipes	80	0.02	0.02
R31	Electric water heater not wrapped	Wrap electric water heater	58	0.01	0.01
R32	Electric Meter	Energy Usage and Display Monitor	494	0.02	0.02
R33	Early Retirement of HVAC system, if SEER< 8.5	Install Heat Pump SEER = 16	3,484	-	1.76
R34	Early Retirement of HVAC system, if SEER< 8.5	Install Heat Pump SEER = 14	3,331	-	1.68
R35	Early Retirement of HVAC system, if SEER< 8.5	Install Heat Pump SEER = 15	3,331	-	1.68
R36	De-humidifier early retirement	Removed unit uses no energy	275	-	0.14
R37	Room A/C Unit early retirement	Removed unit uses no energy	153	-	0.08
R38	Freezer early retirement	Removed unit uses no energy	954	-	0.19
R39	Failure of HVAC system, Replace with 13 SEER	Replace with 14 SEER Unit	232	-	0.11
R40	Failure of HVAC system, Replace with 13 SEER	Replace with 15 SEER Unit	433	-	0.21
R41	Failure of HVAC system, Replace with 13 SEER	Replace with 16 SEER Unit	609	-	0.29
R42	Refrigerator early retirement	Removed unit uses no energy	1,006	-	0.19

Table 52: Energy savings C&I Lighting

ID#	Potential Situation	Improvement	kW	kWh
C&I L1	T12 - 20W -2' 1 Lamp - Magnetic	T8 - 17W -2' 1 Lamp - Electronic	0.01	27.60
C&I L2	T12 - 20W -2' 2 Lamp - Magnetic	T8 - 17W -2' 2 Lamp - Electronic	0.01	34.96
C&I L3	T12 - 20W -2' 3 Lamp - Magnetic	T8 - 17W -2' 3 Lamp - Electronic	0.02	73.60
C&I L4	T12 - 20W -2' 4 Lamp - Magnetic	T8 - 17W -2' 4 Lamp - Electronic	0.02	80.96
C&I L5	T12 - 30W -3' 1 Lamp - Magnetic	T8 - 25W -3' 1 Lamp - Electronic	0.01	40.48
C&I L6	T12 - 30W -3' 2 Lamp - Magnetic	T8 - 25W -3' 2 Lamp - Electronic	0.01	36.80
C&I L7	T12 - 30W -3' 3 Lamp - Magnetic	T8 - 25W -3' 3 Lamp - Electronic	0.01	44.16
C&I L8	T12 - 30W -3' 4 Lamp - Magnetic	T8 - 25W -3' 4 Lamp - Electronic	0.02	73.60
C&I L9	T12- 34W - 4' 1 Lamp - Magnetic	T8 32W - 4' 1 Lamp - Electronic	0.01	51.52
C&I L10	T12- 34W - 4' 2 Lamp - Magnetic	T8 32W - 4' 2 Lamp - Electronic	0.02	62.56
C&I L11	T12- 34W - 4' 3 Lamp - Magnetic	T8 32W - 4' 3 Lamp - Electronic	0.03	117.76
C&I L12	T12- 34W - 4' 4 Lamp - Magnetic	T8- 32W - 4' 4 Lamp - Electronic	0.04	139.84
C&I L13	T12 - 60W - 8' 1 Lamp - Magnetic	T8 - 59W - 8' 1 Lamp - Electronic	0.01	40.48
C&I L14	T12 - 60W - 8' 2 Lamp - Magnetic	T8 - 59W - 8' 2 Lamp - Electronic	0.02	73.60
C&I L15	T12 - 95W - 8' 1 Lamp - Magnetic - HO	T8 - 86W - 8' 1 Lamp - HO - Electronic	0.03	92.00
C&I L16	T12 - 95W - 8' 2 Lamp - Magnetic - HO	T8 - 86W - 8' 2 Lamp - HO - Electronic	0.05	184.00
C&I L17	32 W T8 Lamp	Low Watt T8 Lamp	0.00	14.72
C&I L18	T12- 34W - 4' 1 Lamp - Magnetic	T5 - 4' 1 Lamp - 28 watt	0.01	44.16
C&I L19	T12- 34W - 4' 2 Lamp - Magnetic	T5 - 4' 2 Lamp - 28 watt	0.01	44.16
C&I L20	T12- 34W - 4' 3 Lamp - Magnetic	T5 - 4' 3 Lamp - 28 watt	0.03	99.36
C&I L21	T12- 34W - 4' 4 Lamp - Magnetic	T5 - 4' 4 Lamp - 28 watt	0.02	88.32
C&I L22	T12- 34W - 4' 2 Lamp - Magnetic	T5 - 4' 1 Lamp HO - 54 watt	0.02	55.20
C&I L23	T12 - 60W - 8' 2 Lamp - Magnetic	T5 - 4' 2 Lamp HO - 54 watt	0.01	36.80
C&I L24	T12- 34W - 4' 4 Lamp - Magnetic	T5 - 4' 2 Lamp HO - 54 watt	0.03	103.04
C&I L25	T12 - 8' and 4' Avg	T5 - 4' 2 Lamp HO - 54 watt	0.02	69.92
C&I L26	T12 - 95W - 8' 2 Lamp - Magnetic - HO	T5 - 4' 3 Lamp HO - 54 watt	0.03	92.00
C&I L27	T12 - 60W - 8' 4 Lamp - Magnetic	T5 - 4' 4 Lamp HO - 54 watt	0.02	77.28
C&I L28	T12 - 95W - 8' 2 Lamp - Magnetic - HO	T5 - 4' 4 Lamp HO - 54 watt	(0.03)	(121.44)
C&I L29	T12 - 95W - 8' 2 Lamp - Magnetic - VHO	T5 - 4' 4 Lamp HO - 54 watt	0.14	504.16
C&I L30	T12 - 95W - 8' 2 Lamp - Magnetic - HO - VHO Avg	T5 - 4' 4 Lamp HO - 54 watt	0.05	191.36
C&I L31	Hi-Bay 250 W Hi Intensity Discharge	Hi-Bay 3L T5 HO Fluorescents	0.11	449.28
C&I L32	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 4L T5 HO Fluorescents	0.21	881.92
C&I L33	Hi-Bay 400W Hi Intensity Discharge	Hi-Bay 6L T5 HO Fluorescents	0.09	374.40
C&I L34	Hi-Bay 1000W Hi Intensity Discharge	Hi-Bay 2-6L T5 HO Fluorescents	0.35	1,456.00
C&I L35	Hi-Bay 250 W Hi Intensity Discharge	Hi-Bay 4L F32 T8 Fluorescents	0.15	615.68
C&I L36	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 6L F32 T8 Fluorescents	0.23	960.96
C&I L37	Hi-Bay 400W Hi Intensity Discharge	Hi-Bay 8L F32 T8 Fluorescents	0.16	648.96
C&I L38	Hi-Bay 1000W Hi Intensity Discharge	Hi-Bay 2-8L F32 T8 Fluorescents	0.48	2,005.12
C&I L39	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 8L 42W CFL	0.08	345.28
C&I L40	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 320 Watt Metal Halide - Pulse Start	0.11	470.08
C&I L41	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 350 Watt Metal Halide - Pulse Start	0.08	332.80
C&I L42	Hi-Bay 400 W Hi Intensity Discharge	Hi-Bay 400 Watt Metal Halide - Pulse Start	-	-
C&I L43	60W Inc	15W CFL	0.04	149.04
C&I L44	2-60W Inc Fixture	2-13 W CFL Fixture	0.08	308.02
C&I L45	Exit Signs have CFLs	Retrofit to LED EnergyStar Exit sign	0.03	166.69
C&I L46	Standard lighting switch	Install Occupancy Sensor	0.12	519.22
C&I L47	Traffic Signal, Incandescent	Install EnergyStar Rated LED Traffic Signal	0.05	290.13
C&I L48	No Skylight or light tube	Install Light Tube Commercial Skylight	0.10	432.68
C&I L49	No centralized lighting controls	Install centralized lighting controls	3.12	13,499.75
C&I L50	No lighting controls	Install Multilevel Lighting Controls	2.44	10,557.50
C&I L51	No lighting controls	Install Daylight Lighting Control Sensors	4.02	17,393.91

Table 53: Energy savings, C&I refrigeration

ID#	Potential Situation	Improvement	kW	kWh
C&I Refrig 1	No Controls on Vending Machine	Install Cold Beverage Vending Machine Controllers	0.15	844.00
C&I Refrig 2	No anti-sweat heater control	Install Anti-sweat heater controls	0.21	1,570.89
C&I Refrig 3	Standard condenser	Install Efficient Refrigeration Condenser	0.02	126.60
C&I Refrig 4	No covers on food cases	Install Night Covers for Food Cases	-	72.08
C&I Refrig 5	No compressor head controls	Install compressor head controls	0.18	1,333.52
C&I Refrig 6	Standard Commercial Solid Door Refrigerators less than 20ft3	ENERGY STAR Commercial Solid Door Refrigerators less than 20ft3	0.05	391.41
C&I Refrig 7	Standard Commercial Solid Door Refrigerators 20-48 ft3	ENERGY STAR Commercial Solid Door Refrigerators 20-48 ft3	0.08	573.92
C&I Refrig 8	Standard Commercial Solid Door Refrigerators more than 48ft3	ENERGY STAR Commercial Solid Door Refrigerators more than 48ft3	0.12	877.76
C&I Refrig 9	Standard Commercial Solid Door Freezers less than 20ft3	ENERGY STAR Commercial Solid Door Freezers less than 20ft3	0.05	337.60
C&I Refrig 10	Standard Commercial Solid Door Freezers 20-48 ft3	ENERGY STAR Commercial Solid Door Freezers 20-48 ft3	0.04	323.88
C&I Refrig 11	Standard Commercial Solid Door Freezers more than 48ft3	ENERGY STAR Commercial Solid Door Freezers more than 48ft3	0.04	297.51
C&I Refrig 12	Standard Ice Machines less than 500 lbs	Energy Efficient Ice Machines less than 500 lbs	0.23	1,266.00
C&I Refrig 13	Standard Ice Machines 500-1000 lbs	Energy Efficient Ice Machines 500-1000 lbs	0.33	1,846.25
C&I Refrig 14	Standard Ice Machines more than 1000 lbs	Energy Efficient Ice Machines more than 1000 lbs	0.92	5,137.85

Table 54: Energy savings, C&I Process and Other

ID#	Potential Situation	Improvement	kW	kWh
C&I Process1	No Barrel Wraps for Injection Molders & Extruders	Pellet Dryer Tanks & Ducts 3 dia	0.02	103.39
C&I Process2	No Barrel Wraps for Injection Molders & Extruders	Pellet Dryer Tanks & Ducts 4 dia	0.03	141.37
C&I Process3	No Barrel Wraps for Injection Molders & Extruders	Pellet Dryer Tanks & Ducts 5 dia	0.03	184.62
C&I Process4	No Barrel Wraps for Injection Molders & Extruders	Pellet Dryer Tanks & Ducts 6 dia	0.04	227.88
C&I Process5	No Barrel Wraps for Injection Molders & Extruders	Pellet Dryer Tanks & Ducts 8 dia	0.06	320.72
C&I Process6	Standard nozzles _Compressed air	Engineered Nozzles - COMPRESS AIR	1.39	7,746.86
C&I Other1	Std Commercial Clothes Washers	Energy Star Commercial Clothes Washers	0.04	226.83
C&I Other2	No Plug Load Occupancy Sensors Document Stations	Plug Load Occupancy Sensors Document Stations	0.15	847.17
C&I Other3	Std. Power Supply_Desktop Unit	80Plus Power Supply_Desktop Unit	0.02	89.67
C&I Other4	Std. Power Supply_Server Unit	80Plus Power Supply_Server Unit	0.06	317.56
C&I Other5	No Computer Power Manager	Computer Power Manager	0.13	712.13

Table 55: Energy savings, C&I Motive Power

ID#	Potential Situation	Improvement	kW	kWh
CI Motive Power 1	Std. EPACT Motors 1-5 HP	NEMA Premium Motors 1-5 HP	0.03	129.81
CI Motive Power 2	Std. EPACT Motors 7.5-20 HP	NEMA Premium Motors 7.5-20 HP	0.08	346.15
CI Motive Power 3	Std. EPACT Motors 25-100 HP	NEMA Premium Motors 25-100 HP	0.29	1,254.78
CI Motive Power 4	Std. EPACT Motors 125-250 HP	NEMA Premium Motors 125-250 HP	0.66	2,855.72
CI Motive Power 5	Std. Pump HP 1.5	Hi Efficiency Pump HP 1.5	0.10	415.38
CI Motive Power 6	Std. Pump HP 2	Hi Efficiency Pump HP 2	0.13	553.84
CI Motive Power 7	Std. Pump HP 3	Hi Efficiency Pump HP 3	0.19	830.75
CI Motive Power 8	Std. Pump HP 5	Hi Efficiency Pump HP 5	0.32	1,384.59
CI Motive Power 9	Std. Pump HP 7.5	Hi Efficiency Pump HP 7.5	0.48	2,076.88
CI Motive Power 10	Std. Pump HP 10	Hi Efficiency Pump HP 10	0.64	2,769.18
CI Motive Power 11	Std. Pump HP 15	Hi Efficiency Pump HP 15	0.96	4,153.77
CI Motive Power 12	Std. Pump HP 20	Hi Efficiency Pump HP 20	1.28	5,538.36
CI Motive Power 13	No Variable Frequency Drive HP 1.5	Install Variable Frequency Drive HP 1.5	0.39	1,687.47
CI Motive Power 14	No Variable Frequency Drive HP 2	Install Variable Frequency Drive HP 2	0.52	2,249.96
CI Motive Power 15	No Variable Frequency Drive HP 3	Install Variable Frequency Drive HP 3	0.78	3,374.94
CI Motive Power 16	No Variable Frequency Drive HP 5	Install Variable Frequency Drive HP 5	1.30	5,624.90
CI Motive Power 17	No Variable Frequency Drive HP 7.5	Install Variable Frequency Drive HP 7.5	1.95	8,437.34
CI Motive Power 18	No Variable Frequency Drive HP 10	Install Variable Frequency Drive HP 10	2.60	11,249.79
CI Motive Power 19	No Variable Frequency Drive HP 15	Install Variable Frequency Drive HP 15	3.90	16,874.69
CI Motive Power 20	No Variable Frequency Drive HP 20	Install Variable Frequency Drive HP 20	5.20	22,499.58
CI Motive Power 21	No Variable Frequency Drive HP 25	Install Variable Frequency Drive HP 25	6.50	28,124.48
CI Motive Power 22	No Variable Frequency Drive HP 30	Install Variable Frequency Drive HP 30	7.80	33,749.37
CI Motive Power 23	No Variable Frequency Drive HP 40	Install Variable Frequency Drive HP 40	10.40	44,999.16
CI Motive Power 24	No Variable Frequency Drive HP 50	Install Variable Frequency Drive HP 50	13.00	56,248.96
CI Motive Power 24	No Variable Frequency Drive HP 50	Install Variable Frequency Drive HP 50	0.04	226.83
CI Motive Power 24	No Variable Frequency Drive HP 50	Install Variable Frequency Drive HP 50	0.15	847.17
CI Motive Power 24	No Variable Frequency Drive HP 50	Install Variable Frequency Drive HP 50	0.02	89.67
CI Motive Power 24	No Variable Frequency Drive HP 50	Install Variable Frequency Drive HP 50	0.06	317.56
CI Motive Power 24	No Variable Frequency Drive HP 50	Install Variable Frequency Drive HP 50	0.13	712.13

Table 56: Energy Savings, C&I HVAC measures

ID#	Potential Situation	Improvement	kW	kWh
C&I HVAC 1	AC 65,000 1 Ph, 66 kWh/ton	AC 65,000 1 Ph, 59 kWh/ton	0.11	346.86
C&I HVAC 2	AC 65,000 3 Ph, 49 kWh/ton	AC 65,000 3 Ph, 44 kWh/ton	0.08	259.66
C&I HVAC 3	AC 65,000 - 135,000, 77 kWh/ton	AC 65,000 - 135,000, 60 kWh/ton	0.26	809.87
C&I HVAC 4	AC 135,000 - 240,000, 120 kWh/ton	AC 135,000 - 240,000, 107 kWh/ton	0.82	2,531.56
C&I HVAC 5	AC 240,000 - 760,000, 63 kWh/ton	AC 240,000 - 760,000, 56 kWh/ton	0.54	1,659.42
C&I HVAC 6	AC >760,000, 83 kWh/ton	AC >760,000, 93 kWh/ton	2.06	6,367.43
C&I HVAC 7	HP 65,000 1 Ph, 99 kWh/ton	HP 65,000 1 Ph, 96 kWh/ton	0.16	505.73
C&I HVAC 8	HP 65,000 3 Ph, 57 kWh/ton	HP 65,000 3 Ph, 58 kWh/ton	0.10	308.58
C&I HVAC 9	HP 65,000 - 135,000, 108 kWh/ton	HP 65,000 - 135,000, 108 kWh/ton	0.37	1,139.41
C&I HVAC 10	HP 135,000 - 240,000, 124 kWh/ton	HP 135,000 - 240,000, 119 kWh/ton	0.81	2,508.34
C&I HVAC 11	HP >240,000, 153 kWh/ton	HP >240,000, 150 kWh/ton	1.29	3,966.21
C&I HVAC 12	Ground Source HP Closed Loop <135,000, 9 kWh/ton	Ground Source HP Closed Loop <135,000, 7 kWh/ton	0.09	278.52
C&I HVAC 13	WLHP <17,000, 24 kWh/ton	WLHP <17,000, 22 kWh/ton	0.01	25.30
C&I HVAC 14	WLHP 17,000-65,000, 21 kWh/ton	WLHP 17,000-65,000, 19 kWh/ton	0.02	67.17
C&I HVAC 15	WLHP 65,000-135,000, 21 kWh/ton	WLHP 65,000-135,000, 19 kWh/ton	0.05	167.93
C&I HVAC 16	PTAC, 28 kWh/ton	PTAC, 24 kWh/ton	0.01	29.63
C&I HVAC 17	PTAC-HP, 48 kWh/ton	PTAC-HP, 45 kWh/ton	0.02	47.46
C&I HVAC 18	Economizer, 159 kWh/ton	Economizer, 109 kWh/ton	0.54	1,675.34
C&I HVAC 19	Tuneup - Refrigerant Charge, 145 kWh/ton	Tuneup - Refrigerant Charge, kWh/ton	0.50	1,533.97
C&I HVAC 20	No ES Sleeve AC over 14,000 Btu hr	Install ES Sleeve AC over 14,000 Btu hr	0.06	179.35
C&I HVAC 21	No ES Sleeve AC under 14,000 Btu hr	Install ES Sleeve AC under 14,000 Btu hr	0.02	73.85
C&I HVAC 22	No Setback_Programmable Thermostat	Install Setback_Programmable Thermostat	3.08	9,512.94
C&I HVAC 23	Chilled Water Reset Air Cooled 0-100 tons	Replace with Min ARI rated Efficiency	0.88	2,712.41
C&I HVAC 24	Chilled Water Reset Air Cooled 100-200 tons	Replace with Min ARI rated Efficiency	2.64	8,138.27
C&I HVAC 25	Chilled Water Reset Air Cooled 200-300 tons	Replace with Min ARI rated Efficiency	4.40	13,564.14
C&I HVAC 26	Chilled Water Reset Air Cooled 300-400 tons	Replace with Min ARI rated Efficiency	6.15	18,990.00
C&I HVAC 27	Chilled Water Reset Air Cooled 400-500 tons	Replace with Min ARI rated Efficiency	7.91	24,415.87
C&I HVAC 28	Chilled Water Reset Water Cooled 0-1000 tons	Replace with Min ARI rated Efficiency	3.50	10,790.54
C&I HVAC 29	Chilled Water Reset Water Cooled 1000-2000 tons	Replace with Min ARI rated Efficiency	10.49	32,369.51
C&I HVAC 30	Chilled Water Reset Water Cooled 2000-3000 tons	Replace with Min ARI rated Efficiency	17.49	53,948.48
C&I HVAC 31	Air Cooled Chillers	Replace with Min ARI rated Efficiency	1.05	3,253.62
C&I HVAC 32	Water Cooled Chillers less than 150 ton	Replace with Min ARI rated Efficiency	1.53	4,734.27
C&I HVAC 33	Water Cooled Chillers 150 - 300 ton	Replace with Min ARI rated Efficiency	14.72	45,411.62
C&I HVAC 34	Water Cooled Chillers more than 300 ton	Replace with Min ARI rated Efficiency	53.31	164,490.18
C&I HVAC 35	No Window Film	Install Window Film	1.05	3,253.62
C&I HVAC 36	Electric Water heater	HP Water Heater 500 gal_day	5.87	21,635.00
C&I HVAC 37	Electric Water heater	HP Water Heater 1000 gal_day	11.84	43,637.00
C&I HVAC 38	Electric Water heater	HP Water Heater 1500 gal_day	17.81	65,639.00

(B) Benefits per installation of each endues measure in each avoided cost period shall be calculated as the demand reduction multiplied by the levelized avoided demand cost plus the energy savings multiplied by the levelized avoided energy cost.

DSMore calculated benefits as demand reduction multiplied by the levelized avoided demand cost. The levelized cost of a combustion turbine was used for the demand period avoided cost.

DSMore calculates energy savings as the hourly avoided market price of energy time the hourly energy saved. GMO has a waiver to model avoided cost using DSMore's market energy price model.

1. Avoided costs in each avoided cost period shall be levelized over the planning horizon using the utility discount rate.

DSMore calculates annual values of avoided costs using the hourly values over the life of the measure. The present value of these annual avoided costs are discounted at the utility discount rate and represents a levelized value.

2. Annualized benefits shall be calculated as the sum of the levelized benefits over all avoided cost periods.

Avoided benefits are represented by an hourly value over the life of the end use measures and includes all avoided cost periods. The present value of these annual avoided costs are discounted at the utility discount rate and represents a levelized value.

(C) Annualized costs per installation for each end-use measure shall be calculated as the sum of the following components:

1. Incremental costs of implementing the measure (regardless of who pays these costs) levelized over the life of the measure using the utility discount rate;

2. Incremental annual operation and maintenance costs (regardless of who pays these costs) levelized over the life of the measure using the utility discount rate; and

3. Any probable environmental impact mitigation costs due to implementation of the end-use measure that are borne by either the utility or the customer.

Annualized costs per installation for each end-use measure included the incremental cost of the measure, an annual operation and maintenance cost, and probable environmental cost. Avoided environmental costs were included as the projected cost of future potential CO_2 regulation. Total annual costs are calculated by DSMore as the levelized cost over the life of the measure discounted at the utility discount rate.

(D) Annualized costs for end-use measures shall not include either utility marketing and delivery costs for demand-side programs or lost revenues due to measure-induced reductions in energy sales or billing demands between rate cases.

Utility marketing, delivery and lost revenue cost were not included in end-use measure screening.

(E) Annualized benefits minus annualized costs per installation must be positive or the ratio of annualized benefits to annualized costs must be greater than one (1) for an endues measure to pass the screening test. The utility may relax this criterion for measures that are judged to have potential benefits which are not captured by the estimated load impacts or avoided costs.

(F) End-use measures that pass the probable environmental benefits test must be included in at least one (1) potential demand-side program.

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 14" allows GMO to use the software package, DSMore, for the evaluation of end-use measures.

GMO did not include any marketing or delivery costs in the screening evaluation. DSMore is an MS-Excel software based tool that provided all the data needed to calculate the Probable Environmental Benefits Test (PEBT).

Table 57 below identifies the residential end-use measures that did not pass the PEBT and were not included in a program;

Table 57: Residential Measures Not Included In A Program

ID	DESCRIPTION	PEBT
R8	Add 2 More Inches Of Insulation On Ducts In Attic	0.8
R20	Solar Screens On E/W Windows	0.66
R21	Plant Deciduous Trees On E/W Side	0.64
R25	Install An Energy Star Dishwasher	0.73
R26	Install An Energy Star Clothes Washer	0.3
R30	Insulate Hot Water Pipes	0.74
R40	Replacement Of A Failed Residential A/C Unit With 15 Seer	0.46
R41	Replacement Of A Failed Residential A/C Unit With 16 SEER	0.49

(G) For each end-use measure that passes the probable environmental benefits test, the utility also shall perform the utility benefits test for informational purposes. This calculation shall include the cost components identified in paragraphs (3)(C)1. and 2..

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 14" allows GMO to use the software package, DSMore, for the evaluation of end-use measures.

GMO did not include any marketing or delivery costs in the screening evaluation. DSMore is an MS-Excel software based tool that provided all the data needed to calculate the Probable Environmental Benefits Test.

DSMore returns both cost-based and market-based standard practice economic benefit / cost test results for each end-use measure under evaluation. Market based results value DSM using a statistical price forecast at the hourly level and reflects more accurate valuations of DSM by including weather effects, and the associated covariance of price and load. Cost based results reflect traditional marginal production cost valuation which does not capture the value associated with market price volatility and load variance due to weather. Table 58 is a list of the cost / benefit tests. The probable environmental benefits test was used for initial screening of end-use measures.

Table 58: Economic Benefit / Cost Test Formulas
SCREENING BENEFIT-COST TESTS

Test	Formula
Total Resource Cost Test (TRC)	= (Total Avoided Cost - Arrears) / (Total Utility Program Cost + Participant Cost -Rebates)
Utility Cost Test (UCT)	= (Total Avoided Cost, Market Based + Arrears Reduced) / (Total Utility Program Cost)
Rate Impact Measure Test (RIM)	= (Total Avoided Costs, Market Based + Arrears Reduced) / (Total Utility Program Cost + Lost Revenue)
Societal Cost Test	= (Total Avoided Costs, Market Based + Arrears Reduced + Tax Savings Benefits + Total Environ Benefits) / (Total Utility Program Cost + Participant Cost – Rebates)
Participant Cost Test (PCT)	= (Total Lost Revenue + Incentives) / Participant cost
Probable Environmental Benefits Test (PEB), used for end-use measure initial screening only	= (Total Avoided Costs, Market Based + Total Environ Benefits) / (Total Utility Incentives, which excludes administration and marketing costs + Net Participant Cost after incentives)

Table 59 below lists the utility cost input values that were used by DSMore.

Table 59: DSMore Utility Cost Periods, Model Inputs And Demand Periods

Avoided Costs	Description	Values
Capacity Cost	Per granted waiver, the levelized annual value of an avoided CT	** [redacted] **/kW-Yr (2008 $'s)
T&D Costs	Value of deferred T&D system upgrades	** [redacted] **/kW-Yr (2008 $'s)
Energy Costs / Direct Running Costs	Per granted waiver, energy Market prices on an hourly basis	Varies, Supplied by MIDAS
Cost Periods	Covered by the use of hourly market prices	
Demand Periods	Covered by the waiver to apply the value of an avoided CT	
Arrears reduced (bad debt)	Used in DSMore benefits tests	GMO Value = $0
Rebates	Utility payments to customers for program participation	Varies by program
Total Avoided Costs (TAC)	Sum of: 1) total production costs (avoided capacity, running energy), total avoided T&D and total avoided ancillary services cost	
Environmental Benefits, CO_2	CO_2 emissions cost	$0.01 per kW-hr
Reserve Margin, (ancillary services cost)	SPP reliability requirement cost	13.6% reserve margin

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Table 60 provides the results of the residential measures screening.

Table 60: Residential Measures Screening Results

Measure ID	Description	Probable Environmental Benefits Test	Utility Test	TRC w capacity, no Admin
R1	Under charged-Add refrigerant_MPS	[redacted]	[redacted]	[redacted]
R2	Over charged-Remove refrigerant_MPS	[redacted]	[redacted]	[redacted]
R3	Increase duct sizes or add new ducts_MPS	[redacted]	[redacted]	[redacted]
R4	Increase blower speed_MPS	[redacted]	[redacted]	[redacted]
R5	Reduce duct leakage to 5%_MPS	[redacted]	[redacted]	[redacted]
R6	Size AC units (A) to 100% of Manual J_MPS	[redacted]	[redacted]	[redacted]
R7	Size AC units (B) to 100% of Manual J_MPS	[redacted]	[redacted]	[redacted]
R8	Add two more inches of insulation to ducts in attic_MPS	[redacted]	[redacted]	[redacted]
R9	Install AC SEER = 16 vs 13 SEER_MPS	[redacted]	[redacted]	[redacted]
R10	Install Heat Pump SEER = 13 to 16_MPS	[redacted]	[redacted]	[redacted]
R11	Elec strip-Install Heat Pump SEER = 16_MPS	[redacted]	[redacted]	[redacted]
R12	Add another R-23 attic insulation_MPS	[redacted]	[redacted]	[redacted]
R13	Add another R-19 attic insulation_MPS	[redacted]	[redacted]	[redacted]
R14	Add R-11 wall insulation _MPS	[redacted]	[redacted]	[redacted]
R15	Add R-19 Insulation to floor_MPS	[redacted]	[redacted]	[redacted]
R16	Reduce infiltration to 0.35 ACH_MPS	[redacted]	[redacted]	[redacted]
R17	Add storm windows_MPS	[redacted]	[redacted]	[redacted]
R18	Single pane to Low E double pane window 2904_MPS	[redacted]	[redacted]	[redacted]
R19	Standard double pane to Low E double pane window 2904_MPS	[redacted]	[redacted]	[redacted]
R20	Add solar screens to E & W glass_MPS	[redacted]	[redacted]	[redacted]
R21	Plant deciduous trees on E & W sides_MPS	[redacted]	[redacted]	[redacted]
R22	Use 10 more CFLs throughout house_MPS	[redacted]	[redacted]	[redacted]
R23	Purchase Energy Star refrigerator_MPS	[redacted]	[redacted]	[redacted]
R24	Removed refrigerator unit uses no energy_MPS	[redacted]	[redacted]	[redacted]
R25	Purchase Energy Star dishwasher_MPS	[redacted]	[redacted]	[redacted]
R26	Purchase Energy Star clothes washer_MPS	[redacted]	[redacted]	[redacted]
R27	Install programmable thermostat_MPS	[redacted]	[redacted]	[redacted]
R28	Install faucet aerators_MPS	[redacted]	[redacted]	[redacted]
R29	Install low flow shower heads_MPS	[redacted]	[redacted]	[redacted]
R30	Insulate hot water pipes_MPS	[redacted]	[redacted]	[redacted]
R31	Wrap electric water heater_MPS	[redacted]	[redacted]	[redacted]
R32	Energy Usage and Display Monitor_MPS	[redacted]	[redacted]	[redacted]
R33	Install Heat Pump SEER = 16_MPS	[redacted]	[redacted]	[redacted]
R34	Install Heat Pump SEER = 14_MPS	[redacted]	[redacted]	[redacted]
R35	Install Heat Pump SEER = 15_MPS	[redacted]	[redacted]	[redacted]
R36	Removed unit uses no energy_MPS	[redacted]	[redacted]	[redacted]
R37	Removed unit uses no energy_MPS	[redacted]	[redacted]	[redacted]
R38	Removed unit uses no energy_MPS	[redacted]	[redacted]	[redacted]
R39	Replace with 14 SEER Unit_MPS	[redacted]	[redacted]	[redacted]
R40	Replace with 15 SEER Unit_MPS	[redacted]	[redacted]	[redacted]
R41	Replace with 16 SEER Unit_MPS	[redacted]	[redacted]	[redacted]
R42	Refrig Turn In_MPS	[redacted]	[redacted]	[redacted]

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Table 61 provides the results of the C&I – HVAC measures screening.

Table 61 : C&I HVAC Measures Screening Results

Measure ID	Description	Probable Environmental Benefits Test	Utility Test	TRC w capacity, no Admin
C&I HVAC 1	AC 65,000 1 Ph	[redacted]	[redacted]	[redacted]
C&I HVAC 2	AC 65,000 3 Ph	[redacted]	[redacted]	[redacted]
C&I HVAC 3	AC 65,000 - 135,000	[redacted]	[redacted]	[redacted]
C&I HVAC 4	AC 135,000 - 240,000	[redacted]	[redacted]	[redacted]
C&I HVAC 5	AC 240,000 - 760,000	[redacted]	[redacted]	[redacted]
C&I HVAC 6	AC 760,000	[redacted]	[redacted]	[redacted]
C&I HVAC 7	HP 65,000 1 Ph	[redacted]	[redacted]	[redacted]
C&I HVAC 8	HP 65,000 3 Ph	[redacted]	[redacted]	[redacted]
C&I HVAC 9	HP 65,000 - 135,000	[redacted]	[redacted]	[redacted]
C&I HVAC 10	HP 135,000 - 240,000	[redacted]	[redacted]	[redacted]
C&I HVAC 11	HP 240,000	[redacted]	[redacted]	[redacted]
C&I HVAC 12	Ground Source HP Closed Loop	[redacted]	[redacted]	[redacted]
C&I HVAC 13	WLHP 17,000	[redacted]	[redacted]	[redacted]
C&I HVAC 14	WLHP 17,000-65,000	[redacted]	[redacted]	[redacted]
C&I HVAC 15	WLHP 65,000-135,000	[redacted]	[redacted]	[redacted]
C&I HVAC 16	PTAC	[redacted]	[redacted]	[redacted]
C&I HVAC 17	PTAC-HP	[redacted]	[redacted]	[redacted]
C&I HVAC 18	Economizer	[redacted]	[redacted]	[redacted]
C&I HVAC 19	Tuneup - Refrigerant Charge	[redacted]	[redacted]	[redacted]
C&I HVAC 20	ES Sleeve AC over 14,000 Btu hr	[redacted]	[redacted]	[redacted]
C&I HVAC 21	ES Sleeve AC under 14,000 Btu hr	[redacted]	[redacted]	[redacted]
C&I HVAC 22	Setback_Programmable Thermostat	[redacted]	[redacted]	[redacted]
C&I HVAC 23	Chilled Water Reset Air Cooled 0-100 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 24	Chilled Water Reset Air Cooled 100-200 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 25	Chilled Water Reset Air Cooled 200-300 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 26	Chilled Water Reset Air Cooled 300-400 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 27	Chilled Water Reset Air Cooled 400-500 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 28	Chilled Water Reset Water Cooled 0-1000 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 29	Chilled Water Reset Water Cooled 1000-2000 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 30	Chilled Water Reset Water Cooled 2000-3000 tons	[redacted]	[redacted]	[redacted]
C&I HVAC 31	Air Cooled Chillers	[redacted]	[redacted]	[redacted]
C&I HVAC 32	Water Cooled Chillers less than 150 ton	[redacted]	[redacted]	[redacted]
C&I HVAC 33	Water Cooled Chillers 150 - 300 ton	[redacted]	[redacted]	[redacted]
C&I HVAC 34	Water Cooled Chillers more than 300 ton	[redacted]	[redacted]	[redacted]
C&I HVAC 35	Window Film	[redacted]	[redacted]	[redacted]
C&I HVAC 36	HP Water Heater 500 gal_day	[redacted]	[redacted]	[redacted]
C&I HVAC 37	HP Water Heater 1000 gal_day	[redacted]	[redacted]	[redacted]
C&I HVAC 38	HP Water Heater 1500 gal_day	[redacted]	[redacted]	[redacted]

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Table 62 provides the results of the C&I – lighting measures screening.

Table 62: C&I Lighting Measures Screening Results

Measure ID	Description	Probable Environmental Benefits Test	Utility Test	TRC w capacity, no Admin
C&I L1	T-8 2ft 1 lamp	[redacted]	[redacted]	[redacted]
C&I L2	T-8 2ft 2 lamp	[redacted]	[redacted]	[redacted]
C&I L3	T-8 2ft 3 lamp	[redacted]	[redacted]	[redacted]
C&I L4	T-8 2ft 4 lamp	[redacted]	[redacted]	[redacted]
C&I L5	T-8 3ft 1 lamp	[redacted]	[redacted]	[redacted]
C&I L6	T-8 3ft 2 lamp	[redacted]	[redacted]	[redacted]
C&I L7	T-8 3ft 3 lamp	[redacted]	[redacted]	[redacted]
C&I L8	T-8 3ft 4 lamp	[redacted]	[redacted]	[redacted]
C&I L9	T-8 4ft 1 lamp	[redacted]	[redacted]	[redacted]
C&I L10	T-8 4ft 2 lamp	[redacted]	[redacted]	[redacted]
C&I L11	T-8 4ft 3 lamp	[redacted]	[redacted]	[redacted]
C&I L12	T-8 4ft 4 lamp	[redacted]	[redacted]	[redacted]
C&I L13	T-8 8ft 1 lamp	[redacted]	[redacted]	[redacted]
C&I L14	T-8 8ft 2 lamp	[redacted]	[redacted]	[redacted]
C&I L15	T-8 HO 8 ft 1 Lamp	[redacted]	[redacted]	[redacted]
C&I L16	T-8 HO 8 ft 2 Lamp	[redacted]	[redacted]	[redacted]
C&I L17	Low Watt T8 lamps	[redacted]	[redacted]	[redacted]
C&I L18	1 Lamp T-5 with Elec Ballast replacing T-12	[redacted]	[redacted]	[redacted]
C&I L19	2 Lamp T-5 replacing T-12	[redacted]	[redacted]	[redacted]
C&I L20	3 Lamp T-5 replacing T-12	[redacted]	[redacted]	[redacted]
C&I L21	4 Lamp T-5 replacing T-12	[redacted]	[redacted]	[redacted]
C&I L22	1 Lamp T-5 HO with Elec Ballast replacing T-12	[redacted]	[redacted]	[redacted]
C&I L23	2 Lamp T-5HO replacing T-12	[redacted]	[redacted]	[redacted]
C&I L26	3 Lamp T-5HO replacing T-12	[redacted]	[redacted]	[redacted]
C&I L27	4 Lamp T-5HO replacing T-12	[redacted]	[redacted]	[redacted]
C&I L31	High Bay 3L T5HO	[redacted]	[redacted]	[redacted]
C&I L32	High Bay 4LT5HO	[redacted]	[redacted]	[redacted]
C&I L33	High Bay 6L T5HO	[redacted]	[redacted]	[redacted]
C&I L34	High Bay 6L T5HO - Double fixture replace 1000W HID	[redacted]	[redacted]	[redacted]
C&I L35	High Bay Fluorescent 4LF32T8	[redacted]	[redacted]	[redacted]
C&I L36	High Bay Fluorescent 6LF32T8	[redacted]	[redacted]	[redacted]
C&I L37	High Bay Fluorescent 8LF32T8	[redacted]	[redacted]	[redacted]
C&I L38	High Bay Fluorescent 8LF32T8 - Double fixture replace 1000W HID	[redacted]	[redacted]	[redacted]
C&I L39	42W 8 Lamp Hi Bay CFL	[redacted]	[redacted]	[redacted]
C&I L40	Pulse Start Metal Halide -retrofit only	[redacted]	[redacted]	[redacted]
C&I L43	CFL Fixture	[redacted]	[redacted]	[redacted]
C&I L44	CFL Screw in	[redacted]	[redacted]	[redacted]
C&I L45	LED Exit Signs Electronic Fixtures (Retrofit Only)	[redacted]	[redacted]	[redacted]
C&I L46	Occupancy Sensors under 500 W	[redacted]	[redacted]	[redacted]
C&I L46	Occupancy Sensors over 500 W	[redacted]	[redacted]	[redacted]
C&I L47	LED Auto Traffic Signals	[redacted]	[redacted]	[redacted]
C&I L47	LED Pedestrian Signals	[redacted]	[redacted]	[redacted]
C&I L48	Light Tube	[redacted]	[redacted]	[redacted]
C&I L49	Central Lighting Control	[redacted]	[redacted]	[redacted]
C&I L50	Switching Controls for Multilevel Lighting	[redacted]	[redacted]	[redacted]
C&I L51	Daylight Sensor controls	[redacted]	[redacted]	[redacted]

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Table 63 provides the results of other measures screening.

Table 63: C&I Other Measures Screening Results

Measure ID	Description	Probable Environmental Benefits Test	Utility Test	TRC w capacity, no Admin
C&I Process 1	Barrel Wraps - Inj Mold & Extruders	[redacted]	[redacted]	[redacted]
C&I Process 1	Pellet Dryer Tanks & Ducts 3 dia	[redacted]	[redacted]	[redacted]
C&I Process 2	Pellet Dryer Tanks & Ducts 4 dia	[redacted]	[redacted]	[redacted]
C&I Process 3	Pellet Dryer Tanks & Ducts 5 dia	[redacted]	[redacted]	[redacted]
C&I Process 4	Pellet Dryer Tanks & Ducts 6 dia	[redacted]	[redacted]	[redacted]
C&I Process 5	Pellet Dryer Tanks & Ducts 8 dia	[redacted]	[redacted]	[redacted]
C&I Process 6	Engineered Nozzles - COMPRESS AIR	[redacted]	[redacted]	[redacted]
C&I Refrig 1	Vending Equipment Controller	[redacted]	[redacted]	[redacted]
C&I Refrig 2	Anti Sweat Heater Controls	[redacted]	[redacted]	[redacted]
C&I Refrig 3	Efficient Refrigeration Condensor	[redacted]	[redacted]	[redacted]
C&I Refrig 4	Night covers for displays	[redacted]	[redacted]	[redacted]
C&I Refrig 5	Head Pressure Control	[redacted]	[redacted]	[redacted]
C&I Refrig 6	ENERGY STAR Commercial Solid Door Refrigerators less than20ft3	[redacted]	[redacted]	[redacted]
C&I Refrig 7	ENERGY STAR Commercial Solid Door Refrigerators 20-48 ft3	[redacted]	[redacted]	[redacted]
C&I Refrig 8	ENERGY STAR Commercial Solid Door Refrigerators more than 48ft3	[redacted]	[redacted]	[redacted]
C&I Refrig 9	ENERGY STAR Commercial Solid Door Freezers less than 20ft3	[redacted]	[redacted]	[redacted]
C&I Refrig 10	ENERGY STAR Commercial Solid Door Freezers 20-48 ft3	[redacted]	[redacted]	[redacted]
C&I Refrig 11	ENERGY STAR Commercial Solid Door Freezers more than 48ft3	[redacted]	[redacted]	[redacted]
C&I Refrig 12	Energy Efficient Ice Machines less than500 lbs	[redacted]	[redacted]	[redacted]
C&I Refrig 13	Energy Efficient Ice Machines 500-1000 lbs	[redacted]	[redacted]	[redacted]
C&I Refrig 14	Energy Efficient Ice Machines more than 1000 lbs	[redacted]	[redacted]	[redacted]
CI Motive Power 1	Motors 1-5 HP - Incentives per HP	[redacted]	[redacted]	[redacted]
CI Motive Power 2	Motors 7.5-20 HP - Incentives per HP	[redacted]	[redacted]	[redacted]
CI Motive Power 3	Motors 25-100 HP - Incentives per HP	[redacted]	[redacted]	[redacted]
CI Motive Power 4	Motors 125-250 HP - Incentives per HP	[redacted]	[redacted]	[redacted]
CI Motive Power 5	Pumps HP 1.5	[redacted]	[redacted]	[redacted]
CI Motive Power 6	Pumps HP 2	[redacted]	[redacted]	[redacted]
CI Motive Power 7	Pumps HP 3	[redacted]	[redacted]	[redacted]
CI Motive Power 8	Pumps HP 5	[redacted]	[redacted]	[redacted]
CI Motive Power 9	Pumps HP 7.5	[redacted]	[redacted]	[redacted]
CI Motive Power 10	Pumps HP 10	[redacted]	[redacted]	[redacted]
CI Motive Power 11	Pumps HP 15	[redacted]	[redacted]	[redacted]
CI Motive Power 12	Pumps HP 20	[redacted]	[redacted]	[redacted]
CI Motive Power 13	VFD HP 1.5	[redacted]	[redacted]	[redacted]
CI Motive Power 14	VFD HP 2	[redacted]	[redacted]	[redacted]
CI Motive Power 15	VFD HP 3	[redacted]	[redacted]	[redacted]
CI Motive Power 16	VFD HP 5	[redacted]	[redacted]	[redacted]
CI Motive Power 17	VFD HP 7.5	[redacted]	[redacted]	[redacted]
CI Motive Power 18	VFD HP 10	[redacted]	[redacted]	[redacted]
CI Motive Power 19	VFD HP 15	[redacted]	[redacted]	[redacted]
CI Motive Power 20	VFD HP 20	[redacted]	[redacted]	[redacted]
CI Motive Power 21	VFD HP 25	[redacted]	[redacted]	[redacted]
CI Motive Power 22	VFD HP 30	[redacted]	[redacted]	[redacted]
CI Motive Power 23	VFD HP 40	[redacted]	[redacted]	[redacted]
CI Motive Power 24	VFD HP 50	[redacted]	[redacted]	[redacted]
Custom1	Custom_RF_PNew Construction Level 1	[redacted]	[redacted]	[redacted]
Custom2	Custom_RFP_New Construction Level 2	[redacted]	[redacted]	[redacted]
Custom3	Custom_RFP_New Construction Mid Level	[redacted]	[redacted]	[redacted]
Other1	Commercial Clothes Washers - Washer Only	[redacted]	[redacted]	[redacted]
Other2	Plug Load Occupancy Sensors Document Stations	[redacted]	[redacted]	[redacted]
Other3	80Plus NC_Desktop Unit	[redacted]	[redacted]	[redacted]
Other4	80Plus NC_Server Unit	[redacted]	[redacted]	[redacted]
Other5	CompPowerMgr	[redacted]	[redacted]	[redacted]

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Measure ID	Description	Probable Environmental Benefits Test	Utility Test	TRC w capacity, no Admin
Ice Bear Thermal Energy Storage	Ice Energy 5 Ton System	[redacted]		

HC

SECTION 4: END-USE MEASURE TECHNICAL POTENTIAL

(4) The utility shall estimate the technical potential of each end-use measure that passes the screening test.

Residential measures

RLW Analytics, Inc. conducted two residential studies which estimated the technical potential the residential end-use measures R1 through R31 for the State of Missouri and Kansas City, MO. The first study, "2006 Missouri Statewide Residential Lighting and Appliance Efficiency Saturation Study, Final report", (RLW MO Statewide study) dated September 15, 2006, was prepared by RLW. Sampling for GMO single-family residences was included in this study.

RLW conducted a second study "2007 Kansas City Power & Light Single-Family residential Potential Analysis", (RLW KCP&L study) that was published on March 13, 2007.

RLW prepared an MS-Excel spreadsheet model that was used to estimate GMO technical potential for both studies. This model was used to estimate the technical potential for GMO residential measures R1 through R31 based upon the size of the GMO single-family residential population. The technical potential is listed in Table 64 below.

Morgan Marketing Partners estimated the technical potential for the additional residential end-use measures R32-R42, A technical assessment of the energy and demand saving reductions of these end-use measures can also be found in Table 64 below.

Table 64: Technical Potential Of Residential End-Use Measures

		GMO Energy Savings Measure				Diff. Costs		Technical Potential	Raw Economic Potential	Market Barrier	Annual Market Capture	Yearly Realizable Potential	Potential Installs Per Year	Demand Technical Potential	Demand Economic Potential	Demand Market Potential	Electric Technical Potential	Electric Economic Potential	Electric Market Potential
Pri	ID	Potential Situation	Improvement	Quantity	Total kWh	Before Rebate	After Rebate	%	%	Factor	%	%	Count	MW-S	MW-S	MW-S	MWh	MWh	MWh
1	27	No programmable thermostat	Install programmable thermostat	1 each	666	$200	$100	60 0%	60 0%	1	8 57%	5 14%	9 747	-24 9	-24 9	-2.1	75 760	75,760	6 491
2	22	No Compact Fluorescent Lamps	Use 10 more CFLs throughout house	10 CFLs	543	$80	$40	60 0%	60 0%	2	9 47%	5 68%	10,776	5 9	5 9	0 6	61 808	61,808	5,855
3	24	Refrigerator early retirement	Removed unit uses no energy	1 each	954	$50	$25	47.0%	18 8%	3	8 50%	1 60%	3,030	10 4	4 2	0 4	84,970	33 988	2,891
4	16	House infiltration = 0 8 ACH	Reduce infiltration to 0 35 ACH	2077 SF	1046	$400	$200	25 0%	25 0%	1	4 29%	1.07%	2,033	20 2	20 2	0 9	49,585	49 585	2,126
5	29	No low flow shower heads	Install low fow shower heads	2 each	174	$20	$10	60 0%	60 0%	3	10.00%	6.00%	11,376	0 0	0 0	0 0	19 787	19 787	1,979
6	4	Low evaporator airflow B	Increase blower speed	2 hours	807	$100	$50	13 4%	13 4%	2	7.56%	1.02%	1,927	17.0	17.0	1.3	20,564	20 564	1 555
7	1	AC Refrigerant under charged	Add refrigerant	2 hr & 2 Lb R-22	689	$250	$125	36 0%	36 0%	2	3 08%	1.11%	2,102	12 5	12.5	0 4	47,017	47,017	1,448
8	32	Gas water heater not wrapped	Wrap gas water heater	1 each	118	$60	$30	81 0%	72 9%	3	7.10%	5.18%	9 817	0.0	0 0	0 0	18 122	16,310	1.158
9	3	Low evaporator airflow A	Increase duct sizes or add new ducts	75 SF	981	$950	$475	70 0%	70 0%	2	0 88%	0 62%	1.170	108 6	108 6	1 0	130 175	130.175	1,147
10	30	Hot water pipes not insulated	Insulate hot water pipes	1 each	80	$95	$48	85 0%	85 0%	2	8 02%	6 82%	12,922	0 0	0 0	0 0	12,904	12 904	1,035
11	5	High duct leakage (25%)	Reduce duct leakage to 5%	3 41 tons	606	$600	$300	58 0%	58 0%	2	1 32%	0 77%	1,455	49 9	49 9	0.7	66,687	66 687	883
12	19	Standard double pane windows	Install Low E double pane window 2904	240 SF	520	$357	$179	76 2%	21.9%	2	2.34%	0.51%	970	37.7	10 8	0 3	75,128	21 569	504
13	2	AC Refrigerant over charged	Remove refrigerant	2 hours	176	$100	$50	30 5%	30.5%	3	4 30%	1.31%	2,487	6 7	6.7	0.3	10,196	10.196	438
14	21	No E & W window shading B	Plant deciduous trees on E & W sides	6 each	627	$900	$450	90 0%	65 7%	2	1 07%	0 70%	1,330	15 2	11.1	0.1	53,533	39,079	417
15	28	No faucet aerators	Install faucet aerators	1 each	31	$8	$4	63 0%	63 0%	3	10 00%	6 30%	11,945	0 0	0 0	0 0	3,740	3 740	374
16	25	Dishwasher to be replaced	Purchase Energy Star dishwasher	1 each	107	$150	$75	46 0%	14 6%	1	10 00%	1.46%	2 773	1 0	0 3	0 0	9 373	2 981	298
17	12	Attic insulation = R-7	Add another R-23 attic insulation	1344 SF	879	$1,058	$529	100 0%	8 1%	1	1 79%	0.15%	276	102.9	8 3	0 1	166 742	13 506	242
18	7	Oversized AC units B	Size AC units to 100% of Manual J	3 09 tons	1046	$210	$105	80 0%	5 6%	3	2 05%	0 11%	217	126 2	8.8	0 2	158 692	11,108	227
19	20	No E & W window shading A	Add solar screens to E & W glass	86 SF	172	$258	$129	100 0%	73 2%	3	1.76%	1.30%	2,473	20 5	15 0	0 3	16 260	11,903	212
20	26	Clothes washer to be replaced	Purchase Energy Star clothes washer	1 each	110	$400	$200	47.1%	19 4%	1	4 88%	0 95%	1 796	1 5	0 6	0 0	9 863	4 063	198
21	14	Exposed walls not insulated	Add R-11 wall insulation	1355 SF	2634	$3 500	$1,750	14 0%	14 0%	2	0.29%	0 04%	77	18 4	18 4	0.1	69,903	69 903	202
22	31	Electric water heater not wrapped	Wrap electric water heater	1 each	58	$25	$13	17.1%	17.1%	1	10 00%	1.71%	3,242	0 2	0 2	0.0	1,881	1,881	188
23	23	Refrigerator needs to be replaced	Purchase Energy Star refrigerator	1 each	152	$200	$100	53.4%	5 8%	1	9 05%	0 53%	998	1 9	0 2	0 0	15 354	1 674	151
24	13	Attic insulation = R-11	Add another R-19 attic insulation	1344 SF	541	$809	$405	6.3%	6 3%	1	2.34%	0 15%	279	4 1	4 1	0 1	6 466	6 466	151
25	18	Single pane windows B	Install Low E double pane window 2904	240 SF	1428	$350	$175	6.0%	1.7%	2	2 18%	0 04%	71	6 1	1 8	0 0	16,245	4,679	102
26	9	Gas heat and 13 SEER AC	Install AC SEER = 16	3 41 tons	921	$840	$420	77.0%	5 4%	2	1 04%	0.06%	107	-16 1	-1.1	0.0	134 458	9 412	98
27	8	One inch insul. on ducts in attic	Add two more inches of insulation	3 41 tons	242	$600	$300	49 5%	14 9%	2	1.37%	0 20%	386	22 7	6 8	0 1	22.704	6,811	93
28	17	Single pane windows A	Add storm windows	240 SF	908	$1,020	$510	6.0%	4 3%	2	0 80%	0 03%	64	3 2	2 3	0 0	10 330	7,334	58
29	6	Oversized AC units A	Size AC units to 100% of Manual J	3 09 tons	333	$314	$157	80 0%	4 0%	3	1 44%	0 06%	109	40 8	2 0	0.0	50 528	2,526	36
30	11	Home has electric strip heat	Install Heat Pump SEER = 16	2 65 tons	4061	$4 800	$2,400	11.3%	0 8%	2	0 35%	0 00%	5	-10 3	-0 7	0 0	87,008	6 091	21
31	10	Home has 13 SEER heat pump	Install Heat Pump SEER = 16	3 78 tons	1258	$750	$375	9 0%	0.6%	2	1.10%	0 01%	13	-8 9	-0 6	0 0	21.570	1 510	17
32	15	Floor over basement not insulated	Add R-19 Insulation to floor	614 SF	-223	$393	$197	66 4%	33 2%	2	2.19%	0.73%	1.379	-14 8	-7 4	-0 2	(28,081)	(14,041)	-308
		Sums and Average, All Measures											97,353	559	281	4 4	1,499 273	756,978	30 291
		Sums and Average, Top 20											90,621	511	255	4 3	1,090,907	652,731	29 480
		Top 20 Percent of All											93 1%			95 9%			97.3%

Residential Central Air-Conditioning System, replacement upon failure
Measure IDs: R39, R40, & R41

Technology Description

Residential central air-conditioning systems were evaluated for the replacement of a failed system with a unit having a Seasonal Energy Efficiency Rating (SEER) above 13.

Methodology and Assumptions

A spreadsheet calculation was performed using an minimum required SEER rating of 13 for a new unit with the SEER rating for the more efficient units. SEER ratings were converted to equivalent Energy Efficiency Ratings (EER95) Savings at 12,000 BTU per Ton. Full load cooling hours assumed was based on information from ARI Unitary Directory, August 1, 1992 - January 31, 1993 for Kansas City, MO.

Key assumptions:

Full load cooling hours = 1,050 hours/year

Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

Estimated Energy Savings – kWh

Install AC SEER = 14 vs 13 SEER: 238 kWh per unit

Install AC SEER = 15 vs 13 SEER: 445 kWh per unit

Install AC SEER = 16 vs 13 SEER: 625 kWh per unit

Summer Peak Savings

Install AC SEER = 14 vs 13 SEER: 0.22 kW per unit

Install AC SEER = 15 vs 13 SEER: 0.42 kW per unit

Install AC SEER = 16 vs 13 SEER: 0.59 kW per unit

Measure Life

Residential central air conditioners have an average lifetime of 18 years.

Initial One-Time Cost

Estimates of the incremental cost of a system with a SEER above 13 versus the cost of a SEER 13 system. This incremental costs are :

Install AC SEER = 14 vs 13 SEER: $ 200 per unit

Install AC SEER = 15 vs 13 SEER: $ 900 per unit

Install AC SEER = 16 vs 13 SEER: $1,200 per unit

Technical Potential: 77%

Residential Central Air-Conditioning System, early retirement
Measure IDs: R33, R34, & R35

Technology Description

Residential central air-conditioning systems were evaluated for the early retirement of an operating system with a unit having a Seasonal Energy Efficiency Rating (SEER) above 13 SEER.

Methodology and Assumptions

A spreadsheet calculation was performed using an assumed average SEER rating of 9 for the existing system versus a new replacement unit with a SEER rating above 13.. SEER ratings were converted to equivalent Energy Efficiency Ratings (EER95) Savings at 12,000 BTU per Ton. Full load cooling hours assumed was based on information from ARI Unitary Directory, August 1, 1992 - January 31, 1993 for Kansas City, MO.

Key assumptions:

Full load cooling hours = 1,050 hours/year

Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

Estimated Energy Savings – kWh

Install AC SEER = 14 vs 9 SEER: 3,331 kWh per unit

Install AC SEER = 15 vs 9 SEER: 3,331 kWh per unit

Install AC SEER = 16 vs 9 SEER: 3,484 kWh per unit

Summer Peak Savings

Install AC SEER = 14 vs 9 SEER: 2.29 kW per unit

Install AC SEER = 15 vs 9 SEER: 2.29 kW per unit

Install AC SEER = 16 vs 9 SEER: 2.41 kW per unit

Measure Life

For this case it was assumed that the replacement central air conditioner had an weighted average lifetime of 9.14 years. NOTE: It was assumed that the existing the existing equipment had a remaining available lifetime of 9 years and that a 13 SEER unit be required upon failure in 9 years.

Initial One-Time Cost

Estimates of the incremental cost of a system with a SEER above 13 versus the cost of a SEER 13 system. This incremental costs are :

Install AC SEER = 14 vs 13 SEER: $ 200 per unit

Install AC SEER = 15 vs 13 SEER: $ 900 per unit

Install AC SEER = 16 vs 13 SEER: $1,200 per unit

Residential Central Air-Conditioning System, recommissioning of unit
Various Measure IDs: R2, R3

Technology Description

Residential central air-conditioning systems were evaluated for the recommissioning of an operating system.

Methodology and Assumptions

A spreadsheet calculation was performed using an assumed nameplate SEER rating of 8.5 versus system operating with a degraded SEER rating below 7.

Key assumptions:

Full load cooling hours = 1,050 hours/year

Cost estimates include material costs only. Installation costs and potential maintenance savings are not included.

Estimated Energy Savings – kWh

937 kWh per unit

Summer Peak Savings

0.27 kW per unit

Measure Life

For this case it was assumed that the re-commissioned central air conditioner had an expected lifetime of 10 years.

Initial One-Time Cost

Estimates of the system re-commissioning cost were $135 per unit.

Technical Potential 31% (R1) & 36% (R2)

Commercial and Industrial technical potential was estimated using a spreadsheet model that was developed by Summit Blue Consulting for the C&I market sector.

A reference data base of electric energy usage by customer class was created with GMO specific data. This included information on the C&I market by market segment as summarized in .

Industrial Sector

The majority of the GMO industrial sector is in the category of light manufacturing. Thus their end-use profile is more like that of commercial customers, particularly warehouses and offices, than heavy manufacturing. Specific measure types are difficult to define for the diverse manufacturing segments and the Summit Blue model limited the measure to generic motors and variable frequency drive controls, high-bay lighting, and broadly defined 'custom measures.

In order to estimate the savings for climate-dependent or interactive measures Energy Insights created basic building simulation models using eQUEST v. 3.6. Three models were developed as proxies for the Commercial segment: large office building, small office building and education. Together these three segments represent more than 40% of the GWH sold in the commercial sector.

Large Office

The baseline simulation for the large office segment was prepared by Energy Insights based on market profile data they have compiled for the distribution of energy use among end-uses at a typical commercial office building. The baseline large office building simulation has the following attributes:

Kansas City weather data is used.

Gross building area is about 250,000 ft^2.

Square footprint; approximately 176 feet on each side; 8 stories and about 31,250 ft^2 per floor.

4000 annual hours of operation.

Windows are double-pane clear on the north side and tinted on the East, South, and West.

Lighting systems average efficiency, 1.4 W/ ft^2 lighting power density. This LPD falls between standard T8 and T12 systems for office uses.

Cooling is provided by a pair of equal-sized centrifugal water cooled chillers – 0.67 kW/ton.

Chilled and condenser water are pumped by single speed pumps.

The cooling tower is open-loop with an induced-draft configuration.

The heating plant is modeled either as an electric boiler or natural gas fired boiler in order to capture the different interactive electric effects of lighting retrofits.

Air distribution is variable air volume, modulated with dampers

Air-side economizers are used.

These attributes and others such as load profiles, schedules and system setpoints are largely based on default settings in eQuest. Energy Insights calibrated the simulation against their end-use distribution.

Small Office

The baseline simulation for the small office segment was prepared by Energy Insights based on market profile data they have compiled for the distribution of energy use among end-uses at a typical small commercial office building. The baseline small office building simulation has the following attributes:

Kansas City weather data is used.

Gross building area is about 25,000 ft^2.

Square footprint; approximately 110 feet on each side; 2 stories and about 12,500 ft^2 per floor.

3500 annual hours of operation

Windows are double-pane clear on the north side and tinted on the East, South, and West.

Lighting systems average 1.2 W/ ft^2 lighting power density. This LPD is slightly higher than typical T8 systems for office uses.

Packaged split-system air-cooled direct-expansion coolers (9.5 EER) provide air-conditioning.

The heating plant is modeled either as an electric boiler or natural gas fired boiler in order to capture the different interactive electric effects of lighting retrofits.

Air distribution is single-zone, constant volume

Air-side economizers are used.

These attributes and others such as load profiles, schedules and system setpoints are largely based on default settings in eQuest. Energy Insights calibrated the simulation against their end-use distribution.

Education

The baseline simulation for the education segment was prepared by Energy Insights based on market profile data they have compiled for the distribution of energy use among end-uses at a typical Education segment building. The baseline building simulation has the following attributes:

Kansas City weather data is used.

Gross building area is about 150,000 ft2.

An H-shaped footprint; 2 stories and 75,000 ft2 per floor.

3050 annual hours of operation.

Windows are double-pane clear on the north side and tinted on the East, South, and West.

Lighting systems average 1.6 W/ ft2 lighting power density. This LPD is slightly higher than typical T8 systems for education uses.

Packaged split-system air-cooled direct-expansion coolers (10.0 EER) provide air-conditioning.

The heating plant is modeled either as an electric boiler or natural gas fired boiler in order to capture the different interactive electric effects of lighting retrofits.

Air distribution is single-zone, constant volume

Air-side economizers are used.

These attributes and others such as load profiles, schedules and system set points are largely based on default settings in eQuest. Energy Insights calibrated the simulation against their end-use distribution.

Summit Blue modified each of the baseline models to simulate various energy efficiency measures (EEMs). If the baseline simulation parameters did not match the measure baseline, Summit Blue modified the baseline twice for the measure –first to estimate energy use from the *in*-efficient technology and the second time to model the efficient technology. For example, if general lighting in the baseline model is 1.5 W/ft^2; typical T12 systems are about 1.8 W/ft^2 and T8 systems with the same illumination require about 1.2W/ft^2. Summit Blue modified the baseline to reflect 1.8 W/ft^2 and then again to reflect 1.2 W/ft^2, and the measure savings is the difference between the model results.

The total and annual residential achievable DSM potential results for the first 10 years are shown in Table 65 below. The energy values shown below are for the DSM measures' first-year generator energy savings, the demand savings are the peak coincident demand savings, and the program costs are the total estimated DSM program budgets for a given year, including rebate or other customer incentive costs, as well as administrative, implementation, and evaluation costs.

The total estimated commercial and industrial energy efficiency potential over the 20 year forecast period is about 1,100 GWh and 297 peak MW. Approximately half of this energy efficiency potential is projected to come from energy efficient lighting products, about 19% is projected to come from energy efficient HVAC equipment and controls, and about 23% of the total potential is expected to come from custom and motors measures. The total C&I energy efficiency potential amounts to approximately 16% of GMO's forecast 2029 C&I energy consumption of about 6,790 GWh. This is equal to annual average energy savings of about 55 GWh, or 1.2% of GMO's's forecast 2010 C&I sales.

The total C&I energy efficiency program costs over the 20 year forecast period are estimated at about ** [redacted] **, or about ** [redacted] ** per year on average.

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Table 65: C&I Potential Results

Commercial	[redacted]
Lighting	
Achievable Potential Demand Savings (kW)	
Achievable Potential Energy Savings (kWh)	
Measure Costs	
Program Costs	
HVAC	
Achievable Potential Demand Savings (kW)	
Achievable Potential Energy Savings (kWh)	
Measure Costs	
Program Costs	
Refrigeration	
Achievable Potential Demand Savings (kW)	
Achievable Potential Energy Savings (kWh)	
Measure Costs	
Program Costs	
Water Heating	
Achievable Potential Demand Savings (kW)	
Achievable Potential Energy Savings (kWh)	
Measure Costs	
Program Costs	
Custom	
Achievable Potential Demand Savings (kW)	
Achievable Potential Energy Savings (kWh)	
Measure Costs	
Program Costs	
Total	
Achievable Potential Demand Savings (kW)	
Achievable Potential Energy Savings (kWh)	
Measure Costs	
Program Costs	

HC

Table 66: GMO Energy Sales, 12 months ending 04/09

Segment	Sub-Segment	12 Month usage, kWh
Education	Colleges	75,775,027
Education	Schools	283,130,219
Large Office	Large Office	9,490,729
Manufacturing	Apparel	5,587,122
Manufacturing	Beverage & Tobacco Products	5,139,118
Manufacturing	Chemicals	248,177,813
Manufacturing	Computer & Electronic Products	125,772,121
Manufacturing	Elec. Equip., Appliances, & Components	5,599,493
Manufacturing	Fabricated Metal Products	309,909,203
Manufacturing	Food	173,657,046
Manufacturing	Furniture & Related Products	2,292,437
Manufacturing	Leather & Allied Products	3,332,136
Manufacturing	Machinery	36,552,450
Manufacturing	Nonmetallic Mineral Products	41,768,517
Manufacturing	Paper	18,647,188
Manufacturing	Plastics & Rubber Products	129,511,176
Manufacturing	Primary Metals	10,689,039
Manufacturing	Printing & Related Support	57,380,645
Manufacturing	Textile Product Mills	714,490
Manufacturing	Transportation Equipment	3,597,579
Manufacturing	Wood Products	13,706,493
Small Office	Small Office	259,051,551
Other	Data Center	47,729,147
Other	Farming	65,983,691
Other	Grocery	115,550,035
Other	Heavy Construction	9,887,954
Other	Hospital	3,247,992
Other	Hospitals	119,772,875
Other	Lodging	66,674,433
Other	Mining	6,640,289
Other	Nursing Homes	73,850,694
Other	Oil & Gas Extraction	124,700
Other	Petroleum & Coal Products	202,556
Other	Pipeline	24,208,023
Other	Power Distribution	96,734
Other	Power Generation	25,780,452
Other	Public Assembly	86,090,306
Other	Ref Warehouse	16,031,688
Other	Residential Housing Construction	67,452,258
Other	Restaurant	109,825,700
Other	Retail	396,104,873
Other	Services	226,576,619
Other	Transportation	28,489,946
Other	Warehouse	99,525,872
Other	Waste Treatment	2,660,406
Other	Water Supply	39,117,931
Other	**Total Miscellaneous, or Unclassified**	**879,452,719**
	Totals	**4,330,559,485**

SECTION 5: MARKET RESEARCH ACTIVITIES

(5) The utility shall conduct market research studies, customer surveys, pilot demand-side programs, test marketing programs and other activities as necessary to estimate the technical potential of end-use measures and to develop the information necessary to design and implement cost-effective demand-side programs. These research activities shall be designed to provide a solid foundation of information about how and by whom energy-related decisions are made and about the most appropriate and cost-effective methods of influencing these decisions in favor of greater long-run energy efficiency.

5.1 JD POWER CUSTOMER SATISIFACTION (RESIDENTIAL / BUSINESS)

Established in 1968, J.D. Power and Associates is a global marketing information company that conducts independent and unbiased surveys of customer satisfaction, product quality and buyer behavior. J.D. Power and Associates is best known for its work in the automotive industry. However, in recent years, the company has expanded to serve a number of other industries, including telecommunications, travel and hotels, marine, utilities, healthcare, homebuilder, consumer electronics and financial services.

The electric utility study measures customer satisfaction by examining six key factors: power quality and reliability; price; billing and payment; corporate citizenship; communications; and customer service. The study ranks large and midsize utility companies in four geographic regions: East, Midwest, South and West. Companies in the midsize utility segments serve between 125,000 and 499,999 residential customers, while companies in the large utility segment serve 500,000 or more residential customers. The 2009 Electric Residential Customer Satisfaction Study is being conducted from July 2008 to May 2009 in four waves, with the final report scheduled for release on July 16, 2009. Both GMO and KCP&L customers were included in the survey sample.

KCP&L and GMO utilize the JD Power studies to measure customer satisfaction and has established indicators to measure success. There are several benefits to participating utilities in the JD Power studies including the following:

- Access to the data quarterly (Residential) and biannual (Business) for internal company use
- Full report with benchmarking data on all utilities
- Annual presentations from JD Power representative to discuss findings
- Increased sample sizes for participating utilities
- Network of contacts throughout participating utilities

5.2 COMMUNICATIONS TRACKING (JD POWER)

In 2009, KCP&L and GMO communications are being tracked within the JD Power study. Customers are asked the number of communications recalled and the main topic of the communication. In addition, they rate the company on key measures such as keeping you informed, usefulness of suggestions, getting your attention, how to be safe and communicating changes that impact customers. Results are tracked and reported each quarter of the year.

If and when advertising budgets approved in the future, GMO will most likely implement additional research to measure specific advertising awareness, message recall, and effectiveness.

5.3 ACCOUNTLINK

AccountLink is a free, account management tool designed to allow customers to view and pay their bills online, look up and track payments, view daily energy usage, historical energy usage and generally manage their relationship with GMO in a self-service environment.

At the time of the acquisition, KCP&L and GMO (formerly Aquila) had separate online account access sites. KCP&L's version was called "AccountLink." Although, GMO's version did not have an external facing name, internally it was referred to as "Account Inquiry." In late 2008, a team began a project to bring the presentation and functionality of the two systems closer. This project would create a single presentation tool under the AccountLink name to be available to all KCP&L\ GMO residential and small commercial customers. This upgrade was completed and went live for GMO customers in May of 2009.

Prior to launching AccountLink in the GMO territory Account Inquiry users were surveyed to establish a base read of customer satisfaction to compare against post launch. Future surveys will be conducted to track success and customer satisfaction over time.

5.4 CUSTOMER SOLUTIONS

GMO will be conducting a survey to measure customer satisfaction with Tier 1 and Tier 2A business customers in order to develop account management plans and improve performance. Objectives of this research include the following.

- Collect and report as indicator
- Use general research findings to apply across all business customers

GMO is looking at other cost effective research solutions to measure customer satisfaction of assigned accounts. One future option that the company has identified is the TQS study referenced below that would provide actionable results in addition benchmarking data.

5.5 TQS RESEARCH, INC.

TQS Research (TQS) of Atlanta, Georgia specializes in business-to-business research among the largest energy users in the United States and Canada. TQS has been an affiliate member of the Electricity Consumers Resource Council (ELCON) since 1996.

TQS has conducted a national study of large energy users in the manufacturing segments and some large hospitals and universities. This study provides benchmarking measures across approx. 60 utilities in the United States. The TQS report includes trends, key drivers of customer satisfaction and individual score cards for most of the participating companies. There is also an option to oversample companies who have assigned account representatives for an additional cost.

5.6 PRODUCT AND SERVICES AWARENESS / INTEREST

Product and service saturation is highly dependent on two key factors of awareness and interest. If customer awareness is low and interest is high, the product has typically not reached saturation. However, if awareness is high and interest is low, you might not want to spend a lot of money marketing the product.

GMO has utilized several different channels of marketing including direct mail, bill inserts, tele-marketing, media, and local events. They have estimated customer awareness and interest based on available information but do not truly know by product. GMO is planning on conducting a research study designed to capture customer awareness of products and services along with interest levels based on the program description. The objective of this research will be to better understand the saturation levels of GMO's products and services.

5.7 CONCEPT SCREENING

Starting in 3Q09, GMO will be testing concept ideas of new products / services with customers to gauge their interest earlier in the product development process. Each customer will read a short description of each product / service (approx. 8 concepts) followed by a series of questions to determine interest levels. The study will utilize an online panel of customers who live within GMO service area. The plan is to test a different set of concepts every three to six months as needed.

5.8 ONLINE ENERGY ANALYZER CAMPAIGN

In 2Q09, an email was sent out highlighting KCP&L/GMO's Online Energy Analyzer as part of our efforts to get more customers taking advantage of the program offering. The initial email open rate was very high but the number of customers who completed the online energy audit was much lower. KCP&L/GMO developed a survey to better understand why customers opened the email but did not complete the online energy audit.

The main reasons for customers not completing the Online Energy Analyzer included the following:

- Got interrupted and did not go back (25%)
- Appeared to be too lengthy (22%)
- Required too much information (14%)
- Did not know answers to some of the questions (13%)
- Just got frustrated with it and quit (13%)
- Technical difficulties (3%)

5.9 COOL HOMES

The Cool Homes program offers GMO customers with inefficient home cooling systems an evaluation to determine if their old equipment qualifies for an instant rebate up to $850 towards the purchase of a new high efficiency air conditioner or heat pump rated at SEER 14.0 and above. There is no cost for the initial evaluation.

Participating customers in GMO's Cool Homes program are given the opportunity to provide feedback on their experience with the contractor and their initial evaluation through a survey.

Please share with us your level of satisfaction. Using a scale of "1" to "5" where "1" means "Strongly disagree" and "5" means "Strongly agree," please rate these statements.	**Strongly agree**	**Somewhat agree**	**Neither disagree nor agree**	**Somewhat disagree**	**Strongly disagree**
The information explaining the KCP&L Cool Homes program was helpful.	55.2%	26.0%	10.1%	4.6%	4.0%
The information answered your questions.	55.5%	24.0%	11.3%	4.9%	4.3%
The contractor was professional and courteous	76.0%	13.0%	3.2%	1.2%	6.6%
The overall service I received from the contractor was excellent.	74.0%	13.0%	5.5%	2.0%	5.5%

How would rate the following?	Yes	No
Did the contractor arrive on time?	98.8%	1.2%
Was the contractor's appearance acceptable?	99.7%	0.3%
Did the contractor communicate with you about options for repair or replacement of your equipment?	96.8%	3.2%
Based on your experience with this contractor, would you work with them again?	98.0%	2.0%

5.10 ENERGY OPTIMIZER

GMO's Energy Optimizer participants help control system peak demands during summer months. Each participating customer receives a FREE Honeywell programmable thermostat - a $300 value. On the hottest weekday afternoons from May through September, demands on GMO's system are the highest. At these times, we may either raise your temperature a few degrees, or cycle the air conditioning compressor off and on for 15-minute increments for no more than 4 hours.

In 2009, both participating and non-participating customers of GMO's Energy Optimizer program will be given the opportunity to provide feedback through a survey. These survey results will be used to track performance of the contractor and identify improvement opportunities for the program. Based on voluntary comments and other feedback, customer satisfaction survey results are expected to be high with the contractors and the program itself.

5.11 FOCUS GROUPS

The GMO research plan includes focus groups as need to obtain more in-depth understanding of customer views. Focus groups are used as a qualitative tool to drill down in areas where we need further understanding of why or what customers are thinking. Areas that have been identified at this point include rate case, new products & services, eServices, and communications.

5.12 CUSTOMER UNDERSTANDING (GMO FOCUS)

KCP&L's customer territory has expanded with the acquisition of Aquila (GMO) and the make-up of our customer needs have changed. KCP&L's current customer understanding is based mostly off of research with legacy KCP&L customers. Our GMO knowledge is limited to research studies such as JD Power where we have access to benchmarking data that includes Aquila (GMO). The demographics are different when comparing KCP&L and GMO customers and therefore customer needs and expectations of their electric utility are different. The objective of this research is to determine what those differences are and develop business plans and processes to work towards those customer needs.

5.13 SEGMENTATION

In 2008, KCP&L completed a segmentation study of residential customers (prior to acquisition of Aquila) to help better identify customer needs. After the Customer Understanding research this would be Phase II of the GMO customer focused research. This will help identify the customer needs of GMO and allow us to target customer communications and initiatives.

5.14 CALL CENTER

GMO's call center receives telephone calls from customers needing assistance with something. The company prides itself in providing excellent customer service to these customers. As part of their continuous efforts to improve customer satisfaction a survey was implemented among customers who have recently called GMO. This call center study will capture customer opinions of their experience while calling GMO. This study will provide a supplemental read to the customer service ratings from the JD Power study that has smaller sample sizes due to methodology. The objective of this research is to identify improvement opportunities of processes and customer offerings.

This study just fielded in June 2009 but early results show high satisfaction among customers who have called GMO call center. This is an ongoing study that will be expanded upon as needs change and processes are improved to fully enhance that customer experience.

5.15 WEB RESEARCH

Most of GMO's web research has been done internally through Zoomerang surveys with our online program customers. The eServices group has also done some web usability testing with employees at a no cost alternative. In the future GMO would like to do more research with general customers to identify their needs and design and implement new web program offerings and solutions. Reducing cost by offering more self-serve web solutions is a high priority of the company.

5.16 CHARTWELL

Chartwell is a leading facilitator of knowledge exchange within the utility industry; providing best practices case studies, analysis and networking opportunities through an integrated, trusted and unrivaled approach. Chartwell is another well known and respected source of utility information and reports that leading utilities use throughout the United States. Our membership allows us access to industry reports, white papers, and webinars (2 seats included for webinars), consulting, utility contacts, discounts on all Chartwell conferences. This information is very useful in keeping up with industry updates including technology, program/services, and industry best practices. In addition, membership provides great networking opportunities with other utility employees to discuss various topics of interest to KCP&L and GMO.

5.17 ESOURCE

E Source provides unbiased, independent analysis and exclusive information services for energy service providers, major energy users, and other key players in the retail energy marketplace. We subscribe to their E Business, and Efficiency and Demand Response component offerings. E Source is a well known and respected consulting service that leading utilities use throughout the United States. E Source provides utility reports, consulting, webinars, industry contacts, conferences throughout the year within our subscription of services. GMO does an annual review of the benefits the company received from the membership in addition to an assessment of the company's future needs.

	Project	2009	2010	2011	2012	2013
5.0	**KCP&L Market Research Activities**	**$264,500**	**$242,500**	**$362,500**	**$296,500**	**$301,500**
5.1	JD Power Studies - Residential / Business	$110,000	$110,000	$110,000	$110,000	$110,000
5.2	Communications[1]			$25,000	$25,000	$25,000
5.3	AccountLink					
5.4	Customer Solutions	$12,000				
5.5	TQS		$15,000	$15,000	$15,000	$15,000
5.6	Product & Services Awareness / Interest					
5.7	Concept Screening	$12,000	$12,000	$12,000	$12,000	$12,000
5.8	Online Energy Analyzer Campaign					
5.9	Cool Homes					
5.10	Energy Optimizer					
5.11	Focus Groups[2]	$35,000	$35,000	$35,000	$35,000	$35,000
5.12	Customer Understanding (GMO Focus)	$35,000				
5.13	Segmentation			$85,000		
5.14	Call Center					
5.15	Web Research		$10,000	$20,000	$25,000	$30,000
5.16	Chartwell	$14,500	$14,500	$14,500	$14,500	$14,500
5.17	eSource	$46,000	$46,000	$46,000	$60,000	$60,000

[1] *Assumes moving back to Ad Effectiveness Study in 2011*
[2] *Assumes six focus groups per year*

ELECTRIC POWER RESEARCH INSTITUTE

GMO financially supports research conducted by the Electric Power Research Institute (EPRI). GMO has access to a the EPRI library of energy efficiency and demand response research and data that is available to program participants.

The electric utility industry launched a new initiative in 2007 to investigate, demonstrate, and assess application of efficient end-use technologies and demand response systems. This effort, the EPRI 2007 Energy Efficiency

Initiative, reestablished the electric utility industry as a leader in energy efficiency RD&D. More than 40 utility companies including collaborated to identify cost-effective technology and system options for increasing efficiency and enabling dynamic energy management.

A Key Initiative accomplishment include the creation of a Living Laboratory to test energy efficiency and demand response technologies and their interoperability. Perhaps the single largest achievement has been establishment of a Living Laboratory dedicated to testing the functionality of products necessary to support energy efficiency and demand response in a smart grid environment—as well as in today's system infrastructure. Products ranging from dimmable advanced lighting systems to programmable communicating thermostats to communication and control gateways have been assessed. Through bench tests and through "living" applications at EPRI staff offices, performance results have been documented, with emphasis on items that can lead to field tests and demonstrations—and system interoperability. The laboratory, located at EPRI facilities in Knoxville, Tennessee, has also served as an educational center, providing a venue for technology tours and demonstrations for utility representatives and the public.

Research results are available as a significant collection of reports and data on technology and program potential, including material related to influencing factors such as greenhouse gas emissions and smart grid development. Through EPRI research, the industry has developed information on load growth (which could potentially offset efficiency benefits) and the potential cost/benefit of energy efficiency and demand response. Major converging factors that affect efficiency and load management are addressed, such as greenhouse gas effects and integration with advanced metering infrastructure and smart grid deployment.

More information about the EPRI energy efficiency and demand response program research can be found on their website, www.epri.com.

Additional research planned for 2009 – 2010:

PROJECT: Multi-Family Residential Study - Market Saturation and Potential Analysis

Serving as an extension study to both the 2006 Missouri Statewide Market Assessment and the 2007 KCPL/GMO Single-Family Potential Analysis, the primary objective of this assessment is to evaluate the technical, economic, and market potential for building measures, appliances, and lighting of multi-family buildings from an extrapolation of collected baseline market saturation data throughout KCPL/GMO coverage territory. Extending evaluation goals from the single-family sector to the multi-family sector, this assessment will calculate and present technical, economic, and market potential analyses for energy efficiency opportunities helping target future programs that will have the largest and/or most cost-effective impact on peak demand and energy consumption in the multi-family residential sector. This combination of targeted residential sector assessments should provide KCPL/GMO with valuable information about their residential market as a whole while extending the multi-family analysis to include KCPL's expanded service territory.

Scope of Work

This evaluation will be divided into ten tasks. These tasks include:

Task 1: Conduct a project initiation meeting;

Task 2: Develop a comprehensive sampling plan capable of achieving the agreed upon statistical accuracy levels in conjunction with the study's design goals;

Task 3: Develop and submit a work plan;

Task 4: Develop and submit multi-family residential telephone and on-site data survey collection instruments and recruitment letters;

Task 5: Carry-out initial residential mail and telephone recruitment and surveys;

Task 6: Conduct residential on-site audits recording saturation information and data on currently in-place efficiency measures;

Task 7: Perform data quality control and model number and efficiency matching as applicable;

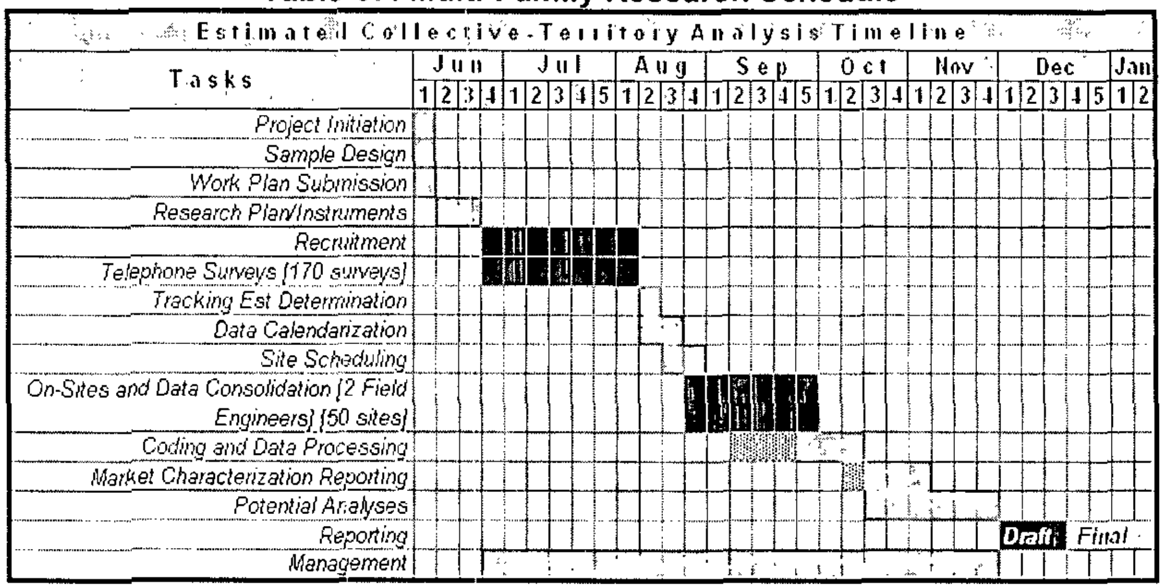
Task 8: Perform technical, economic, and market potential analyses;

Task 9: Deliver draft report; and

Task 10: Deliver final report.

The project schedule for these tasks is shown below in Table 67.

Table 67: Multi-Family Research Schedule



Measure Identification

In the identification of possible measures to target, KCPL/GMO will consider those measures previously identified in the 2007 KCPL Single-Family Potential Analysis as well as the additional measures recently identified by KCPL/GMO for this analysis. Table 68 below reflects the measures to be reviewed. In a few cases, depending upon the measure, proxy data will be used for impact and potential savings estimations (e.g. A/C undercharged/overcharged, A/C oversized, evaporator overflow, and house infiltration). Plug load electronics will be collectively reviewed as one potential measure. Under this measure the following technologies will be reviewed: a) televisions; b) set top boxes (cable or satellite); c) home computers/notebooks; d) printers; e) wireless routers; f) modems; g) compact audio systems; h) home entertainment systems; and i) DVD players. The qualification threshold for each of these measures will be whether or not they meet Energy Star standards.

Table 68 : Multi-Family End-Use Measures

2009 Multi-Family Potential Analysis Measures	
2007 Potential Measures Evaluated	2009 Additional Potential Measures
1 Low evaporator airflow A	27 Split DX A/C recommissioning (tune-up) from 7.1 SEER operating to nameplate 8.5 SEER
2 Low evaporator airflow B	28 A/C refrigerant undercharged
3 High duct leak age (25%)	29 A/C refrigerant overcharged
4 Oversized AC units A	30 Early retirement of a split DX A/C operating at 7.1 SEER to a 14 SEER
5 Oversized AC units B	31 Early retirement of a split DX A/C operating at 7.1 SEER to a 15 SEER
6 One inch insulation on ducts in attic	32 Early retirement of a split DX A/C operating at 7.1 SEER to a 16 SEER
7 Home has 13 SEER heat pump	33 Replacement upon failure of a split DX A/C install 14 SEER versus 13 SEER
8 Home has electric strip	34 Replacement upon failure of a split DX A/C install 15 SEER versus 13 SEER
9 Attic insulation = R-7	35 Replacement upon failure of a split DX A/C install 16 SEER versus 13 SEER
10 Attic insulation = R-11	36 Purchase Energy Star dishwasher
11 Exposed walls not insulated	37 Purchase Energy Star refrigerator
12 Floor over basement not insulated	38 Purchase Energy Star clothes washer
13 House infiltration = 0.8 ACH	39 Efficient furnace fan. (ECM, variable speed)
14 Single pane windows A	40 Existence of ceiling fan
15 Single pane windows B	41 Efficient ventilation fans
16 Standard double pane windows	42 Electric clothes dryer fuel switch to gas
17 No E & W window shading A	43 Electric hot water switch to gas
18 No E & W window shading B	44 Evaluation of select "plug load" electronics (Energy Star)
19 No compact fluorescent lamps	45 Evaluation of common area lighting in halls and building walkways
20 Refrigerator early retirement	46 Evaluation of common-use laundry room washers and dryers (Energy Star)
21 No pogrammable thermostat	
22 No faucet aerators	
23 No low flow shower heads	
24 Hot water pipes not insulated	
25 Electric water heater not wrapped	
26 Gas water heater not wrapped	

PROJECT: Research to Evaluate Additional Demand Response Programs

Research will be conducted to evaluate GMO's existing demand response programs, historical participation and potential for additional programs. The project schedule for these tasks is shown below in Table 69

Scope of Work

This evaluation will be divided into seven tasks. These tasks include:

Task 1: Evaluation of existing demand response programs

Review of program features, benefits and historical participation

Identify gaps in current offering and identify opportunities

Evaluate current and future capacity needs in context of GMO current portfolio

Task 2: Research Best Practices in demand response programs

Task 3: Develop menu of proposed programs

Conduct stakeholder engagements, roundtables, & focus groups

Task 4: Potential for Smartgrid synergies

Identify enabling technologies

Evaluate potential vendors

Development implementation plan

Task 5: Cost / Benefit analysis

Complete analysis of benefit / cost analysis

Assess rate and revenue impacts

Task 6: Prepare final report and recommendations

Task 7: Deliver final report.

Table 69: Demand Response Program Research

	2009				2010						
	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JUL
Tasks	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Task 1: Evaluation of existing demand response programs											
Task 2: Research Best Practices											
Task 3: Develop menu of proposed programs											
Task 4: Potential for Smartgrid synergies											
Task 5: Cost / Benefit analysis											
Task 6: Prepare final report										Draft	Final

Project: Alternative Rate Analysis, Time-of-use (TOU), Variable peak and Critical Peak Pricing

Research will be conducted in 2009 – 2010 to evaluate alternative electric rate structures . The project schedule for these tasks is shown below in Table 70

Scope of Work

This evaluation will be divided into seven tasks. These tasks include:

Task 1: Evaluation of existing TOU rate structures.

Review of customer participation in existing TOU rate structures

Complete customer load profile and TOU response

Task 2: Research Best Practices

Task 3: Develop menu of proposed alternative rates

Assess market programs

Back-test against historical participation

Develop participation and impact forecasts

Task 4: Evaluate potential for Smartgrid integration

Identify enabling technologies for price discovery and automated response

Development implementation plan

Task 5: Cost / Benefit analysis

Complete analysis of benefit / cost analysis

Assess rate and revenue impacts

Task 6: Prepare final report and recommendations

Task 7: Deliver final report.

Table 70: Alternative rate research schedule

	2009				2010						
	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JUL
Tasks	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Task 1: Evaluation of existing TOU rate structures											
Task 2: Research Best Practices											
Task 3: Develop menu of proposed alternative rates											
Task 4: Evaluate potential for Smartgrid integration											
Task 5: Cost / Benefit analysis											
Task 6: Prepare final report										Draft	Final

Project: Analysis of Energy Efficient Street Lighting

Research will be conducted in 2009 – 2010 to evaluate energy efficienct street lighting technology. The project schedule for these tasks is shown below in Table 71.

Scope of Work

This evaluation will be divided into seven tasks. These tasks include:

Task 1: Identification of Street Lighting Customers

Task 2: Analysis of Historical Usage

Task 3: Review of Current Lamp types

Task 4 Technical review of alternative technologies

Task 5: Cost / Benefit analysis

Complete analysis of benefit / cost analysis

Task 6: Prepare final report and recommendations

Task 7: Deliver final report.

Table 71 : Evaluation of energy efficienct street lighting

	2010											
	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC
Tasks	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Task 1: Identification of Street Lighting Customers												
Task 2: Analysis of Historical Usage												
Task 3: Review of Current Lamp types												
Task 4: Technical review of alternative technologies												
Task 5: Cost / Benefit analysis												
Task 6/7: Prepare final report									Draft	Final		

SECTION 6: POTENTIAL DEMAND-SIDE PROGRAM DEVELOPMENT

(6) The utility shall develop a set of potential demand-side programs that are designed to deliver an appropriate selection of end-use measures to each market segment. The demand-side program planning and design process shall include at least the following activities and elements:

(A) Identify market segments that are numerous and diverse enough to provide relatively complete coverage of the classes and decision-makers identified in subsections (1)(A) and (B), and that are specifically defined to reflect the primary market imperfections that are common to the members of the market segment;

6.1 SEGMENTATION OVERVIEW

For the Commercial and Industrial (C&I) market, GMO has segmented the market based on industry classifications by kWh usage. The top ten segments identified are:

- Retail 8.9%
- Fabricated Metal Products 6.7%
- Education, Schools & Colleges 6.4%
- Small Office 6.3%
- Chemicals 5.7%
- Services 5.1%
- Church 4.2%
- Food 4.0%

- Plastics & Rubber Products 3.0%
- Computer & Electronic Products 2.9%

Based on these segments, a channel strategy is being developed to deliver product information to customers through key partners. These partners may include trade associations, architects & engineers, manufacturers, retailers or contractors. By understanding our key business segments, GMO can prioritize channel and marketing efforts accordingly. This type of rigor will ensure that strategic investments are being made with customer segment who are most likely to benefit from participating in GMO's products and services.

6.2 PRIMARY RESEARCH

In addition, KCP&L has conducted primary research with the objective of defining market segments by understanding customer attitudes as well as behaviors.

In 2008, focus groups were conducted in order to gain knowledge about key business and residential customer segments. Attitudes, awareness and behaviors related to Energy usage and efficiency were captured and ultimately helped shape future marketing efforts. As noted in the plan, further primary research will be conducted on a regular basis to ensure we are in tune with customer trends.

Research Results are outlined below:

6.2.1 LOW INCOME CUSTOMERS

These customers are skeptical of KCP&L's motives, but show interest in weatherization.

6.2.1.1 Attitudes toward electric bill

Bill is important, ranked behind rent/mortgage and credit card bills in terms of those that must be paid.

Little attention paid to usage versus dollars.

Unaware of recent rate increases and insensitive to changes if less than 20%.

6.2.1.2 Energy efficiency behaviors

Generally aware of energy efficiency options (mainly through bill inserts), but very skeptical of KCP&L's motives ("Why would they want my bill to go down?", "What's the catch?").

Versus other groups, lower income customers are more likely to feel there's nothing they can do about the cost of electricity – "it is what it is".

Concerned about qualification criteria for programs.

6.2.2 SMALL BUSINESS OWNERS

This segment is the least interested in energy efficiency as many owners rent or lease their facilities.

6.2.2.1 Attitudes toward electric bill

Like residential customers, small business owners do not review their electric bill in detail.

Expect the price of goods to increase an average of 10% annually.

Insensitive to rate increases as mostly passed along to customers.

6.2.2.2 Energy efficiency behaviors

Many small business owners are taking steps to curb energy usage, but not as a part of a formal program.

Efforts focused on CFLs, turning off equipment/PCs, and adjusting thermostat.

Very little familiarity with KCP&L EE programs for businesses – EE awareness comes from residential efforts.

Prospect of saving money in the short-term is dominated by fear the owner will not realize the full longer-term benefits.

6.2.3 MID-INCOME CUSTOMERS

This segment tends to view energy efficiency as sacrificing control and comfort.

6.2.3.1 Attitudes toward electric bill

More likely to pay their KCP&L bills online, and therefore devote very little attention to rates and usage.

Unaware of recent rate increases and not likely to notice increases up to 20%.

6.2.3.2 Energy efficiency behaviors

Most claim to be doing what they can to control usage, but are unwilling to do more for fear of sacrificing personal comfort.

Many view EE programs as giving up personal control, a theme more dominant with mid-income customers versus the other two groups.

Most are unclear regarding how much money they would actually save in the short-term and tend to heavily discount the promise of future savings.

In 2008, KCP&L initiated a research and analytics effort to develop residential customer segments based on actual energy usage, census demographics, program participation and attitudes related to Energy Efficiency. This segmentation model has been implemented in the Customer 360 database and will be utilized to improve marketing effectiveness going forward. An online customer segment model is also being developed that will be implemented to improve the marketing efficiencies to KCP&L customers who prefer to transact online.

The following segments have been identified in the legacy KCP&L customer base and will be rolled out and validated in the GMO territory upon funding.

Old School (share of market -- 28%)

Customers in this segment have mixed emotions about energy efficiency. They are the least likely to know how much they currently pay per kWh, but do take actions to help decrease their monthly electric bills and are concerned about the environment. The Old School segment can be influenced to participate in EE programs, but customers need to be convinced that the cost savings are worth the effort. They view Energy Optimizer as a cost-effective program with a positive return.

Green Elite (26%)

Customers in this segment are concerned about the environment and the welfare of future generations. They live a "green" lifestyle, frequently buying organic foods and recycling even when it's not convenient. They are the most willing to pay more for energy from renewable sources, and are relatively unconcerned about the cost of participating in EE programs.

Do The Math (18%)

Customers in this segment are older and want to save energy to reduce their monthly costs. Although they care about the environment, they are not willing to pay more for the sake of environmental protection. They focus on the dollar cost versus benefit trade-offs when considering EE programs, and will participate if the financial payoff is positive. Many have experimented with Energy Analyzer.

All About Me (16%)

Customers in this segment are young and do not want anyone telling them how to use their money. They will not sacrifice personal comfort for the sake of reducing costs, and do not pay attention to energy efficiency messages sent by KCP&L. They are the least likely to participate in outdoor activities, the most likely to eat out instead of cooking, and are not focused on reducing household bills. They will pay for green energy because they believe doing so won't affect their personal comfort.

Whatever (13%)

Customers in this segment are younger, live for today ,and do not believe that energy consumption harms the environment. They don't trust utility companies, and are indifferent about taking actions to reduce their electric bills (for example, they are the least likely to shop for Energy Star appliances). They don't understand what "green energy" means, and are completely unwilling pay for it.

(B) Analyze the interactions between endues measures (for example, more efficient lighting reduces the savings related to efficiency gains in cooling equipment because efficient lighting reduces intrinsic heat gain);

(C) Assemble menus of end-use measures that are appropriate to the shared characteristics of each market segment and cost-effective as measured by the screening test; and

(D) Design a marketing plan and delivery process to present the menu of end-use measures to the members of each market segment and to persuade decision-makers to implement as many of these measures as may be appropriate to their situation.

6.3 MARKETING OVERVIEW

In 2010, KCP&L / GMO will continue to focus efforts on higher probability segments and evolve the status quo.

6.3.1 RESIDENTIAL:

- Invest in 2009/2010 ES brand-building and trust-building communications to build increased levels of market consideration across segments to facilitate increased trial/conversion receptivity in 2010

- Focus on Green Elite and Do the Math segments

6.3.2 SMALL-MEDIUM BUSINESS (SMB):

- Research suggests minimal opportunity for 2009
- Engage SMB market via residential initiatives

Tier 1:

- The current way of doing business is likely to continue to generate comparable results through 2009/2010

Tiers 2-3:

- Continue to increase availability of successful Tier 1 level programs and execute per the Tier 1 model

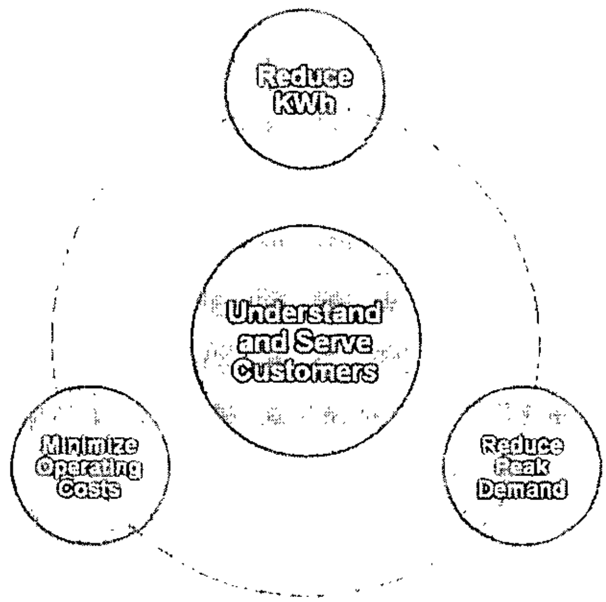
Business Objectives	Marketing Objectives	Strategies	Audience Focus	Initiatives
•Understand Customers •Reduce KWh •Reduce Peak Demand •Reduce operating costs	•Initiate Customer Centered Marketing •Increase consistency and cohesiveness of communications •Increase TRUST in KCPL Energy Solutions •Increase TRIAL of EE programs	•Improve understanding of customer motivations •Create a compelling ES BRAND with a unified communications architecture •Educate customers on MUTUAL BENEFITS of EE •Align communications to customer motivation	•Tier 1 customers •Tier 2-3 customers •Channel partners •Residential segments	•Multiple per marketing objective

6.4 SITUATION ANALYSIS

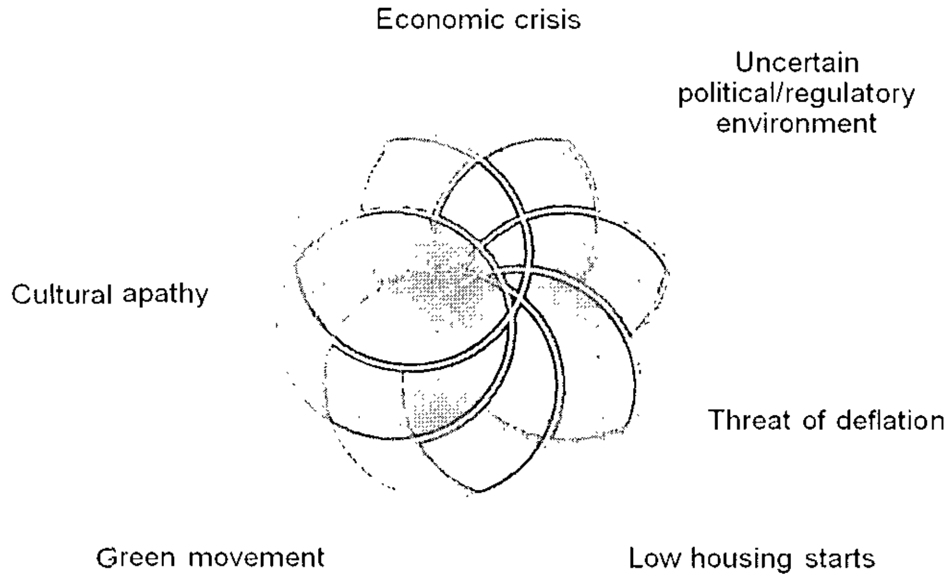
GMO's key business objectives are the following:

- To better understand customer attitudes, desires, needs, and thresholds regarding energy usage.
- To reduce relative customer energy utilization.

- To impact the demand curve, especially during peak demand periods between June and September.
- To minimize operating costs via eService programs.



2010 is a time of sea-change. As global warming and carbon footprints capture headlines, a "perfect storm" of social and economic factors are converging.



According to Michael Gross (IPSOS), U.S. consumer sentiment remains under siege.

"Although energy prices have declined sharply, consumer sentiment remains under siege due to persistent negative forces ranging from the escalating job crisis to the prolonged housing debacle and the growing credit crunch, according to the most recent results of the RBC CASH (Consumer Attitudes and Spending by Household) Index."

Highly visible statistics in the news on a daily basis are:

- Trillions lost in consumer real estate and investments
- U.S. unemployment at 25 year high
- $700B banking & finance bailout
- U.S. auto industry entering bankruptcy

Consequently, according to the Principal Financial Well-Being, more Americans are pinching pennies when it comes to everyday spending.

- 56% of workers and 55% of retirees have pared spending because of the economy's woes.
- More than two-thirds of both groups said they're forking over about $100 more a week on groceries compared with last year.
- About half of both groups are eating out less and also stocking up on store or generic brands more often.
- More than one-third of them are giving up convenience and premium items for cheaper alternatives and stalking multiple stores in search of sales.

According to the Kansas City Area Development Council, the demographics of Kansas City residents is as follows:

- Metro population is 2 million
- The annual per household income is $67,000
- Per capita income is $37,331
- Median home price in Kansas City is $153,000
- The average age is 36.1
- 89.4% of KC residents have a high school education
- 32% of KC residents have a college degree

GMO customers have the following characteristics:

- 350,000 new customers

- Mostly rural
- Minimal exposure to KCP&L / GMO Energy Solutions with recent launch
- Cost effective media opportunities (local newspapers, radio)
- Strong field support
- Less customer fatigue on messaging
- JD Power results indicate that customers are seeking Energy Conservation products and services.

6.5 OVERALL MARKETING STRATEGY

6.5.1 RESIDENTIAL

The marketing and communications strategy will be designed to inform customers of the availability and benefits of the program and how they can participate in the program. The strategy will include outreach to all customers. An important part of the marketing plan will be content and functionality on the KCP&L website, which will direct customers to information about the program. More specifically, the marketing and communications plan will include:

A combination of strategies includes major media advertising and outreach community forums and events, and through direct outreach to customers.

Marketing activities will include:

- Brochures that describe the benefits and features of the program including program participation and processes. The brochures will be available for various public awareness events (presentations, seminars etc).
- Bill inserts, bill messages and email messages.

- KCP&L website content providing program information resources, contact information, and links to other relevant service and information resources.
- KCP&L customer representatives trained to promote the program to their customers.
- Presence at conferences and public events used to increase general awareness of the program and distribute program promotional materials.

6.5.2 COMMERCIAL AND INDUSTRIAL (C&I)

The marketing strategy for C&I will be stratified with segmentation and a more direct approach based on actual energy needs, usage trends, industry classifications, LEED certification requirements, new and retrofit construction, and incentive requirements. Company account mangers (Energy Consultants and Commercial Consultants) will work closely with facility mangers to identify opportunities and engage appropriate third parties and industry experts to deliver energy saving solutions on an on-going basis. Marketing materials and presentations will be created to feature C&I products and services that can be distributed at trade shows, meetings, and presentations.

Customized newsletters (called Energy Talk) will be created and sent to C&I partners and prospects to educate and inform them about KCP&L/GMO's product suite. Events will be sponsored to build relationships with partners and an Advisory Council will be created to solicit feedback from C&I partners on a quarterly basis. Partnerships will be created with key users to include actual energy savings programs as well as educational and community components to build KCP&L/GMO's awareness through its strategic partners.

6.6 MARKETING BUDGET

Annual GMO Marketing Budget for Existing Programs (based on filed tariffs)

	2010	2011
Affordability, CEP	[redacted]	
Affordable New Homes		
Low Income Weatherization		
Energy Efficiency, CEP		
Building Operator Certification		
Change a Light		
C&I Rebates		
Cool Homes Program		
ENERGY STAR New Homes		
Home Energy Analyzer		
Home Performance with ENERGY STAR		
Demand Response		
Energy Optimizer		
MPower		
Total		

HC

Total budgets for the new programs per year have been determined and is shown in Table 72 below. GMO annual spending on demand side programs will exceed one-percent of annual revenue. The marketing budget for these enhanced and new programs is under development.

Table 72: Proposed Total Budget for Enhancements to Existing Programs and Proposed New Programs ** Highly Confidential **

	2010	2011
Proposed Enhancements to Existing Programs	[redacted]	[redacted]
Residential Cool Homes, Enhanced	[redacted]	[redacted]
Residential, Home Performance with Energy Star	[redacted]	[redacted]
Residential, Online Energy Information with Kit Program	[redacted]	[redacted]
C&I, Custom Rebates, and RFP Program	[redacted]	[redacted]
C&I Prescriptive Program	[redacted]	[redacted]
Proposed New Residential Programs	[redacted]	[redacted]
Residential Energy Use Monitor	[redacted]	[redacted]
Residential Appliance, Turn In Program	[redacted]	[redacted]
Total	[redacted]	[redacted]

KCP&L's Web Site

kcpl.com has a wealth of information that can be beneficial to both business and residential customers. However, the current architecture, look and feel and overall site usability have room for improvement.

kcpl.com should be a high value marketing communications asset that could be used to improve conversion, satisfaction and shareholder value with an overall site redesign using customer needs and behavior as the compass. Expanded capabilities will facilitate more robust marketing delivery to enhance conversion rates and customer satisfaction

The following are the benefits of a web site redesign:

HC

- Sign up customers for on-going communication that they request or prefer such as newsletters, alerts, billing, etc.
- Drive participation in products and programs.
- Drive customers into more cost efficient relationships such as online billing, reduction in call center requests, etc.
- Improve cross-sell capabilities to more effectively market programs to existing participants cost-effectively.
- Activate and merchandise business relationships on an on-going basis.
- With 80% of KCP&L customers online, the web site can become a significant marketing/communication resource that will provide many benefits and capabilities to reach customers where they are.
- Improving web capability will also accelerate the ability to reach GMO customers.
- Opportunity to re-design Human Resources web presence and job application process.

Also, with a redesign we will have the ability to expand our capabilities where we can offer the following:

Web applications that deliver content to mobile devices

- Automated alerts on outages
- Notification of restored power
- Notification of appointments in field
- Interactive content delivery from Power & Light district
- Notification of bill notice/payments/reminders

- Rebate fulfillment to improve speed of processing and customer satisfaction. Add Energy Efficiency Blog to educate customers on an on-going basis.

New web site will also provide and architecture for social media applications that are being evaluated to meet our customers where they go to seek information about energy efficiency.

eServices

In 2008, KCP&L acquired new technology that enabled HTML email that could be sent to the customer base on a regular basis. With the appropriate consent, nearly 25% of the customer base receives promotional and informational emails from KCP&L 2-3 times a month. Email has proven to be an extremely effective tool in reaching this customer segment and conversion rates have been impressive. As an example, one email communication in particular was very successful -- a Home Energy Analyzer email sent in February 2009. The goal of this email was to increase traffic on the Home Energy Analyzer and get customers to complete the Level 1 energy audit. By using two different messages sent to the entire KCP&L Legacy email list, the communication drove participation by 3,484 customers. This was nearly quadruple the number of online audits the program has seen in past March periods when no specific campaigns were being conducted.

The total cost of this campaign was $1,400, resulting in an acquisition cost of $0.40 per user. The participation rate was far higher than would have been obtained with a bill insert and the expense was a fraction of what a mailing or insert would have cost.

With this kind of success, email will continue to be an important component of the future marketing efforts related to the product and services.

SECTION 7: COST-EFFECTIVE SCREENING OF DEMAND-SIDE PROGRAMS

(7) Cost-Effectiveness Screening of Demand-Side Programs. The utility shall evaluate the cost-effectiveness of each potential demand-side program developed pursuant to section (6) using the total resource cost test. The utility cost test shall also be performed for purposes of comparison. All costs and benefits shall be expressed in nominal dollars. The following procedure shall be used to perform these tests:

Overview

Greater Missouri Operations developed its portfolio of programs using experience gained in the development of programs for its affiliate company, KCP&L along spreadsheet models that were developed by RLW Analytics, Inc, and Summit Blue Consulting. The residential RLW model and Summit Blue C&I model was calibrated to mirror GMO customer electricity usage, along with the number and type of customers.

To determine cost effectiveness, GMO utilized DSMore, a cost effectiveness software tool. All residential electric technologies and a listing of potential C&I technologies were run through the model.

The last step was a combining of similar measures that would be delivered in a single program that reduces administrative and marketing delivery costs. The new "programs" were also analyzed using DSMore for cost effectiveness. The program descriptions that follow are the result of that analysis and are put forth by GMO for consideration.

Planned new programs are both informational and direct impact programs. They target residential customers and C&I customers, and target both the retrofit and new construction markets.

The incentive levels set for the measures covered by both new and planned programs have been assessed through a cost-effectiveness analysis using the DSMore model that evaluated the Total Resource Cost (TRC), Utility Cost (UC), Ratepayer Impact Measure (RIM), Societal Test (ST) and Participant (PT) tests. The cost-effectiveness tests account for the energy and demand savings, the associated avoided costs and net benefits to GMO, the incremental or installed costs, and the program costs.

In addition to helping customers reduce and manage their energy costs, these programs provide other societal and customer benefits. These include reduced greenhouse gas emissions, improved levels of service from energy expenditures, and lower overall rates and energy costs compared to other resource options.

GMO had developed demand-side and energy efficiency programs and had these approved by the Commission in its Comprehensive Energy Plan (CEP). These programs are shown below with detailed descriptions following. The proposed new programs are then listed with detailed descriptions following.

Existing Programs

AFFORDABILITY – RESIDENTIAL

- Low Income Affordable New Homes
- Low Income Weatherization

Energy Efficiency – Residential

- Change a Light
- Home Performance With Energy Star® Program
- Energy Star® New Homes

Energy Efficiency – C&I

- Building Operator Certification

Demand Response - Residential

- Energy Optimizer

Demand Response – C&I

- MPower

<u>Proposed New Programs</u>

Energy Efficiency -Residential

- Appliance Turn-In
- Blue Line
- Cool Homes
- Home Performance with Energy Star® Home Energy Analyzer Plus
- On Line Audit

Energy Efficiency – C&I

- Custom Prescriptive Incentive Program
- C&I Custom Rebate Program

EXISTING AFFORDABILITY PROGRAMS

Program Name	**Low Income Affordable New Homes**
Objective	This voluntary program is intended to provide incentives to builders of qualified new homes for low-income customers for the installation of Energy Star® rated lighting fixtures, Energy Star® rated refrigerators, high-efficiency central cooling equipment, and increased R-factor insulation in the home's attic, floor, or crawlspace.
Target Market and Eligibility	This Program is available to builders of qualified new homes, within the GMO service territory, for persons having household earnings that meet designated income criteria.
Program Description	The Program will be administrated by GMO. Agreements will be established with builders of qualified homes, who will then invoice GMO for incentives and will be paid for installing Energy Star® rated lighting fixtures, an Energy Star® rated refrigerator, high efficiency central cooling equipment (14 SEER or greater), and for upgrading to at least one of the following: R42 attic insulation, R25 floor insulation, or R19 crawlspace insulation. Proof of installation will be required prior to payment of incentives.
Rebates and Incentives	▪ Up to $100 per home for installing Energy Star rated lighting fixtures ▪ Up to $200 per home for installing an Energy Star refrigerator ▪ Up to $800 per home for installing high-efficiency central cooling equipment (14 SEER or greater) ▪ Up to $400 per home for installing the following: R42 attic insulation or R25 floor insulation or R19 crawl space insulation
Channel Partner	
Tariff Approved Date	March 2008

Program Name	**Low-Income Weatherization**
Objective	Weatherization benefits low-income GMO customers by reducing heating and cooling bills by as much as 31% annually and by resolving energy efficiency concerns in their homes before their bills increase. Additionally, the money that customers save on their energy bill can be used for other critical household expenses.
Target Market and Eligibility	This Program is available to any Customer currently receiving service under any generally available residential rate schedule for a minimum of one year prior to completion of an application for weatherization assistance and who also meets the additional Customer eligibility requirements defined in the agreement between the Company and the Social Agency. The Social Agency will select Customers eligible for Low-Income Weatherization using the following criteria: The Customer's household earnings at or below 185% of the current year Federal Poverty Level guidelines or below 60% of the state median income, whichever is higher for the number of persons in the residence, the residence must have energy consumption greater than 3,000 kWh per year, the Customer has received electric service from the Company for a minimum of one year prior to completion of an application, and other eligibility requirements defined in the agreement between the Company and the Social Agency.
Program Description	Qualified lower income customers can get help managing their usage and bills through GMO's Low-Income Weatherization Program. The program works directly with local Community Action Program (CAP) agencies that already provide weatherization services to low-income customers. GMO provides supplemental funds to CAP Agencies to cover the costs of additional cost-effective weatherization measures. Typical services include installing insulation, calking windows, and repairing heating and central cooling systems.
Rebates and Incentives	The cost to the customer is free with the weatherization measures performed on the residence capping at $3,500 per residence.
Channel Partner	City of Kansas City, MO (KCMO), West Central MO Community Action Agency, MO Valley Community Action Agency, Central Missouri Community Action
Tariff Approved Date	March 2008

EXISTING ENERGY EFFICIENCY-RESIDENTIAL

Program Name	**Online Energy Information And Analysis Program Using** Aclara® **Residential Suite.**
Objective	This is a free, online tool to help residential customers understand how they use energy in their home. It allows customers to see where their energy dollars go by end use, see how they compare to similar houses in their area, and find ways they can improve their home's energy efficiency.
Target Market and Eligibility	This product is for residential customers with Internet access.
Program Description	The online energy information and analysis program allows all residential customers with Internet access to retrieve their billing information and comparisons of their usage on a daily, weekly, monthly or annual basis. This tool will analyze the end use make-up of their home displayed by percentages. It will provide information on ways to save energy by end use through a searchable resource center. This tool also allows the user to analyze why their bill may have changed from one month to another. A home comparison displays an evaluation of the customer's home versus an average similar home via an Energy guide label concept.
Rebates and Incentives	None
Channel Partner	Aclara Software (formerly Nexus)
Tariff Approved Date	October 2008

Program Name	**Home Performance With ENERGY STAR®**
Objective	Home Performance with Energy Star (HPwES) is a program designed for existing homes. This Program may be applied to any home where the current resident is receiving service under any generally available residential rate schedule offered by the Company. All Assessments must be requested by the owner of the home. Program rebates are limited to one rebate per Assessment.
Target Market and Eligibility	HPwES is an innovative program that strives to produce an economically sustainable model that captures significant energy savings by encouraging a whole-house approach to Energy Efficiency improvements in existing homes. The program begins with a whole-house energy assessment performed by trained and Building Performance Institute (BPI) certified contractors. The assessment is then provided to the homeowners to follow through and complete energy improvements to their homes. Quality Assurance is a primary function of this program. HPwES is a statewide approach coordinating efforts between the state sponsor, Missouri Department of Natural Resources' Energy Center (MODNR) and local partners. GMO will collaborate regionally with the Metropolitan Energy Center (MEC) to implement a successful program in the Kansas City area.
Program Description	GMO offers a Home Performance with Energy Star rebate of up to $600 for customers who implement at least one qualifying energy efficient improvement that is recommended by the Home Performance certified contractor or consultant.
Rebates and Incentives	Missouri Department of Natural Resources – Energy Center (MDNR), Metropolitan Energy Center (MEC)
Channel Partner	1/23/08
Tariff Approval Date	April 2008

Program Name	**Change A Light**
Objective	The Residential Lighting Program is a year-round program designed to encourage the replacement of (inefficient) incandescent light bulbs with Energy Star compact fluorescent light (CFL) bulbs. The Company will provide a rebate that covers a portion of the difference in cost between incandescent and CFL bulbs.
Target Market and Eligibility	The Program is available to any of the Company's Missouri residential electric customers.
Program Description	Any retailer located in GMO's Missouri service territory that has completed an agreement with the Company to sell CFL bulbs is eligible to participate in this program. Each participating customer completes a rebate form at check-out, provides the completed form to the retailer, and then receives a rebate for each applicable CFL purchased as an instant credit. Rebate forms are available at all participating retailer locations. The information collected through the rebate forms will serve to verify the number of CFLs installed in the Company's service territory and will provide customer contact information that may be used for program evaluation. The Company reimburses the retailer for the approved rebate plus a handling fee. Customer rebates must be redeemed through participating Missouri retailers located in GMO service territory.
Rebates and Incentives	The rebate incentive would be limited to 6 bulbs per customer per visit.
Channel Partner	Midwest Energy Efficiency Alliance located in Chicago, IL
Tariff Approval Date	March 2008

Program Name	**Cool Homes**
Objective	Improve the operating efficiency of single and multi-family homes with central air cooling systems. Reduce energy consumption for single and multi-family homeowners through the tune-up and early replacement of working inefficient cooling equipment. Achieve market transformation through HVAC contractor training.
Target Market and Eligibility	The target market for the program includes both GMO residential customers who have working inefficient central air conditioners and the HVAC contractors that serve this market. Targeted market customers are identified through the integration of weather data and billing analysis and the use of property tax records.
Program Description	The Cool Homes program is a residential central air-conditioning rebate program designed to help reduce excess energy usage during the peak summer months and cut carbon dioxide emissions through the maintenance and early retirement of inefficient central air conditioning equipment. This program encourages residential customers to have existing cooling systems evaluated and if feasible, brought back to factory specifications (re-commissioned), or replace less efficient, working central cooling systems with high efficiency central cooling systems.
Rebates and Incentives	The Cool Homes program provides contractors incentives to provide recommissioning and quality installation practices and customer rebate incentives offered through participating HVAC contractors to help offset the early replacement equipment costs. Contractor Incentives: GMO pays a $35 incentive to the contractor for the unit testing which is typically 1/3 of the service visit. Contractors will receive $45 upon completion of proper airflow and coolant recharge if the system requires Proctor Engineering will complete the processing for incentives, and will certify the efficiency of the HVAC system. The Program Administrator will pay contractor incentives upon successful completion of program standards. Customer Incentives:

	GMO customers who use participating Cool Homes HVAC contractors to test, repair, and/or replace working A/C or heat pumps with high-efficiency equipment rated at 14 SEER or above may be eligible for a rebate. ($650 : 14/15 SEER or $850 : SEER +16). Rebates are applied, per system, toward the purchase of a high-efficiency A/C or heat pump through a Cool Homes HVAC service contractor. The program Administrator pays HVAC contractors for the customer incentives offered through the program.
Channel Partner	Conservation Services Group (CSG), Proctor Engineering Group (PEG) and GMO service area HVAC contractors
Tariff Approval Date	October 2008

Program Name	**ENERGY STAR® New Homes**
Objective	Builders and developers will construct more energy-efficient homes and purchasers will benefit from reduced energy costs. A secondary benefit is the potentially increased value of the home and sustainability of the construction.
Target Market and Eligibility	Builders of newly constructed residential structures three stories or less including site constructed homes, attached or detached homes, single or low-rise multi-family residential buildings, system-built homes (structural insulated panels or modular) and log homes. Homes can be qualified as an Energy Star® home through two different paths. The prescriptive path uses Building Option Packages, which represent a set of construction specifications for a specific climate zone. The performance path qualifies the home based on a home energy rating. Currently available to Missouri customers only..
Program Description	1. The company will complete the necessary requirements to obtain status with Energy Star® to promote the ESNH Program regionally. 2. The Company will work with Builders in GMO's Missouri service territory to help them achieve Partner status with Energy Star® under the ESNH program. 3. As necessary, the Company will expand the availability of Raters certified to evaluate homes under the Home Energy Rating System (HERS) standards within the Company's service territory. The HERS program will be used to provide independent, third party verification of ESNH construction. 4. Builders will construct homes according to one of the following agreement structures: a. Performance agreement – In this structure Builders submit construction plans for analysis prior to construction. Using standardized software, the analysis will yield a HERS Index Rating. Homes built to the specifications of construction plans analyzed to have an index of 85 or below will qualify for Energy Star® rating. b. Prescriptive agreement – In this structure Builders apply specific energy efficiency measures, pre-defined by Energy Star®

	and available through their website, to a new home. The measures include high efficiency heating and cooling equipment, ductwork, windows, water heating, lighting, and appliances. Where applicable, Energy Star® rated equipment is specified. 5. For single homes, onsite inspections will be completed by HERS Raters twice during the construction and once following completion of the home to verify compliance with Energy Star® requirements. For multiple homes built in the same subdivision, HERS Raters will use the "Energy Star® for Homes Revised Sampling Protocol Guidelines." HERS Raters will be assigned to a Builder by the Company. The Company will reimburse Builders for HERS ratings and as also defined per Section 13 of the GMO rules and regulations. A Builder whose homes consistently fail the verification process will become ineligible to participate in the Program. 6. For homes that achieve Energy Star® qualification, Builders may request a rebate toward the incremental cost of meeting Energy Star® requirements. The rebate request form is available from the Company. 7. The Company will promote the Program to residential Customers through mediums that may include press releases, direct mailings, bill messages, bill inserts, trade ally communications, and web site materials. 8. The Company will obtain Energy Star® materials and establish a clearinghouse of training materials, marketing resources and tools that can be used by Builders and the Company to implement and promote the Program.
Rebates and Incentives	An $800 rebate per home is available for qualified builders whose home meets ENERGY STAR requirements. GMO will also pay for the rating and inspections directly to the energy rater, up to $750 per home.
Channel Partner	GMO is working with Metropolitan Energy Center (MEC), builders, realtors and lenders
Tariff Approval Date	March 2008

ENERGY EFFICIENCY-C&I

Program Name	**Energy Audit and Energy Savings Measures**
Objective	To encourage GMO's C&I customers to install energy efficient processes, refrigeration and other efficient equipment and controls.
Target Market and Eligibility	C&I customers interested in investigating energy efficiency measures opportunities for existing and new buildings.
Program Description	GMO's Energy Audit Program and Energy Saving Measures Program is designed to encourage energy efficiency improvements in building shells, installation of efficient electrical equipment in new buildings, and the replacement of inefficient electrical equipment in existing buildings. The program provides rebates for an energy audit and subsequent improvements in the energy efficiency of the building space and/or equipment. 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 1.0 or higher. In addition, the project's incremental payback must be greater than two years.
Rebates and Incentives	GMO will offer rebates to customers to cover up to 50% of the cost of an energy audit. In order to receive the rebate, the customer must implement at least one of the audit recommendations that qualify for a GMO equipment rebate. The energy audit rebate will be set at 50% of the audit cost up to $300 for customers with facilities less than 25,000 square feet and up to $500 for customers with facilities over 25,000 square feet. Customers with multiple buildings will be eligible for multiple audit rebates. Energy Saving Measures Program: This Program provides a rebate for installing qualifying higher energy efficiency equipment or systems, or replacing or retrofitting HVAC systems, motors, lighting, pumps or other qualifying equipment or systems with higher energy efficiency equipment or systems. Both new construction projects and retrofit projects are eligible to apply. To become a Participant in the Energy Saving Measures Program, Customers must request a rebate for an energy saving measures project by submitting an application to GMO.
Channel Partner	Energy efficiency vendors, trade and professional organizations
Tariff Approval Date	April 2008

Program Name	**Building Operator Certification (BOC)**
Objective	Building Operator Certification is a market transformation effort to train facility operators in efficient building operations and management (O&M), establish recognition of and value for certified operators, support the adoption of resource-efficient O&M as the standard in building operations, and create a self-sustaining entity for administering and marketing the training. The program is a cost effective way to educate and encourage change leading to reduced energy consumption.
Target Market and Eligibility	This program is targeted to Commercial and Industrial building operator professionals interested in learning techniques to improve the energy efficiency of the facilities they manage. The certification courses funded by this program will be available through MDNR for any building operator employed by a company having at least one Missouri or Kansas commercial property receiving electrical service from GMO. Reimbursements for the successful completion of the certifications are available to any building operator associated with at least one Missouri commercial property receiving electrical service from GMO.
Program Description	BOC is a professional development program for building operators and maintenance staff. Level I training consists of a series of seven courses, 56 hours of instruction total, normally completed in seven months and five projects on energy and resource efficient operation of buildings. Level II training consists of six courses, 49 hours of instruction total, normally completed in six months and three projects. The goal of the program is to achieve measurable energy savings in the operation of buildings by training individuals responsible for day-to-day operations.
Rebates and Incentives	GMO will reimburse the MDNR for the amount paid annually to license the Level 1 and Level 2 curriculums for the GMO area, currently $25,000 per certification class (about 20 students per class). Tuition reimbursements of $575 per certification level will be paid to the sponsor or individual paying the tuition. To receive the reimbursement, qualified Building Operators must complete a reimbursement request and submit it to GMO. The reimbursement form is available by contacting GMO directly.
Channel Partner	Missouri Department of Natural Resources (MDNR)
Tariff Approval Date	March 2008

DEMAND RESPONSE-RESIDENTIAL

Program Name	**Energy Optimizer**
Objective	Residential and small commercial Air Conditioning (A/C) cycling program designed to reduce peak system electric demand requirements.
Target Market and Eligibility	All residential, and some small commercial GMO customers with an eligible central a/c system, This program does not include chillers.
Program Description	Optimizer participants receive a free web-programmable thermostat when they sign up for the program. Installation and maintenance of the thermostat is also free to the customer. The thermostat is equipped to receive a radio frequency signal, which allows GMO to cycle the customer's central a/c system during times of peak demand.
Rebates and Incentives	The customer owns the thermostat after three years.
Channel Partner	Honeywell
Tariff Approval Date	October 2008

DEMAND RESPONSE-C&I

<table>
<tr><td>Program Name</td><td>MPower</td></tr>
<tr><td>Objective</td><td>A commercial and industrial load curtailment program focused on reducing electrical demand during peak requirements.</td></tr>
<tr><td>Target Market and Eligibility</td><td>Current GMO electric customers on a non-residential rate, who are able to provide a minimum seasonal reduction of 25kW.</td></tr>
<tr><td>Program Description</td><td>MPower is a commercial and industrial Demand Response program, whereby customers are paid for reducing demand upon GMO request. The program is used by GMO to help manage its peak load.Customers pick the maximum number of events for which they are willing to commit (from one to ten) and payouts increase linearly based on the number of events chosen. The curtailment season runs from June through September.</td></tr>
<tr><td>Rebates and Incentives</td><td>Customer compensation shall be defined within each Customer contract and will be based on contract term, Maximum Number of Curtailment Events and the number of actual Curtailment Events per Curtailment Season. Timing of all payments/credits shall be specified in the curtailment contract with each Customer. Payments shall be paid to the Customer in the form of a check or bill credit as specified in the contract. The credits shall be applied before any applicable taxes. All other billing, operational, and related provisions of other applicable rate schedules shall remain in effect. Compensation will include:

PROGRAM PARTICIPATION PAYMENT: For each Curtailment Season, Customer shall receive a payment/credit based upon the contract term, the number of consecutive years under contract, and the Maximum Number of Curtailment Events. The Program Participation Payment for a Curtailment Season is equal to the per kilowatt of Curtailable Load rate as defined in the table below multiplied by the Maximum Number of Curtailment Events stated in the Customer's contract.

<table>
<tr><th>CONTRACT TERM</th><th># OF CONSECUTIVE YEARS UNDER CONTRACT</th><th>$/KW OF CURTAILABLE LOAD</th></tr>
<tr><td>One year</td><td>1</td><td>$2.50</td></tr>
<tr><td>One year</td><td>2</td><td>$2.50</td></tr>
<tr><td>One year</td><td>3</td><td>$3.25</td></tr>
<tr><td>One year</td><td>4</td><td>$3.25</td></tr>
<tr><td>One year</td><td>5</td><td>$4.50</td></tr>
<tr><td>Three years</td><td>1</td><td>$3.25</td></tr>
<tr><td>Three years</td><td>4</td><td>$3.25</td></tr>
<tr><td>Three years</td><td>5</td><td>$4.50</td></tr>
<tr><td>Five years</td><td>Any</td><td>$4.50</td></tr>
</table>
</td></tr>
</table>

	The Program Participation Payment will be divided by the number of months in the Curtailment Season and applied as bill credits equally for each month of the Curtailment Season.
Channel Partner	Energy Curtailment Specialists (ECS)
Tariff Approval Date	October 2008

PROPOSED NEW PROGRAMS

ENERGY EFFICIENCY-RESIDENTIAL

Program Name	Cool Homes - Enhanced
Objective	Assist single and multi-family homeowners with central air cooling systems to upgrade the efficiency of their systems. Reduce energy consumption for single and multi-family homeowners through the tune-up and early replacement of working, inefficient cooling equipment. Achieve market transformation through HVAC contractor training.
Target Market and Eligibility	The target market for the program includes both GMO residential customers who have working inefficient central air conditioners and the HVAC contractor market. Targeted market customers are identified through the integration of weather data and billing analysis and the use of property tax records.
Program Description	The Cool Homes program is a residential central air-conditioning rebate program designed to help reduce excess energy usage during the peak summer months and cut carbon dioxide emissions through the maintenance and early retirement of inefficient central air conditioning equipment. This program encourages residential customers to have existing cooling systems evaluated and if feasible, brought back to factory specifications (re-commissioned), or replace less efficient, working central cooling systems with high efficiency central cooling systems.
Rebates and Incentives	The Cool Homes program provides contractor incentives to provide for quality installation practices and customer rebate incentives offered through participating HVAC contractors to help offset customer equipment costs. Contractor Incentives: GMO pays a $35 incentive to the contractor for the unit testing which is typically 1/3 of the service visit. Contractors will receive

	$45 upon completion of proper airflow and coolant recharge if the system requires. Proctor Engineering will complete the processing for incentives, as they are responsible for the software and technical information needed to certify the efficiency of the HVAC system. The program Administrator will pay contractor incentives upon successful completion of program standards. Customer Incentives: GMO customers who use participating Cool Homes HVAC contractors to test, repair, and/or replace working A/C or heat pumps with high-efficiency equipment rated at 14 SEER or above may be eligible for an instant rebate. (14/15 SEER: $650 or 16+ SEER: $850). Rebates are applied, per system, toward the purchase of a high-efficiency A/C or heat pump through a Cool Homes HVAC service contractor. The program Administrator pays HVAC contractors for the customer incentives offered through the program.
Enhancement	GMO will work with market channels to increase participation.

Program Name	**Home Performance with Energy Star Program**
Objective	The program offers a comprehensive approach to home improvement, remodeling, and renovation that will make homes more efficient, reduce energy costs, while improving indoor air quality, and create a more comfortable, healthy home while protecting the environment through energy conservation.
Target Market and Eligibility	HPwES is a program designed for existing homes of all ages. This Program may be applied to any home where the current resident is receiving service under any generally available residential rate schedule offered by the Company. All Assessments must be requested by the owner of the home. Program rebates are limited to one rebate per Assessment.
Program Description	Home Performance with Energy Star (HPwES) is an innovative program that strives to produce an economically sustainable model that captures significant energy savings by encouraging a whole-house approach to Energy Efficiency improvements in existing homes. The program begins with a whole-house energy assessment performed by trained and Building Performance Institute (BPI) certified contractors. The infrastructure is then provided for homeowners to follow through and complete energy improvements to their homes. Quality Assurance is a primary function of this program. HPwES is a statewide approach coordinating efforts between the state sponsor, Missouri Department of Natural Resources' Energy Center (MODNR) and local partners. GMO will collaborate regionally with the Metropolitan Energy Center (MEC) to implement a successful program in the Kansas City area.
Rebates and Incentives	GMO offers a Home Performance with Energy Star rebate of up to $600 for customers who implement at least one qualifying energy efficient improvement that is recommended by the Home Performance certified contractor or consultant.
Enhancement	The primary objective of the program is to increase the adoption of high efficient Energy Star products through retail markets. The theory is that through market support of retailers, these products will have more exposure to customers and better placement in the store. The sales force will also be more aware of the product and promote it more often. Customers will then try the product and increase use of these products. It is expected that as the product is more widely accepted and prices are reduced, that GMO may reduce or drop the incentives and consumers will commonly adopt the measures.

	The enhancements will be designed to: ❖ Provide retail or distribution incentives to residential customers for the installation of measures to reduce energy use in the home and information about other programs that encourage the installation of high-efficiency lighting, heating and cooling systems and appliances. ❖ Provide a marketing mechanism for retailer and high efficiency product suppliers to promote energy efficient equipment and products to end users.

Program Name	**Online Energy Information Plus – Residential**
Objective	To provide GMO residential customers with an easy-to-use online tool that allows them to view their real energy usage on a monthly basis and provide recommendations to reduce energy consumption cost effectively.
Target Market and Eligibility	This product is for residential customers with Internet access.
Program Description	The online energy information and analysis program allows all residential customers with computers and Internet access to retrieve their billing information and comparisons of their usage on a daily, weekly, monthly or annual basis. This tool will analyze the end use make-up of their home displayed by percentages. It will provide information on ways to save energy by end use through a searchable resource center. This tool also allows the user to analyze why their bill may have changed from one month to another. A home comparison displays an evaluation of the customer's home versus an average similar home via an Energy guide label concept.
Rebates and Incentives	None
Enhancement	• GMO will offer Energy Efficiency Starter Kits to individuals who sign up. The largest barrier to success of the program is making the customer aware of the website. To overcome this barrier GMO will offer these Kits as an incentive to use the on-line energy analyzer. For those customers interested in how they use energy and lowering their energy bills, the website contains the audit tool, an appliance calculator, a micro site to evaluate the bill impact of implementing the starter kit, efficient products e-catalog and a library of energy information. The challenge is to get them to visit the website, which will happen primarily through direct marketing to the end user and promotion through the Call Center Customer Service Representative.

ENERGY EFFICIENCY PROGRAMS – C&I

Program Name	**Commercial and Industrial Custom Incentives**
Objective	The primary goal of the program is to encourage GMO's C&I customers to install energy efficient process, refrigeration, and other efficient equipment & controls in existing facilities. More specifically, the program is designed to: • Provide incentives to facility owners and operators for the installation of high-efficiency process, refrigeration and other equipment and controls. • Provide a marketing mechanism for consulting engineers, process and equipment contractors and distributors to promote energy-efficient equipment to end users.
Target Market and Eligibility	All GMO commercial and industrial retail customers are eligible for the program. However, the main target markets are customers in existing buildings. The separate New Construction program covers new construction design applications. Industrial customers, grocery stores, and other large commercial customers are expected to be the primary target markets for this program.
Program Description	The Commercial and Industrial Custom Incentive Program provides custom incentives to C&I customers for the installation of innovative and non-standard energy-efficiency equipment and controls. This program will pertain to existing facilities only. The separate Prescriptive Incentive program covers standard high-efficiency measures. The separate C&I New Construction Program will cover new construction design measures. The program includes customer educational and promotional pieces designed to assist facility owners, operators and decision makers with the information necessary to improve the energy efficiency of the process, refrigeration and other energy using systems in their facilities. The program also includes customer and trade ally education to assist with understanding the technologies that are being promoted, the incentives that are offered, and how the program functions.
Rebates and Incentives	The C&I Custom Incentive Program is a financial assistance and education program that provides incentives for the installation of

	energy efficiency measures in existing non-residential facilities. Customers/Contractors will submit their project savings estimates during the planning process prior to project initiation. GMO staff or its subcontractor will review these savings estimates and confirm the savings prior to committing to the incentive levels. This check on the savings analysis helps assure that GMO funds are being cost effectively used to promote efficiency. Incentives will be set using a "per saved kWh" and "per saved kW" basis so that both energy and demand savings will be rewarded. Levels of incentives will vary over time based on costs and market need but will typically be established in one-year increments. GMO will use a two-tier custom incentive approach. The first tier is at a lower rate for technologies that are established and known in the market but need financial help to get them implemented. The second tier will be technologies that are newer to the market or have risk that is more significant or other barriers that need higher stimulation and awareness. Most new technologies will start at the second higher incentive tier and migrate to the first lower incentive tier over time as they are accepted within the market. This approach gives appropriate signals to the market about new technologies or riskier technologies that have significant savings potential. Other guidelines to reduce free ridership will also be established. These include years of payback, total incentive dollars per customer per year and percent of total project cost. One barrier to getting measures identified and installed is getting customers to spend funds to analyze the opportunity and savings. To help address this issue, assessment/audit grants will be available to customers for up to 25% of the analysis cost not to exceed $300 for facilities less than 25,000 square feet and not to exceed $500 for larger facilities. If the customer implements that project, an additional bonus will be included in the incentive to cover an additional 25% of the assessment cost using the same caps.
Enhancement	Certain key customer segments will be targeted based on energy savings potential and technology. Initial market segments will include hospitality, food service, health care, grocery, large industrial and large office. The strategy will also include outreach to key equipment partners and trade allies including consulting architects and engineering firms, process and refrigeration contractors and distributors, relevant professional and trade associations and other parties of interest in the market. An important part of the marketing plan will be content and functionality on the GMO website, which will direct customers to information about the program. More specifically, the marketing

	and communications plan will include: Education seminars implemented in each market to provide details about how to participate in the Program. The seminars will be tailored to the needs of business owners, building managers, architects, engineers, vendors, and contractors; A combination of strategies including major media advertising, outreach and presentations at professional and community forums and events, and through direct outreach to key customers and customer representatives. Marketing activities will include: Brochures that describe the benefits and features of the program including program application forms and worksheets. The brochures will be mailed upon demand and distributed through the call center and www.GMO.com and will be available for various public awareness events (presentations, seminars etc). Targeted direct mailings used to educate customers on the benefits of the program and explaining how they can apply. Customer and trade partner outreach and presentations (e.g. Restaurant Association, BOMA and other customer organizations) informing interested parties about the benefits of the program and how to participate. Print advertisements to promote the program placed in selected local media including the Kansas City area newspapers and trade publications. GMO website content providing program information resources, contact information, downloadable application forms and worksheets, and links to other relevant service and information resources. GMO customer account representatives trained to promote the program to their customers.

Program Name	**Commercial and Industrial New Construction**
Objective	The primary goal of the program is to encourage GMO's C&I customers to install energy efficient measures in existing facilities. More specifically, the program is designed to: Provide incentives to facility owners and operators for the installation of high-efficiency equipment and controls. Provide a marketing mechanism for electrical contractors, mechanical contractors, and their distributors to promote energy efficient equipment to end users.
Target Market and Eligibility	All GMO commercial and industrial retail customers are eligible for the program. However, the main target markets are: Customers in both existing buildings and new construction depending on the technology and code requirements. New construction design incentives are covered by the separate New Construction program. Other utilities have found that the following types of larger commercial customers participate with the highest frequency in their C&I EE programs: large office buildings, education facilities, grocery stores, health care facilities, and warehouses. Small business customers are the most difficult market segment to reach with EE programs in general, but such customers tend to more readily participate in the lighting EE programs than other types of EE programs.
Program Description	C&I Prescriptive Incentive Program provides prescriptive incentives to C&I customers for the installation of energy-efficiency equipment for numerous applications including lighting equipment, controls, heating, ventilation and air conditioning (HVAC) equipment, motors, refrigeration, and food service equipment. Prescriptive incentives are offered for a schedule of measures in each of these categories. Innovative energy efficiency measures or measures with large variability in application will be covered as part of the separate Custom Rebate Program. Application to existing facilities and/or new facilities will vary by measure depending on the codes and standards within new construction. New construction design assistance will be covered by the separate C&I New Construction Program. The key to program success is the engagement of the market actors throughout the delivery channel that currently exists. These actors include manufacturers, distributors, consultants,

	engineers and contractors. The program will have staff specifically dedicated to educating, collaborating and engaging these important players in the program. Through these existing market actors who have relationships with C&I customers, the new high efficient technology will be offered to customers as a viable option. To support the market actors, the program also includes customer educational and promotional pieces designed to assist facility owners, operators and decision makers with the information necessary to improve the energy efficiency of the systems in their facilities.
Rebates and Incentives	Incentives for each technology will vary based on cost effectiveness and market response. The program strives to cover at least 50% of the incremental cost of the measure to stimulate the market if it is cost effective. Additional guidelines may be established such as total incentives available per customer per year to assure that funds are allocated across all customer opportunities.
Enhancement	The primary goal of the program is to encourage GMO's C&I customers to build more efficient new buildings and to install energy efficient lighting, HVAC, building envelope, refrigeration, and controls measures in new buildings. More specifically, the program is designed to: • Provide design assistance to the architects and engineers that are designing new buildings. The key design assistance tool is building simulation modeling of more efficient building designs. • Provide incentives to new facility owners for the installation of high-efficiency lighting, HVAC, building envelope, refrigeration and other equipment and controls. Standard high efficiency equipment will be covered through the Prescriptive Program when no modeling is completed. When modeling is completed, they will be considered within the total savings percent and provided incentives as a total package. • Provide a marketing mechanism for architects and engineers to promote energy efficient new buildings and equipment to end users. • Overcome market barriers, including: Customers' lack of awareness and knowledge about the benefits and costs of energy efficiency improvements. Performance uncertainty associated with energy efficiency projects. Additional first costs for energy efficient measures. Lack of time, resources and motivation by the designer/engineer to consider efficient alternatives and model these results for the owner's consideration.

	• Ensure that the participation process is clear, easy to understand and simple. Certain barriers exist to the adoption of energy efficiency measures, including lack of investment capital, competition for funds with other capital improvements, lack of awareness/knowledge about the benefits and costs of energy efficiency measures, high transaction and information search costs, and technology performance uncertainties This program is designed to help overcome these market barriers and encourage greater adoption of energy efficiency measures in the new construction C&I market.

Program Name	**Energy Use Monitor**
Objective	Provide real-time energy use information that helps customers make energy use behavioral changes that reduce energy use.
Target Market and Eligibility	The program will primarily target single-family residential customers in the GMO market. However, the program will be available to all residential customers.
Program Description	The Energy Use Monitor Tool (EUM) will provide the GMO customer with an energy usage-monitoring device aimed at helping them better manage their energy costs through real time feedback. With rising energy costs in all aspects of daily life, customers are looking for information they can act upon which will affect their monthly energy bill. The EUM program also includes the "Energy Efficiency Starter Kit" which includes easily installed measures that demonstrate how easy it is to move towards improved home energy efficiency.
Rebates and Incentives	A free or low cost in home near real time energy monitor.

Program Name	**Appliance Turn-In Program**
Objective	The primary objective of the program is to incent customers to remove improperly operating, inefficient appliances, secondary appliances. The secondary purpose is to raise awareness of the energy benefits of Energy Star appliances. Provide a marketing mechanism for retail stores to promote energy efficient appliances to residential customers.
Target Market and Eligibility	Residential customers throughout the GMO territory are eligible for the program. The main target markets are: Customers with working second and third refrigerators and freezers, inefficient room air conditioners and inefficient dehumidifiers.
Program Description	Older vintage room air conditioners (room AC), refrigerators, freezers and dehumidifiers can be some of the least efficient electrical appliances in the home. Often these old units are used when they are not functioning properly and as a result use electricity very inefficiently. To encourage customers to dispose of their old appliances and purchase efficient Energy Star models, GMO proposes an appliance turn-in program. Located at retailer locations during special promotions, participants would receive coupons towards more efficient units if they turn in an old unit or arrange to have the old unit picked up. Units received will be recycled through a certified recycling agency. The program includes customer educational and promotional pieces designed to assist residential customers with the information necessary to improve the energy efficiency of their entire home. The program also includes customer and trade ally education to assist with understanding the technologies and applications that are being promoted, the incentives that are offered, and how the program functions.
Rebates and Incentives	Incentives will be provided on two levels, first an incentive to turn in or have picked up the old unit and the second an additional incentive to upgrade to an Energy Star appliance.

ENERGY EFFICIENCY PROGRAMS – C&I

Program Name	C&I Prescriptive Incentive Program
Objective	The primary goal of the program is to encourage GMO's C&I customers to install energy efficient measures in existing facilities. More specifically, the program is designed to: Provide incentives to facility owners and operators for the installation of high-efficiency equipment and controls. Provide a marketing mechanism for electrical contractors, mechanical contractors, and their distributors to promote energy efficient equipment to end users.
Target Market and Eligibility	All GMO commercial and industrial retail customers are eligible for the program. The main target markets are: large office buildings, education facilities, grocery stores, health care facilities, and warehouses.
Program Description	C&I Prescriptive Incentive Program provides prescriptive incentives to C&I customers for the installation of energy-efficiency equipment for numerous applications including lighting equipment, controls, heating, ventilation and air conditioning (HVAC) equipment, motors, refrigeration, and food service equipment. Prescriptive incentives are offered for a schedule of measures in each of these categories. Innovative energy efficiency measures or measures with large variability in application will be covered as part of the separate Custom Rebate Program. Application to existing facilities and/or new facilities will vary by measure depending on the codes and standards within new construction. New construction design assistance will be covered by the separate C&I New Construction Program.
Rebates and Incentives	Incentives for each technology will vary based on cost effectiveness and market response. The program strives to cover at least 50% of the incremental cost of the measure to stimulate the market if it is cost effective. Additional guidelines may be established such as total incentives available per customer per year to assure that funds are allocated across all customer opportunities.

Program Name	**Commercial and Industrial RFP Program**
Objective	The primary goal of the program is to encourage GMO's C&I customers to install energy efficient process, refrigeration, and other efficient equipment & controls in existing facilities beyond what they would have installed without the program. The program is to have special offers that stimulate larger package projects, not just measures or specific systems. More specifically, the program is designed to: Stimulate the market and move stalled efficiency projects. Provide incentives to facility owners and operators for the installation of high-efficiency process, refrigeration and other equipment and controls. Provide a marketing mechanism for consulting engineers, process and equipment contractors and distributors to promote specific energy efficient equipment to end users.
Target Market and Eligibility	All KC&L commercial and industrial retail customers are eligible for the program. The RFP's will focus on certain sub segments and with certain types of projects/technologies. Some sample targets include: Hospitals and Health Care institutions HVAC equipment and controls. Printing industry process projects.
Program Description	The C&I RFP Program provides incentives to C&I customers on a very targeted and limited time basis for the installation of innovative and non-standard energy-efficiency equipment and controls. This program will pertain to existing facilities only. This program will be offered through to targeted customer and markets with specific criteria. The RFP will have a limited time with a specific maximum budget. Through limited offerings, customers and contractors are more motivated to move stalled projects. It also allows GMO to increase or decrease projects and spending based on market objectives The RFP program also has the flexibility to target specific technologies or types of projects. The program includes customer educational and promotional pieces designed to assist facility owners, operators and decision makers with the information necessary to respond to the RFP with proposals. The program also includes customer and trade ally education to assist with understanding the technologies that are being promoted, the incentives that are offered, and how the

	program functions.
Rebates and Incentives	The C&I RFP Program is a financial assistance and education program that provides incentives for the installation of energy efficiency measures in existing non-residential facilities in response to the unique specifications of the RFP. Customers/Contractors will submit their project proposals in response to the RFP including savings estimates. GMO staff or its subcontractor will review these proposals and savings estimates and determine if they qualify for a financial award. This review of the savings analysis helps assure that GMO funds are being cost effectively used to promote efficiency. Incentives will be identified within the RFP on a per kWh and per kW saved basis so that both energy and demand savings will be rewarded. Levels of incentives will vary depending on the specific RFP. The initial incentives will be established for each RFP separately based on DSMore cost effectiveness modeling. Other guidelines to reduce free ridership will also be established. These include years of payback, total incentive dollars per customer per year and percent of total project cost.

(A) The utility shall estimate the incremental and cumulative number of program participants and end-use measure installations due to the program and the incremental and cumulative demand reduction and energy savings due to the program in each avoided cost period in each year of the planning horizon.

1. Initial estimates of demand-side program load impacts shall be based on the best available information from in-house research, vendors, consultants, industry research groups, national laboratories or other credible sources.

2. As the load-impact measurements required by subsection (9)(B) become available, these results shall be used in the ongoing development and screening of demand-side programs and in the development of alternative resource plans;

(B) In each year of the planning horizon, the benefits of each demand-side program shall be calculated as the cumulative demand reduction multiplied by the avoided demand cost plus the cumulative energy savings multiplied by the avoided energy cost, summed over the avoided cost periods within each year. These calculations shall be performed using the avoided probable environmental costs developed pursuant to section (2);

(C) Utility Cost Test. In each year of the planning horizon, the costs of each demand-side program shall be calculated as the sum of all utility incentive payments plus utility costs to administer, deliver and evaluate each demand-side program. For purposes of this test, demand-side program costs shall not include lost revenues or costs paid by participants in demand-side programs;

(D) Total Resource Cost Test. In each year of the planning horizon, the costs of each demand-side program shall be calculated as the sum of all incremental costs of end-use measures that are implemented due to the

program (including both utility and participant contributions) plus utility costs to administer, deliver and evaluate each demand-side program. For purposes of this test, demand-side program costs shall not include lost revenues or utility incentive payments to customers;

(E) The present value of program benefits minus the present value of program costs over the planning horizon must be positive or the ratio of annualized benefits to annualized costs must be greater than one (1) for a demand-side program to pass the utility cost test or the total resource cost test. The utility may relax this criterion for programs that are judged to have potential benefits that are not captured by the estimated load impacts or avoided costs; and

(F) Potential demand-side programs that pass the total resource cost test shall be considered as candidate resource options and must be included in at least one (1) alternative resource plan developed pursuant to 4 CSR 240-22.060(3).

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 14" allows GMO to use the software package, DSMore, for the evaluation of both end-use measures and demand-side programs. DSMore meets the requirements of 22.050 Demand-Side Resource Analysis:(7) (A, B C, D E &F)

SECTION 8: LOAD IMPACT ESTIMATES FOR DEMAND-SIDE PROGRAMS

(8) For each demand-side program that passes the total resource cost test, the utility shall develop time-differentiated load impact estimates over the planning horizon at the level of detail required by the supply system simulation model that is used in the integrated resource analysis required by 4 CSR 240-22.060(4).

The Commission granted GMO a waiver under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009. This waiver, referred to as "Waiver Request 14" allows GMO to use the software package, DSMore, for the evaluation of both end-use measures and demand-side programs. DSMore analyzes load impacts at the hourly level and also provides monthly and annual load impacts of programs.

SECTION 9: EVALUATION OF DEMAND-SIDE PROGRAMS

(9) Evaluation of Demand-Side Programs. The utility shall develop evaluation plans for all demand-side programs that are included in the preferred resource plan selected pursuant to 4 CSR 240-22.070(6). The purpose of these evaluations shall be to develop the information necessary to improve the design of existing and future demand-side programs, and to gather data on the implementation costs and load impacts of programs for use in cost-effectiveness screening and integrated resource analysis.

An evaluation work plan for the existing energy efficiency and demand response programs has been authored by Opinion Dynamics Corporation (ODC) can be viewed in Volume 7, Appendix 7B". The evaluation plan scope of work was developed to insure that the evaluation will meet the requirements of 4 CSR 240-22.050(9) as outlined below.

GMO will engage a consultant to evaluate future programs and the scope of work will be identical to the ODC evaluation plan for existing programs.

(A) Process Evaluation. Each demand-side program that is part of the utility's preferred resource plan shall be subjected to an ongoing evaluation process which addresses at least the following questions about program design:

1. What are the primary market imperfections that are common to the target market segment?

2. Is the target market segment appropriately defined or should it be further subdivided or merged with other segments?

3. Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target segment?

4. Are the communication channels and delivery mechanisms appropriate for the target segment? And

5. What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation of each endues measure included in the program?

(B) Impact Evaluation. The utility shall develop methods of estimating the actual load impacts of each demand-side program included in the utility's preferred resource plan to a reasonable degree of accuracy.

1. Impact evaluation methods. Comparisons of one (1) or both of the following types shall be used to measure program impacts in a manner that is based on sound statistical principles:

A. Comparisons of preadoption and postadoption loads of program participants, corrected for the effects of weather and other intertemporal differences; and

B. Comparisons between program participants' loads and those of an appropriate control group over the same time period.

2. The utility shall develop load-impact measurement protocols that are designed to make the most cost-effective use of the following types of measurements, either individually or in combination: monthly billing data, load research data, end-use load metered data, building and equipment simulation models, and survey responses or audit data on appliance and equipment type, size and efficiency levels, household or business characteristics, or energy-related building characteristics.

(C) The utility shall develop protocols to collect data regarding demand-side program market potential, participation rates, utility costs, participant costs and total costs.

SECTION 10: DEMAND-SIDE DESIGN

(10) Demand-side programs and load-building programs shall be separately designed and administered, and all costs shall be separately classified so as to permit a clear distinction between demand-side program costs and the costs of load-building programs. The costs of demand-side resource development that also serve other functions shall be allocated between the functions served.

GMO did not include load-building programs in the IRP evaluations therefore Rule 22.050 (10) has been fulfilled.

SECTION 11: REPORTING REQUIREMENTS

(11) Reporting Requirements. To demonstrate compliance with the provisions of this rule, and pursuant to the requirements of 4 CSR 240-22.080, the utility shall prepare a report that contains at least the following information:

(A) A list of the end-use measures developed for initial screening pursuant to the requirements of section (1) of this rule;

A list of the end-use measures can be found in Section of this document, 22.050 Demand-Side resource Analysis.

(B) The estimated load impacts, annualized costs per installation and the results of the probable environmental ben efits test for each end-use measure identified pursuant to section (1);

(C) The technical potential and the results of the utility benefits test for each end-use measure that passes the probable environmental benefits test;

(D) Documentation of the methods and assumptions used to develop the avoided cost estimates developed pursuant to section (2) including:

1. A description of the type and timing of new supply resources, including transmission and distribution facilities, used to calculate avoided capacity costs;

2. A description of the assumptions and procedure used to calculate avoided running costs;

3. A description of the avoided cost periods and how they were determined;

4. A tabulation of the direct running costs and the probable environmental running costs for each avoided cost period in each year of the planning horizon; and

5. A tabulation of the avoided demand cost, the avoided direct energy costs and the avoided probable environmental energy costs for each avoided cost period in each year of the planning horizon;

(E) Copies of completed market research studies, pilot programs, test marketing programs and other studies as required by section (5) of this rule and descriptions of those studies that are planned or in progress and the scheduled completion dates;

(F) A description of each market segment identified pursuant to subsection (6)(A);

(G) A description of each demand-side program developed for initial screening pursuant to section (6) of this rule;

See demand-side program descriptions in Section 7: above.

(H) A tabulation of the incremental and cumulative number of participants, load impacts, utility costs and program participant costs in each year of the planning horizon for each demand-side program developed pursuant to section (6) of this rule;

See response to Rule 050(11)(I) below.

(I) The results of the utility cost test and the total resource cost test for each demand-side program developed pursuant to section (6) of this rule; and

11.1 CHANGE A LIGHT

Table 73: Change a Light Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	4.91
TRC Test	5.06
RIM Test	0.68
Societal Test	6.13
Participant Test	14.18

Table 74: Change a Light Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
	[redacted]
Participant Costs (net free)	[redacted]
	[redacted]
Avoided Electric Production with Adders	[redacted]
Cost-Based Avoided Electric Capacity	[redacted]
Avoided T&D Electric	[redacted]
Total Avoided Cost	[redacted]
	[redacted]
Administration, Marketing & Delivery Costs	[redacted]
Incentives	[redacted]
Total Program Cost	[redacted]
	[redacted]
Environmental Benefits	[redacted]

Table 75: Change a Light Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

HC

Table 76: Change a Light Impacts and Savings ** Highly Confidential **

Impacts and Savings								
Electric Impacts/Savings								
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]							
2								
3								
4								
5								
6								
7								
8								
9								

Table 77: Change a Light Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]				
2					
3					
4					
5					
6					
7					
8					
9					

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					

HC

11.2 HOME PERFORMANCE WITH ENERGY STAR

Table 78: Home Performance with Energy Star Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	1.56
TRC Test	1.36
RIM Test	0.88
Societal Test	1.45
Participant Test	2.05

Table 79: Home Performance with Energy Star Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
	[redacted]
Participant Costs (net free)	[redacted]
	[redacted]
Avoided Electric Production with Adders	[redacted]
Cost-Based Avoided Electric Capacity	[redacted]
Avoided T&D Electric	[redacted]
Total	[redacted]
	[redacted]
Administration Costs	[redacted]
Incentives	[redacted]
Total	[redacted]
	[redacted]
Environmental Benefits	[redacted]

HC

Table 80: Home Performance with Energy Star Participation Costs ** Highly Confidential **

Participation and Total Participant Costs					
	Participation				
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 81: Home Performance with Energy Star Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Per Participant				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

HC

Table 82: Home Performance with Energy Star Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]				
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					
4					
5					

HC

11.3 LOW INCOME WEATHERIZATION

Table 83: Low Income Weatherization Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	0.99
TRC Test	0.99
RIM Test	0.56
Societal Test	1.09
Participant Test	N/A

Table 84: Low Income Weatherization Lost Revenues, Costs, and Benefits
**** Highly Confidential ****

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	
Avoided Electric Production with Adders	
Cost-Based Avoided Electric Capacity	
Avoided T&D Electric	
Total	
Administration Costs	
Incentives	
Total	
Environmental Benefits	

HC

Table 85: Low Income Weatherization Participation Costs ** Highly Confidential **

Participation and Total Participant Costs					
	Participation				
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 86: Low Income Weatherization Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

HC

Table 87: Low Income Weatherization Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]				
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					
4					
5					

HC

11.4 LOW INCOME AFFORDABLE NEW HOMES

Table 88: Low Income Affordable New Homes Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	2.61
TRC Test	1.67
RIM Test	1.28
Societal Test	1.76
Participant Test	1.32

Table 89: Low Income Affordable New Homes Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	
Avoided Electric Production with Adders	
Cost-Based Avoided Electric Capacity	
Avoided T&D Electric	
Total	
Administration Costs	
Incentives	
Total	
Environmental Benefits	

HC

Table 90: Low Income Affordable New Homes Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								

Table 91: Low Income Affordable New Homes Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								

HC

Table 92: Low Income Affordable New Homes Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]				
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					
4					
5					

HC

11.5 ENERGY STAR NEW HOMES

Table 93: Energy Star New Homes Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	3.89
TRC Test	1.86
RIM Test	1.30
Societal Test	1.97
Participant Test	1.48

Table 94: Energy Star New Homes Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	
Avoided Electric Production with Adders	
Cost-Based Avoided Electric Capacity	
Avoided T&D Electric	
Total	
Administration, Marketing & Delivery Costs	
Incentives	
Total	
Environmental Benefits	

Table 95: Energy Star New Homes Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]							
2								
3								
4								
5								

HC

Table 96: Energy Star New Homes Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]							
2	[redacted]							
3	[redacted]							
4	[redacted]							
5	[redacted]							
6	[redacted]							
7	[redacted]							
8	[redacted]							
9	[redacted]							
10	[redacted]							
11	[redacted]							
12	[redacted]							
13	[redacted]							
14	[redacted]							
15	[redacted]							
16	[redacted]							
17	[redacted]							
18	[redacted]							
19	[redacted]							

Table 97: Energy Star New Homes Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]				
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					

[redacted]		
Year		
1		
2		
3		
4		
5		

HC

11.6 BUILDING OPERATOR CERTIFICATION

Table 98: Building Operator Certification Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	1.54
TRC Test	1.36
RIM Test	0.86
Societal Test	1.49
Participant Test	2.88

Table 99: Building Operator Certification Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	
Avoided Electric Production with Adders	
Cost-Based Avoided Electric Capacity	
Avoided T&D Electric	
Total	
Administration Costs	
Incentives	
Total	
Environmental Benefits	

Table 100: Building Operator Certification Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]							
2								
3								
4								
5								
6								
7								

HC

Table 101: Building Operator Certification Impacts and Savings ** Highly Confidential **

Impacts and Savings		
	Electric Impacts/Savings	
	Incremental	Cumulative
Year	[redacted]	
1		
2		
3		
4		
5		
6		
7		

Table 102: Building Operator Certification Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario	
	Electric
Year	[redacted]
1	
2	
3	
4	
5	
6	
7	

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					
4					
5					

HC

11.7 ENERGY OPTIMIZER

Table 103: Energy Optimizer Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	4.92
TRC Test	4.92
RIM Test	4.92
Societal Test	4.92
Participant Test	1.00

Table 104: Energy Optimizer Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	
Avoided Electric Production with Adders	
Cost-Based Avoided Electric Capacity	
Avoided T&D Electric	
Total	
Administration, Marketing & Delivery Costs	
Incentives	
Total	
Environmental Benefits	

HC

Table 105: Energy Optimizer Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Table 106: Energy Optimizer Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

HC

Table 107: Energy Optimizer Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario	
	Electric
Year	[redacted]
1	[redacted]
2	[redacted]
3	[redacted]
4	[redacted]
5	[redacted]
6	[redacted]
7	[redacted]
8	[redacted]
9	[redacted]
10	[redacted]
11	[redacted]
12	[redacted]
13	[redacted]
14	[redacted]
15	[redacted]
16	[redacted]
17	[redacted]
18	[redacted]
19	[redacted]
20	[redacted]
21	[redacted]
22	[redacted]
23	[redacted]
24	[redacted]
25	[redacted]

HC

11.8 <u>MPOWER</u>

Table 108: MPower Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	4.15
TRC Test	4.15
RIM Test	3.07
Societal Test	4.15
Participant Test	N/A

Table 109: MPower Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
	[redacted]
Participant Costs (net free)	[redacted]
	[redacted]
Avoided Electric Production with Adders	[redacted]
Cost-Based Avoided Electric Capacity	[redacted]
Avoided T&D Electric	[redacted]
Total	[redacted]
	[redacted]
Administration Costs	[redacted]
Implementation / Participation Costs	[redacted]
Total	[redacted]
	[redacted]
Environmental Benefits	[redacted]

HC

Table 110: MPower Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]							
2	[redacted]							
3	[redacted]							
4	[redacted]							
5	[redacted]							
6	[redacted]							
7	[redacted]							
8	[redacted]							
9	[redacted]							
10	[redacted]							
11	[redacted]							
12	[redacted]							
13	[redacted]							
14	[redacted]							
15	[redacted]							
16	[redacted]							
17	[redacted]							
18	[redacted]							
19	[redacted]							
20	[redacted]							

Table 111: MPower Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	[redacted]							
1	[redacted]							
2	[redacted]							
3	[redacted]							
4	[redacted]							
5	[redacted]							
6	[redacted]							
7	[redacted]							
8	[redacted]							
9	[redacted]							
10	[redacted]							
11	[redacted]							
12	[redacted]							
13	[redacted]							
14	[redacted]							
15	[redacted]							
16	[redacted]							
17	[redacted]							
18	[redacted]							
19	[redacted]							
20	[redacted]							

HC

Table 112: MPower Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
20	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
20	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

HC

11.9 APPLIANCE TURN-IN

Table 113: Appliance Turn In Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	2.24
TRC Test	2.24
RIM Test	0.72
Societal Test	2.56
Participant Test	N/A

Table 114: Appliance Turn In Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
	[redacted]
Participant Costs (net free)	[redacted]
	[redacted]
Avoided Electric Production with Adders	[redacted]
Cost-Based Avoided Electric Capacity	[redacted]
Avoided T&D Electric	[redacted]
Total Avoided Cost	[redacted]
	[redacted]
Administration Costs	[redacted]
Implementation / Participation Costs	[redacted]
Incentives	[redacted]
Total Program Cost	[redacted]
	[redacted]
Environmental Benefits	[redacted]

Table 115: Appliance Turn In Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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Table 116: Appliance Turn In Impacts and Savings ** Highly Confidential **

Impacts and Savings								
Electric Impacts/Savings								
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

Table 117: Appliance Turn In Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario	
	Electric
Year	[redacted]
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					
4					
5					

HC

11.10 BLUE LINE

Table 118: Blue Line Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	4.04
TRC Test	4.13
RIM Test	1.14
Societal Test	4.53
Participant Test	3.68

Table 119: Blue Line Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
	[redacted]
Participant Costs (net free)	[redacted]
	[redacted]
Avoided Electric Production with Adders	[redacted]
Cost-Based Avoided Electric Capacity	[redacted]
Avoided T&D Electric	[redacted]
Total	[redacted]
	[redacted]
Administration, Marketing & Delivery Costs	[redacted]
Incentives	[redacted]
Total	[redacted]
	[redacted]
Environmental Benefits	[redacted]

Table 120: Blue Line Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New	New	Cumulative	Cumulative	Cumulative Participants	One-Time	Annual	Total
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 121: Blue Line Impacts and Savings ** Highly Confidential **

Impacts and Savings								
Electric Impacts/Savings								
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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Table 122: Blue Line Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Utility Program Costs					
	Electric				
Year	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

HC

11.11 COOL HOMES

Table 123: Cool Homes Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	3.07
TRC Test	2.70
RIM Test	1.18
Societal Test	2.86
Participant Test	3.60

Table 124: Cool Homes Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	
Avoided Electric Production with Adders	
Cost-Based Avoided Electric Capacity	
Avoided T&D Electric	
Total Avoided Cost	
Administration, Marketing & Delivery Costs	
Incentives	
Total Program Cost	
Environmental Benefits	

Table 125: Cool Homes Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New	New	Cumulative	Cumulative	Cumulative Participants	One-Time	Annual	Total
1	[redacted]							
2								
3								
4								
5								

HC

Table 126: Cool Homes Impacts and Savings ** Highly Confidential **

Year	Impacts and Savings	
	Electric Impacts/Savings	
	Incremental	Cumulative
1	[redacted]	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
0		
0		
0		

Table 127: Cool Homes Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]				
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					
4					
5					

HC

11.12 ENERGY STAR PRODUCTS

Table 128: Energy Star Products Test Results

Tests	
Benefit / Cost Test Results	
Utility Test	7.62
TRC Test	4.44
RIM Test	1.13
Societal Test	4.94
Participant Test	4.62

Table 129: Energy Star Products Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	
Avoided Electric Production with Adders	
Cost-Based Avoided Electric Capacity	
Avoided T&D Electric	
Total	
Administration, Marketing & Delivery Costs	
Incentives	
Total	
Environmental Benefits	

Table 130: Energy Star Products Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]							
2								
3								
4								
5								

HC

Table 131: Energy Star Products Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]							
2	[redacted]							
3	[redacted]							
4	[redacted]							
5	[redacted]							
6	[redacted]							
7	[redacted]							
8	[redacted]							
9	[redacted]							
10	[redacted]							
11	[redacted]							
12	[redacted]							
13	[redacted]							
14	[redacted]							
15	[redacted]							
16	[redacted]							
17	[redacted]							
18	[redacted]							

Table 132: Energy Star Products Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario					
	Electric				
Year	Production	T&D	Ancillary	Capacity	Total
1	[redacted]				
2	[redacted]				
3	[redacted]				
4	[redacted]				
5	[redacted]				
6	[redacted]				
7	[redacted]				
8	[redacted]				
9	[redacted]				
10	[redacted]				
11	[redacted]				
12	[redacted]				
13	[redacted]				
14	[redacted]				
15	[redacted]				
16	[redacted]				
17	[redacted]				
18	[redacted]				

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2	[redacted]				
3	[redacted]				
4	[redacted]				
5	[redacted]				

HC

11.13 ON-LINE AUDIT

Table 133: On Line Audit Test Results

Tests	
Benefit / Cost Test Results	
Utility Test	12.37
TRC Test	12.37
RIM Test	1.41
Societal Test	13.53
Participant Test	13.28

Table 134: On Line Audit Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
	[redacted]
Participant Costs (net free)	[redacted]
	[redacted]
Avoided Electric Production with Adders	[redacted]
Cost-Based Avoided Electric Capacity	[redacted]
Avoided T&D Electric	[redacted]
Total	[redacted]
	[redacted]
Administration, Marketing & Delivery Costs	[redacted]
Incentives	[redacted]
Total	[redacted]
	[redacted]
Environmental Benefits	[redacted]

Table 135: On Line Audit Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New Participants	New Free Riders	Cumulative Participants	Cumulative Free Riders	Cumulative Participants (net free riders)	One-Time Investment	Annual Investment	Total Costs
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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Table 136: On Line Audit Impacts and Savings ** Highly Confidential **

	Impacts and Savings
	Electric Impacts/Savings
	Incremental / Cumulative
Year	[redacted]
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

Table 137: On Line Audit Avoided Costs and Utility Program Costs ** Highly Confidential **

	Avoided Costs (Net Free Riders) for Today Scenario
	Electric
Year	[redacted]
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

	Utility Program Costs
	Electric
Year	[redacted]
1	
2	
3	
4	
5	

HC

11.14 C&I CUSTOM REBATE

Table 138: C&I Custom Rebate Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	5.71
TRC Test	3.49
RIM Test	1.21
Societal Test	3.87
Participant Test	3.37

Table 139: C&I Custom Rebate Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
	[redacted]
Participant Costs (net free)	[redacted]
	[redacted]
Avoided Electric Production with Adders Cost-Based Avoided Electric Capacity Avoided T&D Electric	[redacted]
Total Avoided Cost	[redacted]
	[redacted]
Administration, Marketing & Delivery Costs Incentives	[redacted]
Total Program Cost	[redacted]
	[redacted]
Environmental Benefits	[redacted]

Table 140: C&I Custom Rebate Participation Costs ** Highly Confidential **

Participation and Total Participant Costs		
	Participation	Total Participant Costs
Year	[redacted]	[redacted]
1	[redacted]	[redacted]
2	[redacted]	[redacted]
3	[redacted]	[redacted]
4	[redacted]	[redacted]
5	[redacted]	[redacted]

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Table 141: C&I Custom Rebate Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	,633.00	443.10	2,532,000	1,772,400	633.0	443.1	2,532,000	1,772,400
2	[redacted]							
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								

Table 142: C&I Custom Rebate Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario	
	Electric
Year	[redacted]
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	

Utility Program Costs	
	Electric
Year	[redacted]
1	
2	
3	
4	
5	

HC

11.15 C&I PRESCRIPTIVE REBATE

Table 143: C&I Prescriptive Rebate Test Results

Tests	
	Benefit / Cost Test Results
Utility Test	4.48
TRC Test	3.19
RIM Test	1.19
Societal Test	3.56
Participant Test	3.01

Table 144: C&I Prescriptive Rebate Lost Revenues, Costs, and Benefits ** Highly Confidential **

Lost Revenues, Costs, and Benefits	
	Today's Value
Lost Revenue (Electric)	[redacted]
Participant Costs (net free)	[redacted]
Avoided Electric Production with Adders	[redacted]
Cost-Based Avoided Electric Capacity	[redacted]
Avoided T&D Electric	[redacted]
Total	[redacted]
Administration, Marketing & Delivery Costs	[redacted]
Incentives	[redacted]
Total	[redacted]
Environmental Benefits	[redacted]

Table 145: C&I Prescriptive Rebate Participation Costs ** Highly Confidential **

Participation and Total Participant Costs								
	Participation					Total Participant Costs		
Year	New	New	Cumulative	Cumulative	Cumulative Participants	One-Time	Annual	Total
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

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Table 146: C&I Prescriptive Rebate Impacts and Savings ** Highly Confidential **

Impacts and Savings								
	Electric Impacts/Savings							
	Incremental				Cumulative			
Year	kW	kW (net free)	kWh	kWh (net free)	kW	kW (net free)	kWh	kWh (net free)
1	[redacted]							
2	[redacted]							
3	[redacted]							
4	[redacted]							
5	[redacted]							
6	[redacted]							
7	[redacted]							
8	[redacted]							
9	[redacted]							
10	[redacted]							
11	[redacted]							
12	[redacted]							
13	[redacted]							
14	[redacted]							
15	[redacted]							
16	[redacted]							
17	[redacted]							
18	[redacted]							
19	[redacted]							
20	[redacted]							
21	[redacted]							
22	[redacted]							
23	[redacted]							
24	[redacted]							

HC

Table 147: C&I Prescriptive Rebate Avoided Costs and Utility Program Costs ** Highly Confidential **

Avoided Costs (Net Free Riders) for Today Scenario	
	Electric
Year	
1	[redacted]
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	

Utility Program Costs					
	Electric				
Year	Administration	Implementation	Incentives	Other	Total
1	[redacted]				
2					
3					
4					
5					

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(J) A description of the process and impact evaluation plans for demand-side programs that are included in the preferred resource plan as required by section (9) of this rule and the results of any such evaluations that have been completed since the utility's last scheduled filing pursuant to 4 CSR 240-22.080.

See response in Section 9:above.