STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

IN THE MATTER OF THE VERIFIED PETITION OF INDIANA MICHIGAN POWER COMPANY FOR APPROVAL OF ALTERNATIVE REGULATORY PLAN FOR DEMAND SIDE MANAGEMENT (DSM) AND ENERGY EFFICIENCY (EE) PROGRAMS FOR 2015 AND ASSOCIATED ACCOUNTING AND RATEMAKING MECHANISMS, INCLUDING TIMELY RECOVERY THROUGH I&M'S DSM/EE PROGRAM COST RIDER OF ASSOCIATED COSTS, INCLUDING ALL PROGRAM COSTS, NET LOST REVENUE, SHAREHOLDER INCENTIVES AND CARRYING CHARGES, DEPRECIATION AND OPERATIONS AND MAINTENANCE EXPENSE ON CAPITAL EXPENDITURES.	)	**CAUSE NO. 44486**

EXHIBITS
OF
INDIANA MICHIGAN POWER COMPANY

VOLUME 2 OF 3

EXHIBIT JCW-2
EXHIBIT JCW-3

Indiana Market Assessment and Action Plan for Electric Demand Side Management (DSM) Programs: Final Report

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Forefront Economics Inc. and H. Gil Peach & Associates. Indiana Market Assessment and Action Plan for Electric Demand Side Management (DSM) Programs: Final Report. Report prepared for Indiana Michigan Power Company, Fort Wayne, Indiana, November 20, 2008.

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EXECUTIVE OVERVIEW

This document presents a long-term demand side management (DSM) market potential assessment and action plan for residential and non-residential electric customers in the Indiana portion of the Indiana Michigan Power Company service area, referred to in this report as I&M-Indiana (I&M). This report was prepared by Forefront Economics Inc and H. Gil Peach and Associates with consultation and review by the DSM Collaborative[1]. The design, implementation, oversight and cost effectiveness of electric DSM programs are addressed in this report.

Overview of Findings

Key findings from the DSM Action Plan are summarized in Table 1.

Table 1. Annual Usage and DSM Potential in Planning Year 20

	kWh (millions)	Percent of Total
Total Usage	20,466	100%
Technical Potential Savings	5,755	28%
Economic Potential (@ $0.07/kWh)*	3,175	16%
Recommended DSM Programs (after 5 years)**	306	1.7%

* Based on incremental cost of measures without administration or overhead costs.
** DSM savings shown as percent of Year 5 usage.

The technical potential shows that if the electric saving technologies identified in this report were applied across all applicable customers, without regard to market or economic constraints, weather normalized annual kWh usage could be reduced by 28 percent. A recent meta-analysis of potential studies found a median technical potential of 33 percent for electric measures across all customer segments.[2] The 28 percent technical potential found in this study is similar to other studies but on the low side of estimates due to the large amount of manufacturing load. Manufacturing customers typically have less DSM opportunities as a percentage of usage than residential or commercial customers. After five years of operation, the DSM programs recommended in this study are projected to lower annual kWh usage by 1.7 percent.

The approach used to develop the set of recommended DSM programs consisted of the following steps:

(1) conduct a market assessment for determining electric usage and characteristics across customer groups;
(2) review a comprehensive list of DSM technologies and estimate the energy savings potential;
(3) consider the appropriateness of selected technologies for the I&M service area in terms of markets, cost effectiveness and accessibility to products;
(4) group the highest potential technologies into logical sets for marketing and outreach;
(5) design program strategies to promote the technologies based on industry best practices;
(6) consider the cost effectiveness of the designed program, including costs to the utility and to participating customers; and
(7) describe a final set of recommended program designs that make the most sense for the utility and have a strong potential for delivering cost effective energy savings.

[1] The DSM Collaborative is comprised of representatives from I&M and the Indiana Office of Utility Consumer Counselor.
[2] Nadel, Steven, Anna Shipley and R. Neal Elliott. The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S. – A Meta-Analysis of Recent Studies. 2004 ACEEE Summer Study in Energy Efficiency in Buildings.

As a result of this process, the following list of DSM programs were designed, evaluated for cost effectiveness, and a recommendation for implementation (yes or no) provided by the authors. I&M will, of course, make the final selection of programs to be submitted for regulatory approval.

Reference	Program Name	Recommended
1	Commercial and Industrial Peak Reduction	Yes
2	Residential Peak Reduction	Yes
3	Renewables and Demonstrations	Yes
4	Commercial and Industrial Incentives	Yes
5	Commercial and Industrial Rebates	Yes
6	Commercial and Industrial Retro-Commissioning Lite	No
7	Commercial and Industrial HVAC Optimization	No
8	Commercial and Industrial Audit	Yes
9	Commercial and Industrial New Construction	Yes
10	Residential Whole House	Yes
11	Residential Rebates	Yes
12	Residential Appliance Recycling	Yes
13	Residential New Construction	No
14	Residential Solar Siting	Yes
15	Residential Low and Moderate Income Weatherization	Yes

All of the recommended programs were found to be cost effective from a total resource cost (TRC) perspective with the exception of the Renewables and Demonstrations and Residential Low and Moderate Income Weatherization programs.

Table 2. Energy Savings and Annual Budget for Recommended Programs

Year	Cumulative kWh Savings (millions)	Program Budget (millions $)	Cost per Customer	Percent of Revenue
1	25.8	6.0	$ 14.94	0.7%
2	70.1	9.9	$ 23.03	1.1%
3	131.6	13.3	$ 30.00	1.5%
4	210.8	15.4	$ 33.85	1.7%
5	306.3	18.7	$ 40.00	2.0%

Annual program budgets are estimated at $18.7 million in Year 5 for all recommended programs. This amounts to approximately 2.0 percent of the revenues from customers included in this study and equates to spending of $40 per customer for program delivery cost and incentives. Based on recent data from the US Department of Energy on DSM program spending, $40 per customer is higher than average of comparably sized utilities but still well within the range of spending. Spending per customer by the comparable utilities ranged from less than one dollar to nearly $90, averaging $23. Spending as a percent of revenue averaged 1.1 percent with a wide range.

Overview of Approach

The purpose of this section is to provide an overview of the approach used in the preparation of this DSM Action Plan. Our approach is perhaps best described as three components, each building off of the last. These components are Market Assessment, DSM Potential and DSM Programs.

Market Assessment

Market Assessment provides the foundation layer of the analysis and supports the work of the other two components. The objective of the market assessment component is to describe customers and loads in sufficient detail to provide an understanding of energy usage by market segment. An important aspect of this project is that the market assessment was completed using a blend of internal I&M data, service territory specific secondary data, and detailed energy modeling. By blending internal utility data with secondary data sources, a much richer market assessment is possible. Key to the market assessment layer is a rigorous analysis of actual customer billing and hourly load data to construct electric usage models for each residential and non-residential segment.

DSM Potential

The DSM potential component of the analysis builds off of the market assessment and provides an estimate of technical potential and DSM supply curves showing the amount of DSM potential available at various costs per kWh. At this stage of the analysis the savings potential of several Energy Efficiency Measures (EEM) is assessed. EEM savings potential is constructed from the use of secondary information documenting the industry's experience with the technology adjusted for the market assessment and load modeling results specific to I&M. The process of blending internal and secondary information along with energy modeling to develop the market assessment and DSM potential estimates is shown in the figure below.

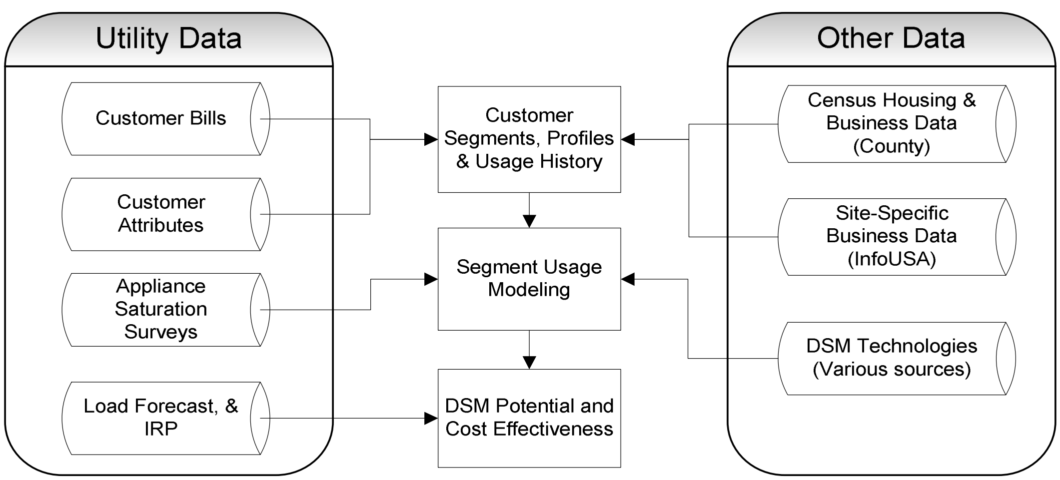


Figure 1. Overview of Market Assessment and DSM Potential Estimates

A significant benefit from this approach is that it results in end-use load profiles and DSM potential estimates by market segment that are based on customer characteristics and energy usage specific to I&M. I&M service territory specific data used to construct the analysis include:

- Monthly energy bills for nearly 47,000 customer sites sampled from 16 market segments.[3]
- Customer attribute information from I&M CIS including housing type, initial service year, and Standard Industrial Classification (SIC) code for non-residential customers.
- Site-specific business data including business type and employment obtained from InfoUSA for I&M service area. These records provided the information necessary to estimate non-residential floor space and energy utilization per square foot by non-residential segment.
- Hourly (8,760) load data for residential and 11 non-residential customer classes. Hourly load data are valuable for calibrating model results.
- Heating fuel and appliance saturation, size of home (square feet) and vintage of construction (year built) were available from a 2005 residential customer survey.

DSM Programs

DSM program design represents the final layer of the core analysis of this Action Plan. The program design process builds off of the prior two layers by mapping measures to programs through an analysis of the best practices from other leading electricity and combined companies. This approach balances engineering and economic characteristics of specific end-use technologies with public policy and corporate objectives. The goals in this effort are, to the extent possible, to incorporate the specific environmental and market characteristics of the service territory, and to orient the programs toward both a technology optimum and a participation optimum. To be effective, these goals in program design and practical implementation will be implemented and optimized within a seasoned marketing framework. Strategic change comes from working closely with customers and suppliers to jointly create program success. The result is a set of recommended programs that are optimized to fit I&M.

Organization of Report

The first three sections following this Overview present the findings of each of the three components or “layers” of analysis discussed above: Market Assessment, DSM Potential and DSM Programs. The final two sections of the main report present program cost effectiveness results and evaluation plans. Several appendices following the main report provide additional documentation on various aspects of the analysis.

In this report the term Demand Side Management (DSM) refers to the planning and implementation of utility programs that influence customer uses of energy in ways that will produce desired changes in the utility's load shape. As such, DSM includes traditional energy efficiency, conservation and load control programs. All energy usage numbers are 2007 weather normalized, unless otherwise stated.

[3] See Appendix E for details on the segmentation and sampling strategy used in this analysis.

MARKET ASSESSMENT

Energy efficiency planning needs to be based on a sound understanding of customer characteristics. The purpose of this section is to provide a foundation for the DSM planning and analysis presented in subsequent sections. We begin with an overview of electricity usage in the I&M market sectors defined in this study. A description of the customer base using internal and secondary data precedes the presentation of energy usage models. These models are used to estimate the electric sales by end-uses; such as, space heat, water heat, lighting, cooking, dryers, process energy, and miscellaneous plug loads. The detailed energy usage models also provide a basis for estimating existing efficiency levels, the technical potential, energy savings and cost effectiveness of a wide variety of demand side measures and programs.

Energy use estimates presented in this report are normalized to long-term weather conditions by using the energy usage models applied to a typical or normal year. All energy use and end-use estimates in the report have been normalized to 30-year monthly temperature normals. Though the energy use estimates are for a normal weather year, the models were developed using actual usage and weather data from January 2007 through December 2007.

Overview of Market Sectors

The focus of this study is on the nearly half a million residential and non-residential retail customers in the I&M service territory.[4] These customers account for 15.7 billion kWh annually, as shown in Table 3.

Table 3. I&M Customers and Weather Normalized Annual Usage by Sector

Sector	Customers	Annual Usage (million kWh)	Percent of Total	Use per Customer (kWh/year)
Residential	389,502	4,529	28.9%	11,627
Non-Residential	58,080	11,163	71.1%	192,202
Total	447,582	15,692	100.0%	35,059

Source: Unique premise counts and billing data from CIS extract (Jan 2007 – Dec 2007).

Energy sales are significantly higher in the non-residential sector compared to the residential sector. With nearly 390,000 customers, the residential sector is far larger in terms of customer count than the non-residential sector. Although there are far fewer non-residential customers than residential, the average non-residential customer uses over 16 times more electricity than the average residential customer.

Monthly electric loads for both sectors are shown in Figure 2 with non-residential broken down between commercial and manufacturing loads (based on SIC code). Monthly residential loads are by far the most seasonal with a slightly higher winter peak than summer. Although not as seasonal as residential, monthly commercial loads peak in the summer and have a less pronounced winter peak. Manufacturing loads are relatively flat across the

[4] Wholesale, street lighting, traffic lighting and customers who are served on high voltage rates are not considered in this analysis. Energy usage in this report also excludes these customers. See Appendix E.

months except for a summer peak in June, July and August, coincident with the residential and commercial summer peak.

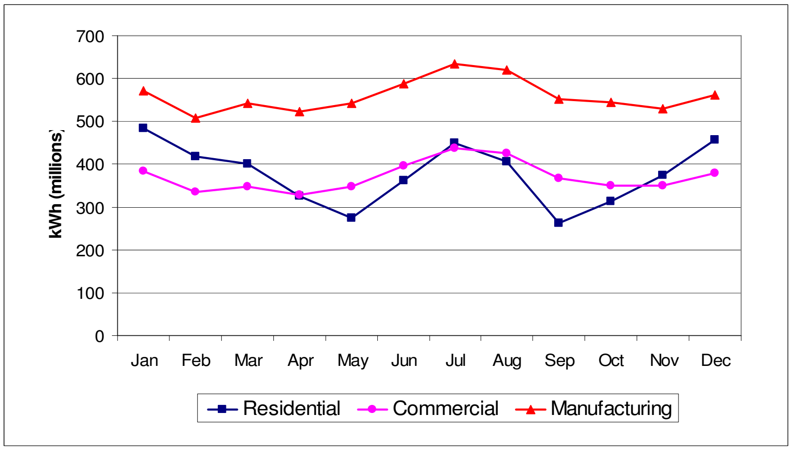


Figure 2. Total I&M Electric Sales by Rate Class

End-use models were estimated for each sector allowing loads to be disaggregated by major end-use. Detailed energy usage analysis by sector and end-use will be presented later in this section. An overview of monthly loads by end-use is presented here for the residential and non-residential sectors combined as an overview of the components of electric consumption. Energy and demand are both important considerations when planning DSM programs. A map of total MW demand by month and time of day is shown in Figure 3.

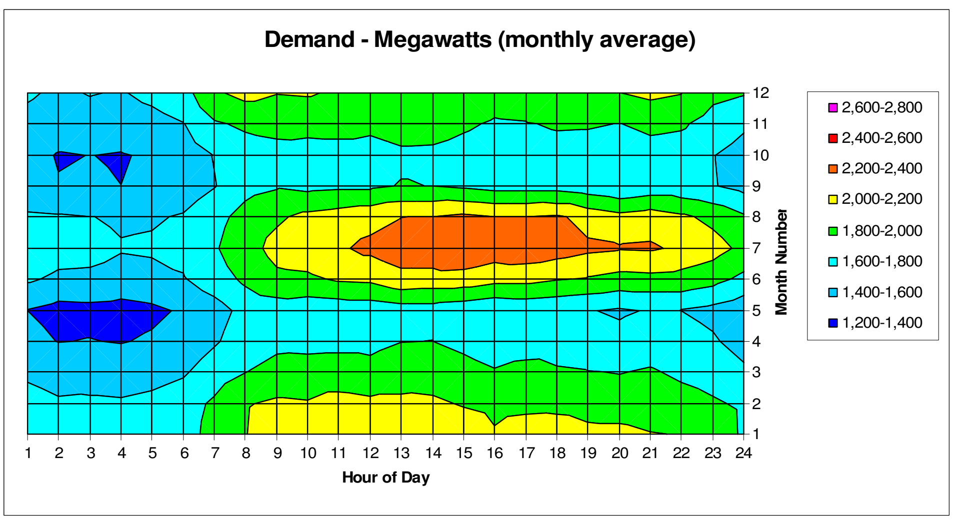


Figure 3. I&M Hourly Average Demand Map

Demand was modeled using several sources of information, including hourly load data provided by I&M. A detailed discussion of the methodology is presented in Appendix A. Demand is at its highest in July between 1 PM and 6 PM, reflective of summer cooling loads. Another less prevalent peak is experienced in January between 8 AM and 2 PM. DSM technologies and programs with impact on loads during these periods will save peak and energy.

Residential

The market assessment presented in this section begins with a high-level view of residential housing in the I&M service area, followed by a detailed analysis of residential electric loads. A simple segmentation strategy based on type of structure and vintage of construction was used to describe and model residential energy usage. The housing type and vintage of construction, based on meter set date, were determined from the I&M customer information system (CIS). This segmentation approach captures the major differences in residential housing stock that impact energy usage and DSM opportunities. The segments were also selected to better describe cost effective DSM opportunities which can vary significantly by type of housing and vintage of construction. Customer counts in each of the four segments are shown in the table below.

Table 4. Residential Customers by Segment

	Single Family	Multifamily	Total
Existing Construction	320,694	52,479	373,173
New Construction	14,821	1,508	16,329
Total	335,515	53,987	389,502
Percent	86%	14%	100%

Source: I&M CIS Data

Single family construction accounts for most of the residential housing stock. The remainder is multifamily housing units including duplexes, condominiums and apartment buildings. Single family and multifamily units exhibit many differences that impact electric consumption and energy efficiency potential. These differences include size of unit, appliance penetration, building shell integrity and lifestyle attributes.

There are typically many important differences between older and newer homes that have large impacts on energy use and energy efficiency potential. Differences in the thermal integrity of the building shell and appliance penetration rates, for example, can lead to large differences in annual usage between older and newer homes. Existing construction is defined as all homes with meters installed prior to 2004. Current building practices are reflected in the new construction segment, defined as all customers connected after 2004. Using 2004 as a cutoff is somewhat arbitrary and less important than having a group of homes to model and contrast the differences between existing and new housing stock. Our objective is to define the cutoff far enough back so that we have adequate billing history for completed and occupied new housing but recent enough to capture current construction practices in usage models. We believe using 2004 as the cutoff best meets this objective.

New Construction Levels

Residential construction estimated from housing permit data for counties within the I&M service territory is shown in Figure 4. Data shown in Figure 4 are based on monthly permit data lagged to approximate the timing of construction and better align temporally with actual electric service installations. Construction activity has trended lower since 2003 with the largest decline in single family construction. In 2007 an estimated 4,500 living units were completed in the I&M service area compared to around 8,000 annually, prior to 2006. Although the mix of construction varies from year-to-year, the mix has averaged 84 percent single family and 16 percent multifamily construction since 2003.

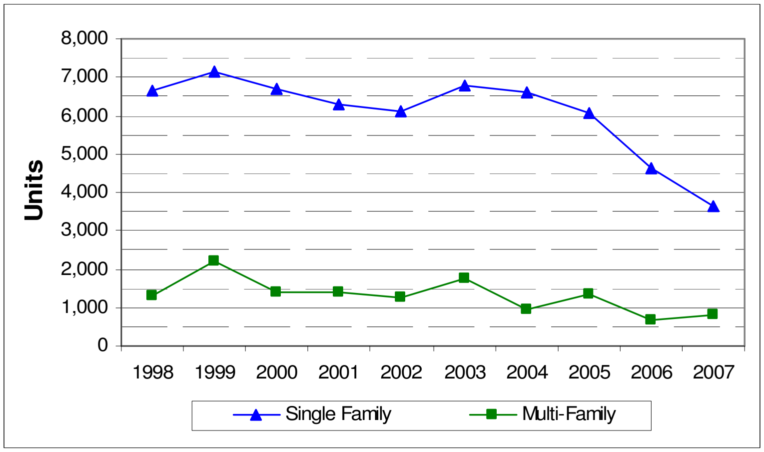


Figure 4. Residential Housing Construction, I&M Service Territory

In addition to the "site built" construction reflected in the permit data, an estimated 200 manufactured homes are placed in the I&M service area annually.[5] Site built homes are constructed on-site without the use of pre-built walls and other major structural components. Manufactured homes are homes built or primarily built off-site and then installed on the building site.

[5] Based on US Census data for statewide placements of manufactured homes (2005-2007) and the percentage of statewide population living in the I&M service area (15%). Manufactured home placements in Indiana are estimated by the US Census to have fallen sharply from 3,000 units in 2003 to only 800 units in 2007. Hence, the estimate of 200 manufactured home placements annually in the I&M service area overstates recent activity.

Housing Stock Characteristics

Figure 5 and Figure 6 were derived from I&M's 2005 Appliance Saturation Survey. Vintage of construction and size of home provide valuable housing attribute details useful for understanding the nature of the housing stock and, therefore, the DSM opportunities.

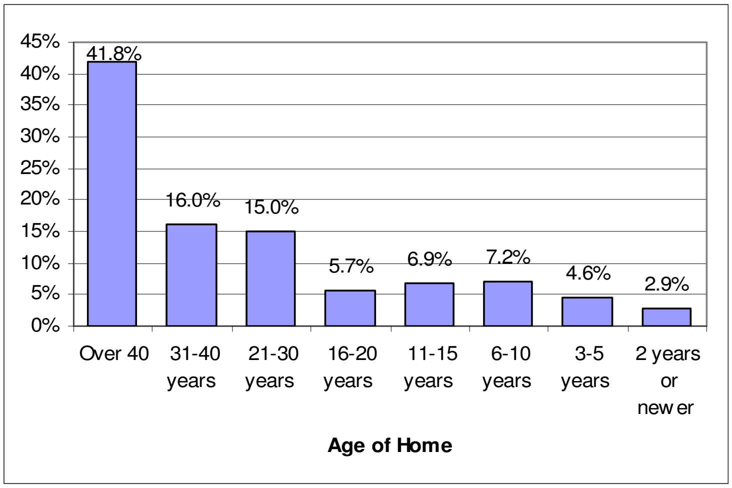


Figure 5. Percent of Housing Stock by Age of Home

Nearly 60 percent of the housing stock is over 30 years old. These homes represent the largest retrofit opportunity both in terms of the number of homes and the most gains to be acquired from improved shell efficiencies. About 15 percent of the housing stock is less than 10 years old.

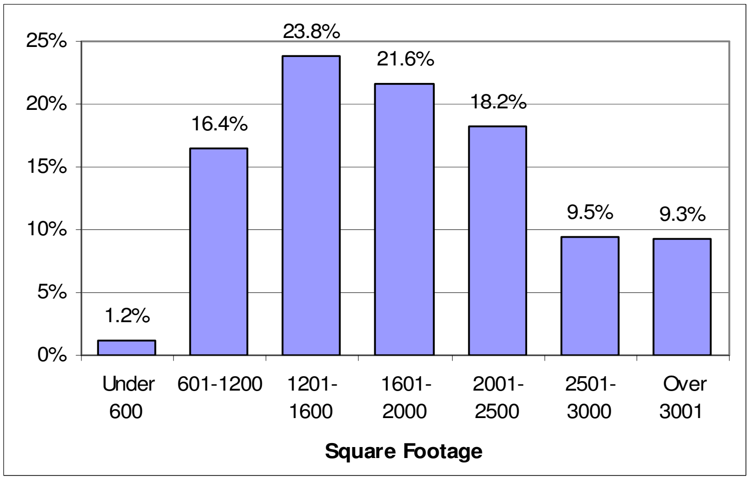


Figure 6. Percent of Single Family Dwellings by Square Feet

The pattern of size of housing units is fairly typical with the largest percentage of homes falling in the 1,200 to 1,600 range and then slowly tailing off percentage wise with larger homes. While the number of survey responses was insufficient to show average square footage by vintage of construction, the most likely result would be ever increasing size of home with newer homes. This trend has shown a leveling off in recent years with home sizes showing little or no increase since about the year 2000.

Appliance Saturation Rates

Appliance saturation rates are important inputs to the segment usage models discussed later in this section. I&M's 2005 Appliance Saturation Survey was used to estimate the prevalence of heating fuels and appliances. Survey results are reported by segment for major end-uses and appliances in Table 5. Segments with insufficient coverage for reporting are listed as "NA".

Table 5. Electric Appliance and End-Use Saturation Rates

	Single Family		Multi-Family	
	Existing	**New**	**Existing**	**New**
	n=733	n=25	n=80	n=5
Main Heating Fuel				
Electric	17%	9%	23%	NA
Natural Gas	74%	70%	55%	NA
Propane or LPG	4%	12%	13%	NA
Other	4%	9%	8%	NA
Main Heating System				
Heat Pump	5%	16%	2%	NA
Central Forced Air	77%	75%	73%	NA
Other	18%	9%	24%	NA
Cooling System				
Heat Pump	5%	14%	3%	NA
Central A/C	69%	86%	54%	NA
Room or Window A/C	18%	0%	41%	NA
Other	1%	1%	0%	NA
None	8%	0%	2%	NA
Water Heating Fuel				
Natural Gas	61%	57%	26%	NA
Electricity	36%	41%	73%	NA
Other	2%	1%	1%	NA
None	0%	0%	0%	NA
Appliances Owned:				
Electric Range	66%	57%	65%	NA
Refrigerators - 2 or more	33%	40%	5%	NA
Freezer	60%	38%	25%	NA
Dishwasher	67%	81%	30%	NA
Clothes Washer	95%	98%	80%	NA
Electric Dryer	69%	73%	77%	NA
Weighted sample counts by DSM potential study segments				
Source: AEP Residential Appliance Survey – I&M 2005				

Because of the variance and potential inaccuracies associated with customer reported fuel and equipment information, survey results are used as a guide in calibrating energy usage models rather than absolute model inputs.

Electricity Usage Analysis

Monthly billing data at the premise level was aggregated by the four residential customer segments used in this report. An end-use energy and demand model was then estimated using the aggregated billing data, residential survey results, detailed hourly load profiles and weather data. Model assumptions were refined to provide the best empirical fit to the actual customer billing data. The annual usage for each residential segment is shown in Table 6 below.

Table 6. Annual Usage by Residential Segment

Segment	Premises	Average Annual kWh per Premise	Total Usage (millions of kWh)
Single Family Existing	320,694	12,226	3,921
Multi Family Existing	52,479	8,391	440
Single Family New	14,821	10,545	156
Multi Family New	1,508	7,576	11
Total Residential	**389,502**	**11,627**	**4,529**
Source: Energy model results using monthly billing data from I&M CIS			

The monthly load profiles resulting from the energy models are shown by segment in Table 7.

Table 7. Residential Monthly Usage by Housing Type

Month	SF Existing	MF Existing	SF New	MF New
	(millions kWh)			
Jan	417	51	16	1.2
Feb	359	44	14	1.0
Mar	345	42	14	1.0
Apr	280	33	12	0.9
May	236	27	11	0.8
Jun	318	31	12	0.9
Jul	395	38	16	1.1
Aug	357	34	14	1.0
Sep	226	25	10	0.7
Oct	272	30	11	0.8
Nov	323	38	13	0.9
Dec	393	48	15	1.1
Total	**3921**	**440**	**156**	**11.4**

Because of the large number of homes, the existing stock of single family homes is by far the largest segment, accounting for nearly 90 percent of the residential sector's energy usage. All segments follow a similar monthly load pattern, as expected.

Monthly residential loads by major end-use are shown in Figure 7 and Table 8. Appliances and electronics are the largest end-use, accounting for 29 percent of annual residential energy consumption. Water heating, space heating and lighting each account for roughly the same level of annual usage, 16 to 18 percent of total residential. Space cooling is only responsible for 10 percent of annual energy usage but is a major contributor to summer loads, accounting for over 40 percent of energy usage in July. Space heating also contributes to seasonal peak, accounting for nearly 40 percent of residential kWh consumption in January.

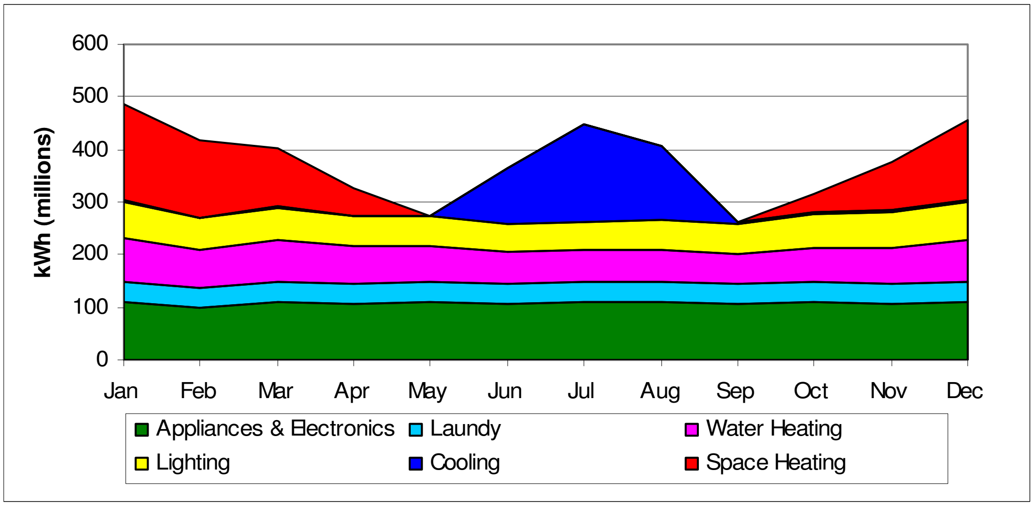


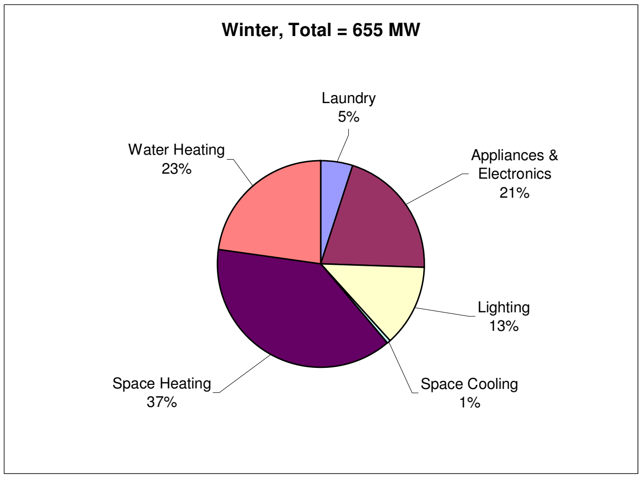
Figure 7. Monthly Residential Loads by End-Use

The percentage distribution by residential end-uses derived by this study is contrast with Energy Information Administration (EIA) estimates in Table 8. Comparing the I&M specific estimates with EIA data can be misleading giving the large differences between fuel shares and space conditioning requirements. Still, the estimates for end-uses not significantly influenced by fuel share and space conditioning requirements (appliances and electronics, laundry, and lighting) compare favorably.

Table 8. Residential Sector Monthly Usage by End-Use

Month	Appliances and Electronics	Laundry	Water Heating	Lighting	Cooling	Space Heating	Total
	(millions of kWh)						
Jan	110	40	80	69	3	182	485
Feb	99	36	73	60	2	147	417
Mar	110	40	77	62	2	109	401
Apr	106	39	70	57	2	51	325
May	110	40	66	56	2	0	274
Jun	106	39	59	53	106	0	363
Jul	110	40	58	55	187	0	450
Aug	110	40	58	56	142	0	406
Sep	106	39	57	57	2	0	262
Oct	110	40	64	64	3	34	314
Nov	106	39	69	67	3	91	375
Dec	110	40	78	71	3	154	456
Annual	**1,296**	**470**	**809**	**729**	**457**	**768**	**4,529**
Percent	**29%**	**10%**	**18%**	**16%**	**10%**	**17%**	**100%**
EIA	**31%**	**12%**	**9%**	**18%**	**19%**	**11%**	**100%**

The distribution of residential demand by end-use shows the importance of space heating and cooling at system coincident peak. Winter and summer average day demand at system coincident peak is shown for the residential segment in the figure below.



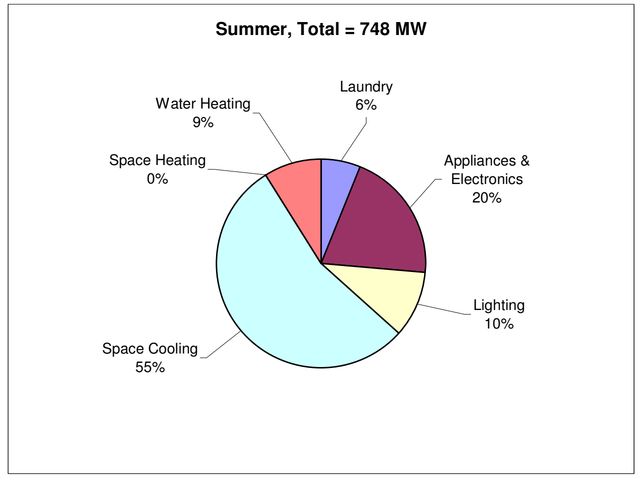


Figure 8. Residential Average Day Demand by End-Use at System Coincident Peak

Over one-third of residential loads at winter system coincident peak are for space heating. Water heating and appliances also contribute significantly to winter peak. Over half of residential summer peak average demand is cooling related. Plug loads (appliances and electronics) and lighting make up about a third of residential summer and winter peak demand.

Non-Residential

The non-residential market is far less homogenous than residential. There are a greater number of basic customer types (segments) and the variation in size of building is much larger in commercial. For these reasons it is useful to describe the non-residential sector not only in terms of number of businesses but also in terms of square footage. Analysis of DSM opportunities in the non-residential segment also benefits from an understanding of the square footage of commercial and industrial space in the service territory.

Square footage estimates were developed using employment data by business segment and employment density estimates by business type. The results of this analysis, summarized by segment, are shown in Table 9.

Table 9. Business Counts and Estimated Square Footage by Segment

Segment	Total Businesses	Percent	Employment	Percent	Total SqFootage	SqFootage Distribution	SqFt per Business
Grocery	1,200	2.4%	19,591	2.6%	9,248,540	1.8%	7,707
Hospitals	128	0.3%	16,553	2.2%	6,048,220	1.2%	47,252
Lodging	406	0.8%	5,859	0.8%	4,464,480	0.9%	10,996
Office	10,984	21.6%	88,704	11.6%	54,002,490	10.3%	4,916
Other	10,371	20.4%	88,793	11.6%	57,901,680	11.1%	5,583
Other Health	4,040	7.9%	78,759	10.3%	38,236,650	7.3%	9,465
Restaurants	3,038	6.0%	56,791	7.4%	27,376,760	5.2%	9,011
Retail	6,847	13.5%	72,924	9.5%	35,657,530	6.8%	5,208
Schools	1,242	2.4%	55,416	7.2%	41,002,080	7.8%	33,013
Wholesale & Warehouse	3,317	6.5%	59,727	7.8%	101,523,220	19.4%	30,607
Total Commercial	**41,573**	**81.7%**	**543,117**	**71.0%**	**375,461,650**	**71.7%**	
Ag, Mining, Util., & Const	5,450	10.7%	63,751	8.3%	41,006,830	7.8%	7,524
Manufacturing	3,835	7.5%	158,407	20.7%	107,229,320	20.5%	27,961
Total Other Non-Residential	**9,285**	**18.3%**	**222,158**	**29.0%**	**148,236,150**	**28.3%**	
Total Non-Residential	**50,858**	**100.0%**	**765,275**	**100.0%**	**523,697,800**	**100.0%**	

Source: Forefront Economics estimate of square footage based on employment and employment density by NAICS.

The last column in the table above shows the average square footage per business. This result will be combined with the number of business sites from I&M's customer records to estimate the non-residential floor space by segment.

Customer Description

Non-residential customer data were segmented using the same SIC-NAICS code classification scheme used to describe the business data acquired for the service territory. Number of premises and annual usage is shown by segment in Table 10 along with other descriptive information about the commercial sector. The number of premises was found to include many non-building types of electrical services (e.g. billboards and railroad controls). An alternative measure was developed to better approximate the number of actual buildings. The data in Table 10 only include premises with at least 3,000 kWh of annual usage.[6]

Applicable square feet shown in Table 10 is the total square footage found for that segment in the service area. The energy utilization index (EUI) is calculated using the estimate of applicable square footage. Energy utilization index results from the 2003 Commercial Building Energy Consumption Survey (CBECS) published by the US DOE are also shown for comparison purposes. Although they follow the same general pattern, there are a few notable differences in EUI estimates. We do not have sufficient information to explain the differences but they are probably due to differences in the penetration of natural gas in the I&M non-residential customer base and the CBECS sample of buildings.

Table 10. Number of Premises and Annual Usage by Segment

Segment	CIS Premises	Average Annual kWh per Premise	Total Usage (millions of kWh)	Percent of C&I Loads	Square Feet per Business (a)	Estimated Total Square Feet (millions)	Square Feet Distribution	EUI (kWh per Sq Ft)	EUI from CBECS
Grocery	529	368,250	195	1.7%	7,707	4.1	1%	47.8	49.4
Hospitals	147	1,696,192	249	2.2%	47,252	6.9	2%	35.9	27.5
Hotels	309	310,144	96	0.9%	10,996	3.4	1%	28.2	13.5
Office	20,354	73,031	1,486	13.3%	4,916	100.1	24%	14.9	17.3
Other	2,252	60,453	136	1.2%	5,583	12.6	3%	10.8	22.5
Health	1,406	152,303	214	1.9%	9,465	13.3	3%	16.1	16.1
Restaurant	1,940	145,626	283	2.5%	9,011	17.5	4%	16.2	38.4
Retail	4,746	134,522	638	5.7%	5,208	24.7	6%	25.8	14.3
Schools	1,118	615,168	688	6.2%	33,013	36.9	9%	18.6	11.0
Warehouse	1,558	148,511	231	2.1%	30,607	47.7	12%	4.9	7.6
Total Commercial	**34,359**	**122,728**	**4,217**	**38%**		**267.2**	**65%**	**15.8**	**NA**
Ag, Mining, Util. & Constr	4,114	52,170	215	1.9%	7,524	31.0	8%	6.9	NA
Manufacturing	3,962	1,694,505	6,714	60.2%	27,961	110.8	27%	60.6	NA
Total Other Non-Residential	**8,076**	**857,882**	**6,928**	**62%**		**141.7**	**35%**	**48.9**	**NA**
Total Non-Residential	**42,435**	**262,639**	**11,145**	**100%**		**408.9**	**100%**	**27.3**	**NA**

Source: Energy model results using monthly billing data from CIS. CBECS is the Commercial Building Energy Consumption Survey (2003, US DOE).
(a) From Table 9, except Hospitals where square footage of 50,000 was used for consistency with other Forefront-Peach studies.
I&M loads and customer counts exclude "small load" premises (about 15,600 accounts with less than 1,200 kWh per year).

Energy utilization indices, plotted in Figure 9, serve a descriptive purpose in this report and are not used for the energy savings estimates. Grocery stores are the most energy intensive of commercial buildings but only account for a small amount of the applicable floor space. Hospitals, hotels and retail have moderately high electric EUI and

[6] Although arbitrary, this level of usage was thought to effectively screen non-building premises such as billboards and switching equipment. About 15,600 accounts were associated with annual usage of less than 3,000 kWh.

account for nearly 10 percent of floor space. Offices have a large amount of square footage and tend to be in the moderate range of energy intensity based on estimates of EUI in this study and CBECS.

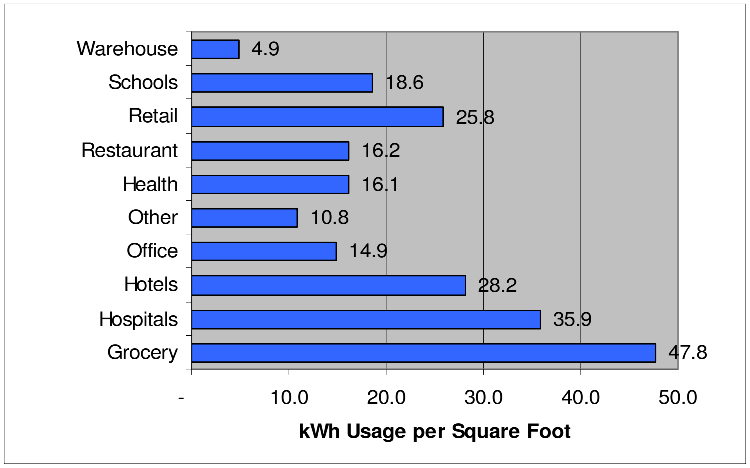


Figure 9. Commercial EUI Distribution

The estimated distribution of commercial square footage is shown in Figure 10. Together the square footage and EUI information are useful for understanding the nature of energy consumption in the commercial segment. Warehouses and offices account for over half of all commercial floor space. Although similar in the amount of floor space, the EUI estimates show that these two segments have significantly different energy requirements. Schools account for 14 percent of all commercial space and have relatively moderate energy intensity.

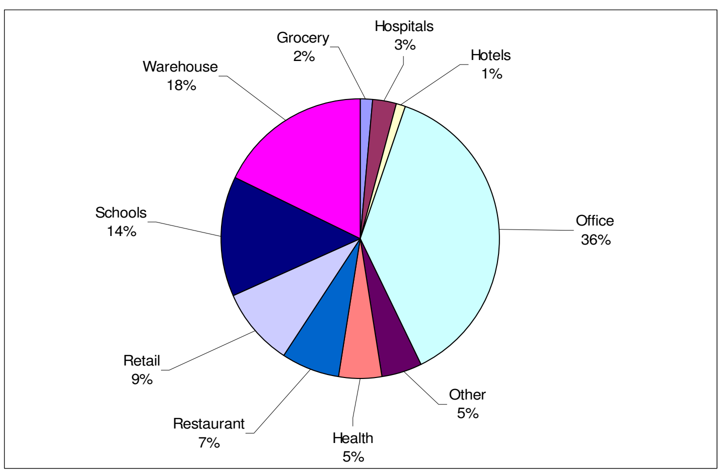


Figure 10. Commercial Square Footage Distribution

The analysis in this section provides insights into the areas where electric DSM measures and programs may have the largest opportunities. Due to the limits of the data used in the analysis of floor space and EUI calculations, conclusions regarding energy intensity and DSM opportunities should be cross-checked with customer service personnel and actual field experience.

Commercial Load Analysis

Annual energy usage by segment has already been presented in Table 10. Commercial energy usage by end-use is shown in Figure 11. Commercial load is characterized by a large percentage of base load with a prominent summer cooling peak.

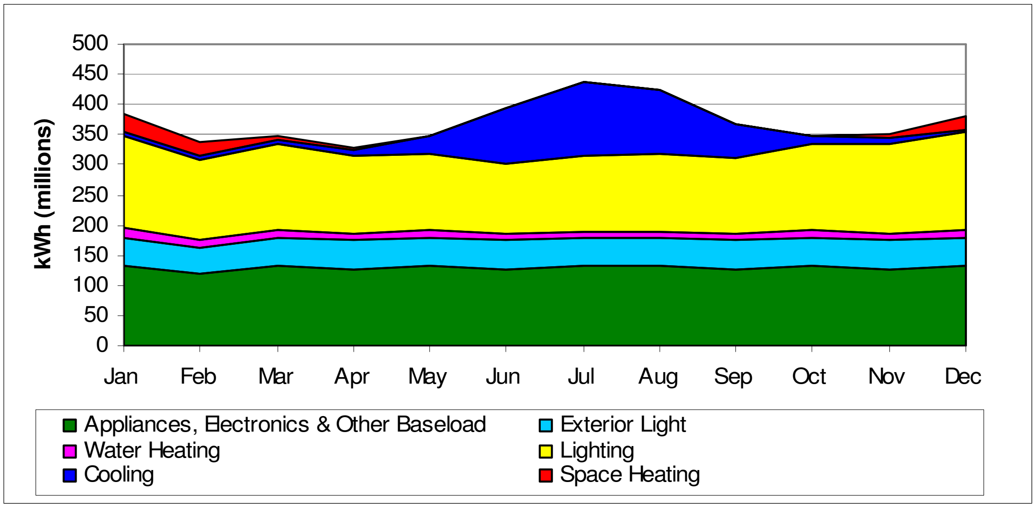


Figure 11. Monthly Commercial Usage by End-Use

Non-residential loads, the total of commercial and industrial customers, are shown at system coincident peak for winter and summer in the figure below.

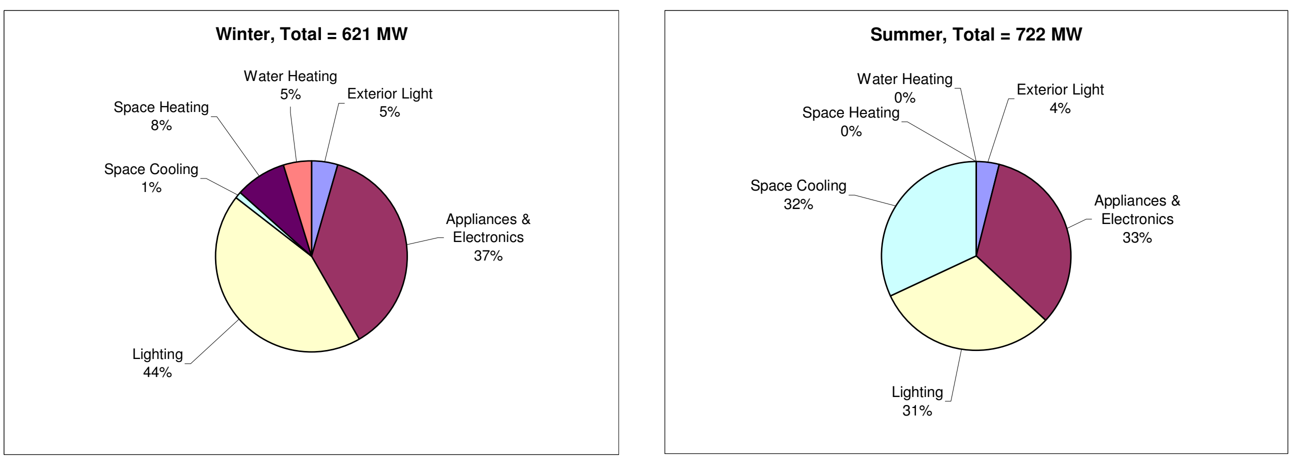


Figure 12. Commercial Average Day Demand by End-Use at System Coincident Peak

About two-thirds of winter coincident peak demand is from motors and other external and appliances and electronics. Lighting also accounts for a sizable portion of commercial winter peak demand. Space cooling contributes less to average summer coincident peak than motors and other external and appliances and electronics.

Manufacturing Load Analysis

Energy sales to manufacturing customers came to nearly 6.7 billion kWh in 2007, about 60 percent of the non-residential sector. As shown in Table 11, manufacturing customers cover a wide range of industries.

Table 11. Manufacturing Customers and Unadjusted 2007 Loads

SIC - Industry Name	Customers	Use per Customer (MWh)	Total Usage (MWh)	Percent	Average Peak (kW)
20 - Food and kindred products	258	1,175	303,189	4%	274
21 - Tobacco manufactures	96	49	4,751	0%	18
22 - Textile mill products	8	345	2,762	0%	98
23 - Apparel and other textile products	33	110	3,614	0%	44
24 - Lumber and wood products	247	291	71,777	1%	105
25 - Furniture and fixtures	104	152	15,848	0%	65
26 - Paper and allied products	95	2,166	205,784	3%	422
27 - Printing and publishing	281	308	86,411	1%	85
28 - Chemicals and allied products	170	4,242	721,188	11%	676
29 - Petroleum and coal products	42	103	4,341	0%	60
30 - Rubber and miscellaneous plastics products	306	1,844	564,210	8%	409
31 - Leather and leather products	8	118	943	0%	46
32 - Stone, clay, glass, and concrete products	160	2,591	414,606	6%	435
33 - Primary metal industries	200	13,684	2,736,706	40%	885
34 - Fabricated metal products	687	768	527,922	8%	218
35 - Industrial machinery and equipment	439	443	194,339	3%	130
36 - Electrical and electronic equipment	117	1,434	167,773	2%	303
37 - Transportation equipment	567	1,256	712,405	10%	296
38 - Instruments and related products	29	931	26,993	0%	248
39 - Miscellaneous manufacturing industries	115	287	32,953	0%	97
Total Manufacturing	**3,962**	**1,716**	**6,798,515**	**100%**	**275**

Primary metals are the largest single industry in terms of energy sales in the I&M service area, accounting for 40 percent of manufacturing energy. Other prominent industries include chemicals, transportation equipment, rubber/plastic products and fabricated metals. Manufacturing energy sales are shown by month in Figure 13. Manufacturing loads are characterized by large process-related consumption that is not highly correlated with weather. Still, there is a noticeable summer cooling load that adds to the coincident July peak.

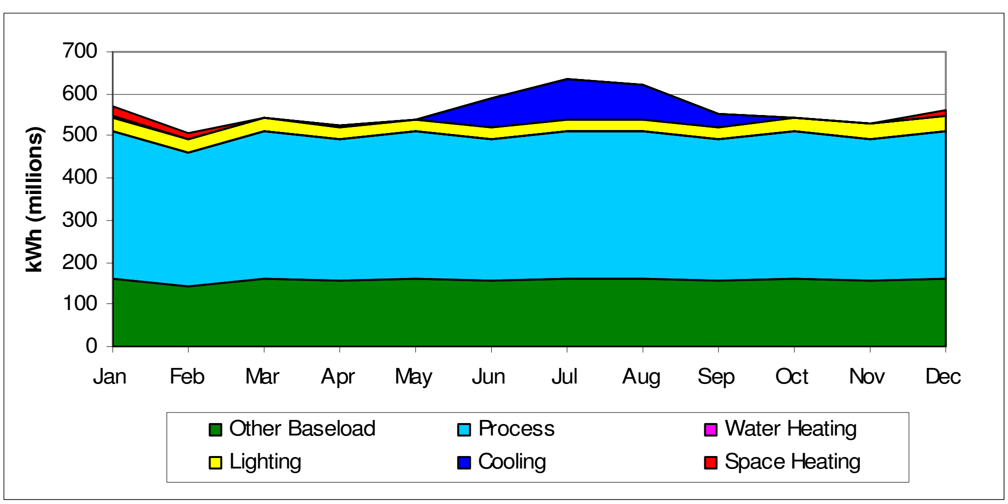


Figure 13. Monthly Manufacturing Usage by End-Use

ENERGY EFFICIENCY MEASURES AND POTENTIAL SAVINGS

In this section we present our estimates of the energy savings potential in the I&M service area. This work builds off of the energy modeling results presented in Appendix A by applying energy efficiency technologies to the model parameters. These technologies, referred to as Energy Efficiency Measures (EEMs), cause a reduction in the load profiles of the end-uses presented in the prior section. In this section we derive estimates of technical and economic potential.

Technical Potential

The technical potential is defined by the application of maximum reasonable energy efficiency improvements to every residential and non-residential customer/building served by I&M. The technical potential also includes extensive application of site-based solar technologies with solar water heating on 60 percent of residential buildings.

The technical potential developed here does not include fuel switching or applications of combined heat and power (CHP). In fact, there are many applications of fuel switching or CHP that are justifiable from the customer or the utility perspective, such as gas backed heat pumps or large commercial or industrial CHP, but these have not been included in the scope of this analysis. This estimate of the technical potential for I&M internal energy and load reductions is intended to define an upper bound for the consequences of a maximal application of energy efficiency technologies to the I&M residential, commercial, and industrial customers.

Table 12 summarizes this technical potential as found for the base year, 2007, and for the planning years 2012 and 2027. Note in Table 12, that these technical potential savings percentages are presented with reference to the I&M customers included in this study. The technical potential estimate only included about 75 percent of I&M energy sales, the remainder being direct service industrials and sales for resale that were not included in this study. The technical potential energy savings for the portion examined for technical potential is about 29 percent energy savings, which is somewhat less than that observed in other studies. This somewhat reduced savings potential is due to a higher industrial load fraction and to lower space heat and water heat penetrations in this utility relative to other utilities.

Notice in Table 12 that the application of efficiency technology has led to reductions in annual energy use, GWh, of the order of 29 percent. And most significantly, the application of this broad range of efficiency measures has led to significant percentage reductions in both the winter and summer peak system load, MW, greater than the percent energy reductions because the energy savings are most concentrated at peak times.

Table 12. Summary of Technical Potential Over 5 and 20 Year Planning Horizon

	2007	2012	2027
Base Case Energy Use, System Requirements, GWh/yr	17,019	17,909	20,466
Technical Potential Energy Savings GWh/yr	4,913	5,135	5,755
Percent reduction in System Requirements	29%	29%	28%
Base Case Summer System Peak - Aug (MW)	2,767	2,910	3,333
Technical Potential Summer Peak Savings (MW)	1,136	1,186	1,327
Percent reduction Summer Peak	41%	41%	40%
Base Case Winter System Peak – Feb (MW)	3,010	3,159	3,592
Technical Potential Winter Peak Savings (MW)	1,279	1,334	1,492
Percent Reduction Winter Peak	42%	42%	42%
Load Control Summer Peak Reduction (MW)	157	165	188
Load Control Percent Peak Reduction	6%	6%	6%

Technical Potential Load Effects

With regard to I&M's reserve margin, an important aspect of the technical potential pertains to the changes in demand MW attributable to the efficiency measures. In general, changes in demand (and load) will vary from hour-to-hour and month-to-month. For the total of I&M customers, we have estimated the average hourly demand curve, and the peak demand curve for each month for the base case and for the technical potential case. These hourly demand curves are the aggregate distributed demand of the I&M customers. The difference between the base case hourly demand and the technical potential case hourly demand is taken here as the technical potential demand offset. The system load offset is then derived from the system demand offset by increasing the demand to account for the associated T&D losses of 7.8 percent. A discussion of energy and demand modeling methodology is found in Appendix A.

Note in Figure 14 through Figure 16 that the modeled hourly load has proceeded from only about 75 percent of the total utility sales, leading to modeled hourly loads that are less than the forecast load. Figure 14 shows the average load curve for summer, July, and Figure 15 shows the average load curve for winter, January. These figures have been colored to identify the source of the load savings. The red portion shows the savings from general efficiency measures and the yellow portion shows the load impact from the site-based solar electric and other solar applications.

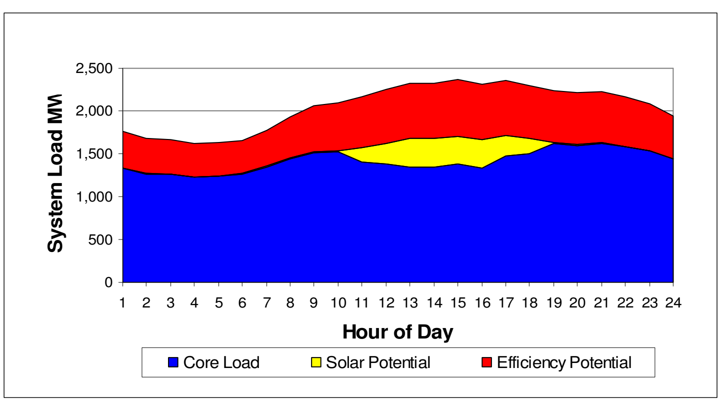


Figure 14. Technical Potential for Demand Reduction – Summer

In Figure 14 it is apparent that some of the significant summer load reductions are due to solar electric generation that is concentrated most during the peak days. Note also that there is some slight evidence of solar savings during non-daylight hours, which is due to solar heated water used later in the day.

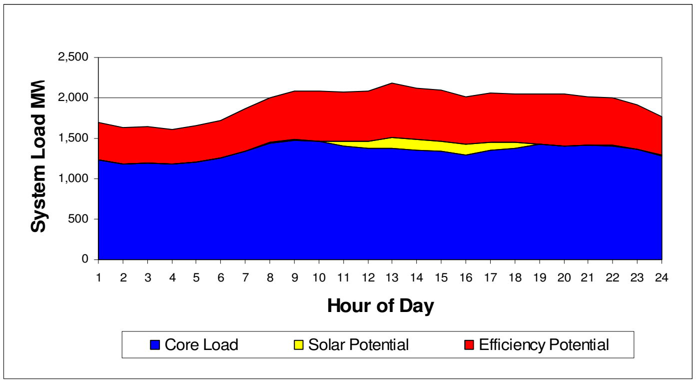


Figure 15. Technical Potential for Demand Reduction – Winter

It is noteworthy that the demand savings for winter are slightly greater than the demand savings for summer. This is because winter heating savings are quite strong. It should be noted that these load savings are a by-product of the energy efficiency savings, and do not include demand response or direct load control.

Technical Potential Load Control

Load control has long been a demonstrated option for managing peak load situations. Recent improvements in communications, networking, and controls have significantly increased capability for large scale control of various end-use loads. These advances are referred to here generally as Advanced Metering Infrastructure (AMI). AMI employs metering and networking to allow large numbers of individual meters to be read remotely and designated loads to be toggled on command. The precise coordinated control of diverse loads can be used to reduce the total diversified system load during system peak periods.

AMI also facilitates the use of time-of-day or critical peak pricing and distribution O&M diagnostics. It is probable that advanced metering will eventually become a common part of the utility system based on these multiple benefits.

An upper bound of the demand reductions achievable by direct load control through AMI will be estimated here. It can be strictly argued that when air conditioners and water heaters are cycled off through direct load control, they involve behavioral choices, but if the cycles are properly designed, there will be almost no perceived loss of amenity. Physically, the precisely sequenced cycling afforded by AMI is leveraging the inherent benefits of the thermal storage of water heaters and the dwellings themselves to reduce peak demand.

Further demand reductions and energy reductions can be achieved through a variety of time-of-use or other rate designs. Such savings are essentially behavioral responses to higher prices. However, the focus of this technical potential study is on the physical potential for energy savings. The many possible avenues of energy savings caused by behavioral changes, while potentially significant, are not part of this study.

The upper bound of AMI related demand savings will be taken as defined by the control of 50 percent of the residential electric water heating load and the control of 225,000 residential /small commercial scale air conditioners. Figure 16 shows the effect of such a large scale control exercise.

In Figure 16 note that the direct load control has reduced the peak demand in the hours of 14:00 to 17:00 by an average of 157 MW. The control of water heaters or air conditioners always involves a temporary increase in demand when these appliances are turned back on. Therefore, the control events must be carefully staged so that the temporary increase in demand does not just shift the peak a few hours.

In this example, the air conditioners are cycled off in three waves during the afternoon, and the water heaters are cycled off much later in the afternoon (around 6 PM). In this manner the demand reductions from the water heater cycling are counteracting the temporary demand increases as the air conditioners are brought back on line. In fact there is less benefit to cycling a water heater during system peak because that is a minimal usage time for water heaters. But later in the day, about 6 PM to 10 PM, water heater usage peaks and there is much more benefit to cycling then. Figure 16 shows that with careful staging, the top of the system peak can be effectively shaved off.

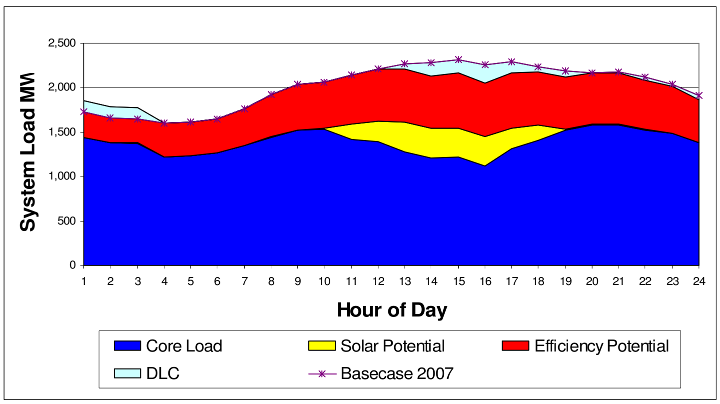


Figure 16. Direct Load Control Demand Reductions - Summer

Note in Figure 16 that the demand has increased by more than 100 MW during the non-peak hours of 1-3 AM as the water heaters are brought back on line.

In this example, only two types of loads have been controlled, unitary air conditioners and storage water heaters. Commercial lighting could also be controlled, but it is not considered here because lighting control, especially day lighting, is expected to be redundant with lighting control installed as an energy saving measure.

Another class of demand reduction measures is associated with industrial load shedding contracts. These industrial load reductions can be quite large, even larger than the load reductions from the direct load control. These load reductions would be in addition to the reductions afforded by the direct load control illustrated here. These unique industrial contracts are not considered in this technical potential study.

It is evident in the figure that this type of DSM load reduction has limited potential relative to the load reduction proceeding generally from energy efficiency. While DR and DLC are potentially the most cost effective and most quickly deployed load reduction measures, they are limited. Nevertheless, these measures will need to play a significant role in any DSM portfolio.

Principal Components of the Technical Potential

A strategic understanding of the possibilities and challenges of a large scale efficiency undertaking requires an understanding of the principal components of the energy technical potential. The technical potential for energy savings divides into three components: retrofit, new construction, and solar. Figure 17 shows these three components over the twenty-year planning horizon in a color-coded fashion.

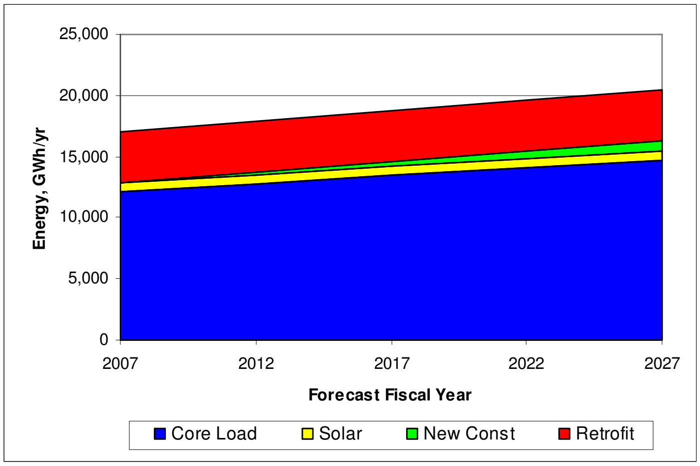


Figure 17. Technical Potential over Planning Horizon

In this figure the retrofit potential, red, represents the technical potential of energy savings that can be achieved in the existing building stock. In this analysis the existing stock is taken as constant over the twenty year time horizon. This is the largest portion of the technical potential, and it contains many energy inefficiencies that were embedded in the customer stock during the last half century. As such, these customers are disproportionately exposed to increasing energy costs, and there will (or could) be a tendency to migrate to more efficiency as a price response.

The technical potential for energy savings in new construction is shown by the green wedge which increases in proportion to the amount of new construction. This is the smallest component of the technical potential, but it is persistently growing. The physical attributes of the new construction technical potential are quite similar to those in the retrofit technical potential: insulation, ventilation control, lighting, efficient heat pumps, etc. But in the case of new construction, the cost for these measures is lower because it is an incremental cost on an existing construction process. Efficiency measures are generally cheaper when applied during initial construction. In this sense, the technical potential associated with new construction is a significant lost opportunity. A very important perspective on the new construction technical potential is that the associated builders, suppliers, and code agencies effectively become the reservoir of energy efficiency practices necessary to support the efficiency undertaking as a whole. New construction efficiency (and new appliance efficiency) is a key infrastructural investment in any long term efficiency plan.

The solar potential, yellow, is large and increases slightly with time and new construction, and as more treeless building sites are used. An important distinguishing feature of this potential is that it is at a maximum during summer and during the utility system peaks.

With regard to solar applications, it is important to draw a perspective from the current state of building science. The design of increasingly efficient buildings has diminishing returns. It appears that building energy use reductions of more than 50 percent beyond the ASHRAE 90.1-2004 building code will be difficult to achieve without resorting to solar applications. The current thrust toward "net zero" buildings can practically only be achieved by significant applications of solar photovoltaic arrays. While these solar applications will require a large area exposed to sunlight, the required solar exposures usually lie within the geometries of most residential and commercial buildings. However, as later analysis will show, the solar potential is beyond the immediate cost effectiveness limit. But this category of potential is technically sound, very large, and homogenous. It may reasonably become cost effective within the 20-year planning window, and it is important to understand the role and size of this resource in the larger picture.

Our analysis of technical potential shows that, as an upper bound, it is technically possible to cut energy usage and system peak load significantly. However, these estimates imply very large expenditures and cannot be considered realistic estimates of actual reductions because they are unconstrained by market, behavioral and budget considerations.

Energy Efficiency Measure Assessment

In order to evaluate technologies for their potential in electric DSM programs it is necessary to compile detailed information at the EEM level of detail. An EEM is a device or action that causes a drop in energy usage. The objective of EEM assessment or screening is to determine the likely set of cost effective measures which can then be used to populate DSM programs that deliver savings through stand-alone or bundled EEMs. An important by-product of this screening is the information necessary to construct a DSM supply curve for determining economic potential.

Our list of EEMs and assumptions was developed through an integrated approach that combined an extensive review of industry literature, the detailed analysis of I&M loads described earlier, and our own expert opinion. These assumptions and sources are documented in Appendix C and Appendix D, starting on pages 109 and 130, respectively. The assumptions required to calculate EEM cost effectiveness are shown in Table 13 for residential and Table 14 for non-residential. Each of these tables uses a standard layout to present the assumptions used to calculate real levelized cost (RLC) per kWh. A discussion of the cost effectiveness approach used to evaluate EEMs follows these two tables.

Descriptions of the columns presented in Table 13 and Table 14 are presented below.

End Uses	EEMs are grouped by the end-use they address.
EEM Description	Brief description of the EEM. See the appendixes for a more detailed description.
EEM Reference	Code to uniquely identify an EEM in this project.
Application (Table 13 only)	For residential measures only, describes the segment of residential sector where the EEM assumptions are applicable. For example, the same EEM may have different assumptions for single family and multifamily applications.
Annual kWh Savings	Annual kWh savings per customer site.
Annual Therm Savings (Table 13 only)	Annual therm savings per customer site when EEM involves a technology with dual fuel impacts. Not applicable to non-residential.
Incremental Cost	The incremental cost of installing the EEM at the typical customer site, including any incremental equipment and labor expenses. Note: "incremental" refers to the costs over and above what would have been expended for a standard efficiency measure. All costs are in 2007 dollars.
Annual O&M	Annual operation and maintenance expenses over and above the O&M expenses incurred for standard efficiency measures. Most EEMs have zero incremental O&M expenses.
Measure Life	The average expected life of the measure.
Real Levelized Cost	The incremental cost and annual O&M expressed as a constant annual payment over the life of the measure and then divided by the annual savings. Real levelized cost provides a way of comparing EEMs with different attributes such as measure life on the same scale.
Measure B:C Ratio	Ratio of the total supply side benefit to measure cost where supply side benefits equal the approximated avoided cost of energy and demand. While the simple ratio lacks the rigor of program cost effectiveness modeling, a ratio greater than one means approximated benefits exceed incremental cost and annual O&M cost.

Table 13. DSM Technology Assessment, Residential

End Uses	EEM Description	EEM Reference	Application	Annual kWh Savings	Annual Therm Savings	Incremental Cost (dollars)	Annual O&M (dollars)	Measure Life (years)	Real Levelized Cost ($/kWh)	Measure B:C Ratio
1. Customer-Sited Generation	Solar Photovoltaic	R-1	All	3,300	0	20,000	10	25	0.5110	0.12
2. Residential Space Conditioning	Resist to SEER 13 Heat Pump	R-2	Elec SF	6,000	0	10,000	20	10	0.2378	0.30
	Resist to SEER 13 Heat Pump	R-3	Elec MF	4,800	0	10,000	20	10	0.2972	0.24
	SEER 8 to SEER 13 CAC	R-4	Gas SF	1,400	0	3,500	20	10	0.3660	0.32
	SEER 8 to SEER 13 CAC	R-5	Gas MF	1,200	0	3,500	20	10	0.4270	0.27
	Refrig Charge/Duct Tune-Up	R-6	Elec	1,200	0	350	0	5	0.0706	0.89
	Refrig Charge/Duct Tune-Up	R-7	Gas	300	47	350	0	5	0.1130	0.22
	SEER 13 to SEER 15 Heat Pump	R-8	SF Elec New	1,110	0	1,050	20	20	0.1055	0.60
	SEER 13 to SEER 15 Heat Pump	R-9	MF Elec New	700	0	1,000	20	20	0.1607	0.39
	SEER 13 to SEER 15 CAC	R-10	SF Gas New	520	0	850	20	20	0.1897	0.61
	SEER 13 to SEER 15 CAC	R-11	MF Gas New	350	0	850	20	20	0.2818	0.41
	Efficient Window AC	R-12	All	200	0	150	10	13	0.1384	0.84
	Cool Roofs	R-13	Elec	560	0	158	0	12	0.0350	3.30
	EE Windows	R-14	Elec	1,334	0	2,500	0	25	0.1571	0.40
	Programmable Thermostats	R-15	Elec	500	0	120	0	10	0.0338	1.87
	Ceiling Insulation (R6-R30)	R-16	Elec	1,500	0	750	0	25	0.0419	1.51
	Ceiling Insulation (R6-R30)	R-17	Gas	300	100	750	0	25	0.0838	0.30
	House Sealing using Blower Door	R-18	Elec	1,000	0	500	0	10	0.0703	0.90
	House Sealing using Blower Door	R-19	Gas	200	42	500	0	10	0.1407	0.18
	Ground Source Heat Pump	R-20	Elec	5,382	0	7,000	20	25	0.1127	0.56
	Wall Insulation (R3-R11)	R-21	Elec	2,100	0	1,400	0	25	0.0559	1.13
	Wall Insulation (R3-R11)	R-22	Gas	400	100	1,400	0	25	0.1173	0.22
	Solar Siting/Passive Design	R-23	New Elec	1,500	0	500	0	25	0.0279	2.26
	Energy Star Manufactured Home	R-24	New	5,000	0	2,600	0	25	0.0436	1.45
	Energy Star Construction	R-25	New Elec	4,223	0	3,000	0	25	0.0595	1.06
3. Load Management	Eliminate Old Refrigerators	R-26	All	1,150	0	165	0	5	0.0347	1.68
	Set Back HVAC	R-27	All	1,000	0	5	0	2	0.0028	22.89
4. Residential Appliances	Energy Star Clothes Washers	R-28	All	400	0	400	0	18	0.0976	0.60
	Energy Star Dish Washers	R-29	All	75	0	50	0	10	0.0938	0.62
	Energy Star Refrigerators	R-30	All	100	0	200	0	18	0.1951	0.30
	Pool Pumps	R-31	All	648	0	180	0	10	0.0391	1.49
5. Residential Lighting	Compact Fluorescent	R-32	All	660	0	24	0	5	0.0088	6.62
	Daylighting Design	R-33	New Elec	750	0	500	0	25	0.0559	1.04
	Occupancy Controlled Outdoor	R-34	All	250	0	100	0	10	0.0563	1.04
6. Water Heating	Tank/Pipe Wrap and Water Temp Setpoint	R-35	All	200	0	50	0	10	0.0352	1.66
	Low Flow Fixtures	R-36	All	500	0	25	0	10	0.0070	8.29
	Heat Pump Water Heaters	R-37	All	2,000	0	2,500	0	18	0.1219	0.48
	Tankless Water Heaters	R-38	All	400	0	1,500	0	18	0.3658	0.16
	Solar Water Heaters	R-39	All	2,600	0	6,000	20	25	0.2011	0.29
	Efficient Plumbing	R-40	New Elec	500	0	500	0	25	0.0838	0.70

Note: Dollar amounts are expressed in 2007 dollars.

Table 14. DSM Technology Assessment, Non-Residential

End Uses	EEM Description	EEM Reference	Annual kWh Savings	Incremental Cost (dollars)	Annual O&M (dollars)	Measure Life (years)	Real Levelized Cost ($/kWh)	Measure B:C Ratio
1. Customer-Sited Generation	Solar Photovoltaic	C-1	12,000	90,000	25	25	0.6307	0.14
2. C&I Space Conditioning	Small HVAC Optimization and Repair	C-2	5,617	1,137	50	5	0.0579	1.53
	Commissioning - New	C-3	40,630	37,000	0	5	0.2206	0.25
	Re/Retro-Commissioning Lite	C-4	20,315	4,000	0	5	0.0477	1.14
	Low-e Windows 1500 ft2 New	C-5	14,979	4,500	0	25	0.0252	2.16
	Low-e Windows 1500 ft2 Replace	C-6	14,979	30,000	0	25	0.1679	0.32
	Premium New HVAC Equipment	C-7	5,617	2,603	250	15	0.0946	0.58
	Large HVAC Optimization and Repair	C-8	9,362	3,201	0	5	0.0828	0.66
5. Design (new)	Integrated Building Design (new)	C-9	26,365	8,932	0	25	0.0284	1.92
	Efficient Package Refrigeration (new)	C-10	17,900	2,654	0	15	0.0160	3.28
6. Motors and Drives	Electrically Commutated Motors	C-11	3,745	1,250	0	15	0.0361	1.46
	Premium Motors	C-12	3,745	412	0	15	0.0119	4.43
	Variable Speed Drives, Controls and Motor Applications Tune-Up	C-13	18,723	16,126	0	15	0.0930	0.57
7. Power Distribution	Energy Star Transformers (new)	C-14	936	76	0	18	0.0079	6.90
	Efficient AC/DC Power	C-15	2,808	209	0	5	0.0180	2.92
8. Data Processing	Network Computer Power Management	C-16	3,745	431	0	2	0.0634	0.83
9. Lighting	New Efficient Lighting Equipment	C-17	18,723	4,924	0	18	0.0257	2.05
	Retrofit Efficient Lighting Equipment	C-18	18,723	6,155	0	18	0.0321	1.64
	LED Exit Signs	C-19	1,470	270	0	10	0.0258	2.04
	LED Traffic Lights (10)	C-20	5,000	2,000	0	10	0.0563	0.93
	Perimeter Daylighting	C-21	5,617	4,771	0	18	0.0829	0.63
10. Water Heating	Low Flow Fixtures	C-22	6,000	1,000	0	10	0.0234	2.24
	Solar Water Heaters	C-23	2,500	6,000	20	25	0.2091	0.43
	Heat Pump Water Heaters	C-24	2,000	2,500	20	18	0.1319	0.67
11. Cooking and Laundry	Energy Star Hot Food Holding Cabinet	C-25	4,100	1,100	0	15	0.0290	1.81
	Energy Star Electric Steam Cooker	C-26	2,200	5,000	0	15	0.2455	0.21
	Pre-Rinse Spray Wash	C-27	9,362	237	0	15	0.0027	19.21
	Restaurant Commissioning Audit	C-28	18,723	1,382	0	5	0.0179	2.94
12. Refrigeration	Grocery Refrigeration Tune-Up and Improvements	C-29	18,723	3,549	0	5	0.0459	1.15
	Refrigeration Casework Improvements	C-30	9,362	3,089	10	10	0.0475	1.11
13. Other	VendingMiser®	C-31	1,000	215	0	10	0.0302	1.74
Note: Dollar amounts are expressed in 2007 dollars.								

Cost Effectiveness[7]

Cost effectiveness of each EEM is measured by the real levelized cost per kWh. Real levelized cost expresses the total incremental cost and any annual operation and maintenance expense as a constant annual payment over the life of the measure divided by annual savings.[8] The advantage of RLC is that it normalizes for differences in measure life and other EEM attributes to provide a means of comparing EEMs in terms of their relative cost effectiveness. As will be demonstrated in the next section, RLC also provides a convenient method for determining economic potential.

Assumptions on average annual savings, installed cost and measure life come from many sources, including the energy modeling work conducted as part of this project using segment-specific billing data for I&M customers.[9] In other words, our annual savings estimates are linked and consistent with the modeled loads reported in the Market Assessment section of this report. Incremental cost for the EEM screening step includes the incremental costs of installing the measure. Depending on the measure, this could be simply the cost of the high efficiency measure over-and-above the standard efficiency option. In other cases, installation labor and site modifications may also be required for the high efficiency model and, hence, would be included in incremental cost. At this stage of analysis, EEM screening, the costs do not include the cost of program administration, implementation and evaluation. Tax credits are also not considered at this stage of the analysis.

It should be pointed out that program design may have an impact on some of the EEM screening assumptions. An owner-installed delivery option, for example, may result in lower installed cost than a contractor installation but come at the possible loss of useful measure life. Such tradeoffs are important program design considerations but beyond the scope of EEM analysis. For the purposes of this stage of analysis, the EEM assumptions provide a reasonable starting point for our assessment of energy efficiency options.

Energy efficiency measures in Table 13 and Table 14 have been grouped by major end-use categories. Measures considered in the screening include solar domestic hot water (DHW) and solar electric. In principle these measures can provide very large energy savings, but they are usually not cost effective. They are included in this screening to keep a broad perspective in the analysis and to reach a fuller understanding of the possibilities and physical limits of potential.

[7] Two types of cost effectiveness analysis are presented in this report. This section deals only with technology assessment using levelized cost. More comprehensive analysis is required at the program level. See Appendix B for a discussion of each type of cost effectiveness analysis.
[8] The formula for this calculation is presented in Appendix B. A real discount rate of 6.74% was used in the calculations. The total incremental cost of measures with both electric and gas savings has been prorated between the two fuels. When gas savings are involved, the total incremental cost is split 40% electric and 60% gas. This leads to levelized gas savings costs ranging from $0.3 to $0.7/therm.
[9] The modeling is described in more detail in Appendix A and EEM assumptions are described in their respective appendixes.

Cost Effectiveness Rankings

The residential and non-residential measures are ranked by cost effectiveness in Table 15 and Table 16, respectively. Descriptions of the columns in these tables are presented below.

EEM Reference	Unique EEM reference number.
EEM Description	Brief description of the EEM. See appendixes for a more detailed description.
Application (Table 15 only)	For residential measures only, describes the segment of residential sector where the EEM assumptions are applicable. For example, the same EEM may have different assumptions for single family and multifamily applications.
Real Levelized Cost ($/kWh)	The incremental cost and annual O&M expressed as a constant annual payment over the life of the measure and then divided by the annual savings. Entries in the EEM ranking table are sorted from least cost (lowest RLC) to highest cost measures.
Annual Savings per Site (kWh)	Annual kWh savings per customer site.
Potential Sites	An estimate of the potential number of customer sites that could have the EEM installed without regard to cost. See appendixes for more information on determining this estimate for each measure.
Potential Annual Savings (MWh)	Total annual energy savings potential in MWh derived by multiplying the annual savings per site by the number of potential sites.

It is apparent in Table 15 that the most cost effective measures are retrofit measures applied to electrically heated residences, and some efficient appliances (notably washers and lighting). Some measures with large technical potential are shown to have relatively high cost (e.g., replacing resistance heat with a heat pump).

Table 15. Ranked Measures, Residential

EEM Reference	EEM Description	Application	Real Levelized Cost ($/kWh)	Annual Savings per Site (kWh)	Potential Sites	Potential Annual Savings (MWh)
R-27	Set Back HVAC	All	0.003	1000	21,452	21,452
R-36	Low Flow Fixtures	All	0.007	500	128,714	64,357
R-32	Compact Fluorescent	All	0.009	660	128,714	84,952
R-23	Solar Siting/Passive Design	New Elec	0.028	1500	23,040	34,560
R-15	Programmable Thermostats	Elec	0.034	500	85,810	42,905
R-26	Eliminate Old Refrigerators	All	0.035	1150	64,357	74,011
R-13	Cool Roofs	Elec	0.035	560	0	0
R-35	Tank/Pipe Wrap and Water Temp Setpoint	All	0.035	200	85,810	17,162
R-31	Pool Pumps	All	0.039	648	21,452	13,901
R-16	Ceiling Insulation (R6-R30)	Elec	0.042	1500	85,810	128,714
R-24	Energy Star Manufactured Home	New	0.044	5000	17,162	85,810
R-21	Wall Insulation (R3-R11)	Elec	0.056	2100	38,313	80,458
R-33	Daylighting Design	New Elec	0.056	750	21,452	16,089
R-34	Occupancy Controlled Outdoor	All	0.056	250	42,905	10,726
R-25	Energy Star Construction	New Elec	0.060	4223	60,067	253,662
R-18	House Sealing using Blower Door	Elec	0.070	1000	85,810	85,810
R-6	Refrig Charge/Duct Tune-Up	Elec	0.071	1200	68,648	82,377
R-17	Ceiling Insulation (R6-R30)	Gas	0.084	300	118,495	35,549
R-40	Efficient Plumbing	New Elec	0.084	500	0	0
R-29	Energy Star Dish Washers	All	0.094	75	85,810	6,436
R-28	Energy Star Clothes Washers	All	0.098	400	85,810	34,324
R-8	SEER 13 to SEER 15 Heat Pump	SF Elec New	0.106	1110	21,452	23,812
R-20	Ground Source Heat Pump	Elec	0.113	5382	12,871	69,274
R-7	Refrig Charge/Duct Tune-Up	Gas	0.113	300	107,262	32,179
R-22	Wall Insulation (R3-R11)	Gas	0.117	400	42,905	17,162
R-37	Heat Pump Water Heaters	All	0.122	2000	68,648	137,295
R-12	Efficient Window AC	All	0.138	200	70,793	14,159
R-19	House Sealing using Blower Door	Gas	0.141	200	150,167	30,033
R-14	EE Windows	Elec	0.157	1334	44,149	58,895
R-9	SEER 13 to SEER 15 Heat Pump	MF Elec New	0.161	700	12,871	9,010
R-10	SEER 13 to SEER 15 CAC	SF Gas New	0.190	520	21,452	11,155
R-30	Energy Star Refrigerators	All	0.195	100	85,810	8,581
R-39	Solar Water Heaters	All	0.201	2600	68,648	178,484
R-2	Resist to SEER 13 Heat Pump	Elec SF	0.238	6000	34,324	205,943
R-11	SEER 13 to SEER 15 CAC	MF Gas New	0.282	350	12,871	4,505
R-3	Resist to SEER 13 Heat Pump	Elec MF	0.297	4800	21,452	102,972
R-38	Tankless Water Heaters	All	0.366	400	14,812	5,925
R-4	SEER 8 to SEER 13 CAC	Gas SF	0.366	1400	64,357	90,100
R-5	SEER 8 to SEER 13 CAC	Gas MF	0.427	1200	14,812	17,774
R-1	Solar Photovoltaic	All	0.511	3300	126,492	417,424
Note: Dollar amounts are expressed in 2007 dollars.						

Another energy saver with poor cost effectiveness is the replacement of poorly performing central air conditioners on a gas heated residence by more efficient ones. This poor cost effectiveness relates to the high initial cost of the equipment, and to the relatively low cooling savings. Generally measures that pertain to efficient new construction are reasonably cost effective because EEMs can be installed at the time of construction with low incremental cost impacts.

The non-residential measures are ranked in Table 16 by cost effectiveness. As with residential, measures pertaining to building efficient new stock are generally cost effective. Also, measures associated with tuning and properly maintaining HVAC and refrigeration equipment are generally cost effective.

Lighting, new design and commissioning are both cost effective and large. Another favored category is Small HVAC Optimization and Repair; it is also cost effective and large. As in the case of residential, the least cost effective measures are efficient glazing, solar water heat and solar photovoltaic.

Table 16. Ranked Measures, Non-Residential

EEM Reference	EEM Description	Real Levelized Cost ($/kWh)	Annual Savings Per Site (kWh)	Potential Sites	Potential Annual Savings (MWh)
C-27	Pre-Rinse Spray Wash	0.003	9,362	2,224	20,821
C-14	Energy Star Transformers (new)	0.008	936	3,707	3,470
C-12	Premium Motors	0.012	3,745	3,097	11,598
C-10	Efficient Package Refrigeration (new)	0.016	17,900	1,549	27,720
C-28	Restaurant Commissioning Audit	0.018	18,723	3,252	60,889
C-15	Efficient AC/DC Power	0.018	2,808	22,241	62,463
C-22	Low Flow Fixtures	0.023	6,000	5,190	31,137
C-5	Low-e Windows 1500 ft2 New	0.025	14,979	8,155	122,150
C-17	New Efficient Lighting Equipment	0.026	18,723	1,549	28,995
C-19	LED Exit Signs	0.026	1,470	44,482	65,388
C-9	Integrated Building Design (new)	0.028	26,365	9,063	238,957
C-25	Energy Star Hot Food Holding Cabinet	0.029	4,100	2,224	9,119
C-31	VendingMiser®	0.030	1,000	3,707	3,707
C-18	Retrofit Efficient Lighting Equipment	0.032	18,723	47,225	884,202
C-11	Electrically Commutated Motors	0.036	3,745	11,120	41,642
C-29	Grocery Refrigeration Tune-Up and Improvements	0.046	18,723	3,097	57,990
C-30	Refrigeration Casework Improvements	0.047	9,362	3,097	28,995
C-4	Re/Retro-Commissioning Lite	0.048	20,315	16,310	331,333
C-20	LED Traffic Lights (10)	0.056	5,000	3,707	18,534
C-2	Small HVAC Optimization and Repair	0.058	5,617	14,827	83,284
C-16	Network Computer Power Management	0.063	3,745	7,414	27,761
C-8	Large HVAC Optimization and Repair	0.083	9,362	7,414	69,404
C-21	Perimeter Daylighting	0.083	5,617	14,827	83,284
C-13	Variable Speed Drives, Controls and Motor Applications Tune-Up	0.093	18,723	3,707	69,404
C-7	Premium New HVAC Equipment	0.095	5,617	14,827	83,284
C-24	Heat Pump Water Heaters	0.132	2,000	4,646	9,292
C-6	Low-e Windows 1500 ft2 Replace	0.168	14,979	7,414	111,046
C-23	Solar Water Heaters	0.209	2,500	2,942	7,356
C-3	Commissioning - New	0.221	40,630	0	0
C-26	Energy Star Electric Steam Cooker	0.245	2,200	2,224	4,893
C-1	Solar Photovoltaic	0.631	12,000	11,120	133,446
Note: Dollar amounts are expressed in 2007 dollars.					

Economic Potential

Economic potential is defined as the total energy savings available at a specified long-term avoided cost of energy. Technologies with levelized costs that are lower than the avoided cost of energy are included in estimates of economic potential. A DSM supply curve provides a flexible framework for presenting economic potential that reflects the direct relationship between the long-term marginal cost of energy supply and energy efficiency potential. Unlike point estimates, DSM supply curves show the economic potential at several levels of marginal supply cost. It is important to note that only incremental cost of measures are included at this stage of analysis.

The DSM supply curve for residential is shown in Figure 18 which shows the cumulative kWh savings from all measures listed in Table 15 with a levelized cost less than the corresponding point on the graph. For example, there are approximately 600 million kWh of annual savings available at a cost $0.05 per kWh or less. Estimated residential economic potential increases to 930 million kWh annually at a cost of $0.06 per kWh or less.

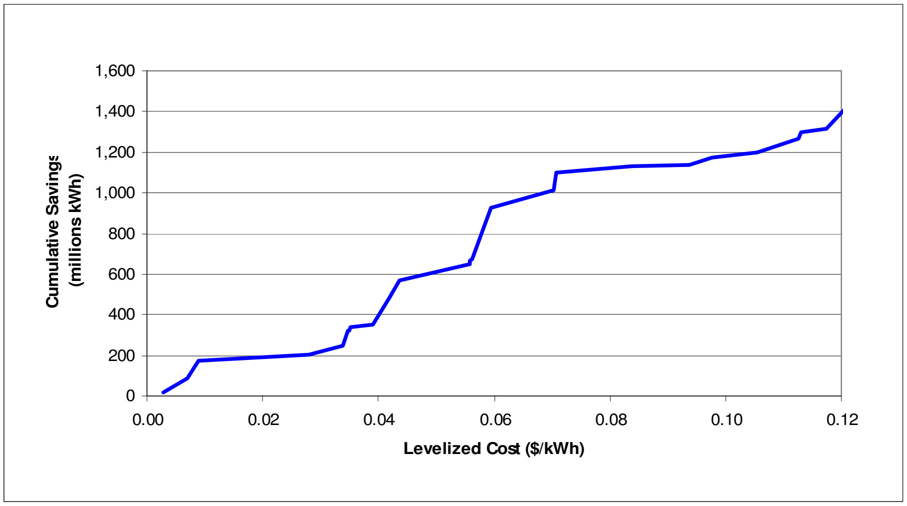


Figure 18. Residential DSM Supply Curve

Since Figure 18 is constructed from the information in Table 15, it is possible to see exactly which measures are responsible for changes along the DSM supply curve. If marginal supply costs increase from $0.05 to $0.06 per kWh, for example, we would pick up about 250 million kWh annually with efficient new construction responsible for most of the increase. I&M's marginal cost of avoided supply depends on the load shape and longevity of savings.[10] Using $0.07 per kWh as an approximate marginal cost of supply, residential economic potential is estimated at 1.0 billion kWh annually.

The DSM supply curve for non-residential is shown in Figure 19 and, like residential, represents an alternate format for the information in Table 16.

[10] Marginal cost of supply varies by time of day and season and the amount of avoided peak load. Since different measures have different load shapes, they also have different marginal supply cost. When measures are grouped into programs, these differences are reflected in the breakeven marginal cost of energy supply for that program which represents the cost that the program must fall under in order to be cost effective.

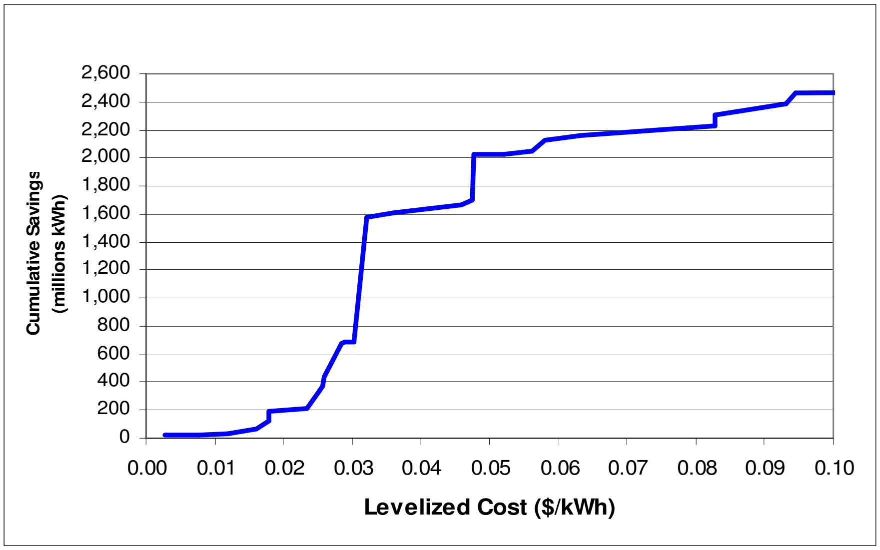


Figure 19. Non-Residential DSM Supply Curve

Figure 19 shows that most of the non-residential efficiency savings are available at levelized costs of less than $0.04 per kWh. One characteristic of the non-residential DSM supply curve is the relatively large amount of energy savings available at around $0.05 per kWh or less, excluding administration and program costs. Using an approximate marginal cost of supply of $0.07, we estimate annual economic potential in the non-residential sector to be approximately 2.2 billion kWh.

Both the residential and non-residential DSM supply curves show a diminishing return as the levelized cost rises above $0.10 per kWh. Over half of the full technical potential is available at levelized costs of less than $0.07 per kWh. Our estimate of total economic potential in both segments is 3.2 billion kWh annually.

DSM PROGRAMS

Programs bundle related energy savings measures or demand reduction measures. The cost effectiveness of the individual measures is shown in the measure tables in the previous section of this report, where individual measure rankings may be reviewed. In moving from the level of consideration of individual measures to the program level, we have included the program administrator's program costs (sometimes called the utility program costs) along with the costs of the individual measures that have been assembled into each program. The cost-effectiveness tests applied at the program level include the additional costs to manage the programs and costs of program evaluation. Cost-effectiveness testing of the programs requires assumptions about the relative frequency of individual measures included in each program option. Using this approach, recommended programs are listed in Table 17.

I&M will, of course, make the final selection of programs to be submitted for regulatory approval. For programs ultimately selected and approved, I&M will then develop a scope of work and will then (for most programs – any that are not determined to be best run internally) issue a RFP to the program vendor community to elicit proposals from which a vender may be selected. Each vendor will propose full program designs in their bid package. The final program designs (the ones actually implemented) will be based on the planned design as approved by the Commission, the scope of work developed by I&M, and the selected vendor's proposal.

Today, most DSM programs are managed with a small internal staff responsible for vendors who do most of the work to implement the programs, develop relationships essential to increasing customer participation, carry out day-to-day operations, and perform the work of data entry for program tracking.[11] There will need to be a sufficient internal I&M DSM staff to insure that program control is efficient and effective and that responsibilities and lines of accountability of vendors to I&M are kept crystal clear.

The programs presented below were designed to capture the most cost-effective opportunities from the Energy Efficiency Measures (EEMs) identified earlier in this report. Cost effectiveness results are presented for all of the programs in the following section of the report. Each of the program plans presented in this section contains information on program design, participation, expected savings, tracking concerns, and implementation budget. This information is organized as follows:

- Description of program design including measures and incentives. This description leads off each program plan.
- Rationale for the program. This is a brief description of the logic of the program.
- Participation and measures included in the program, along with expected energy savings. This provides a five-year overview of number of participants and expected energy savings (annual kWh savings and kW reductions).

[11] Be sure to require vendors to provide consistent and timely tracking system inputs as a condition of submitting a bid. The program tracking system is usually best internal to the company (so it will be consistent across programs rather than each vendor bringing their own system), but the detailed input is usually best made part of program vendor responsibilities (so as to avoid duplication of input effort).

- Marketing Plans. A brief description of suggested marketing efforts specific to the program.[12]
- Program Tracking Considerations
- Detailed Budget Plans. Annual program implementation budgets for five years.
- In addition to the specific plans for each program, it is recommended to have a general marketing and promotional effort to support DSM and to help customers become aware of the programs. This will include effective energy efficiency education efforts, including education in the schools and an energy audit web tool.

Note that in some of the program descriptions organizational or product names are given. These are not recommendations of specific groups or brands, but are included as links for developing further information.

Table 17. Program Recommendations

No.	Program Name	Description	Recommended
		Direct Load Control Programs	
1	C&I Peak Reduction	Air conditioner DLC for commercial, industrial and institutional customers	Yes
2	Residential Peak Reduction	Air conditioner and electric hot water heater DLC for residential customers	Yes
		Research and Demonstration Projects	
3	Renewables & Demonstrations	Demonstrations to push limits and learning for new technologies; and to build customer attention to green and DSM/DR programs	Yes
		Commercial and Industrial Programs	
4	C&I Incentives	Sets of improvements or special measures proposed for individual situations	Yes
5	C&I Rebates	Prescriptive measures for non-residential customers	Yes
6	C&I Retro-Commissioning Lite	Tuning of controls	No
7	C&I HVAC Optimization	Check and optimization of HVAC units	No
8	C&I Audit	Audit program focused on food processing and refrigeration (supermarkets and restaurants)	Yes
9	C&I New Construction	New buildings	Yes
		Residential Programs	
10	Residential Whole House	Free remote audits with kit available to all customers; on-site audit with direct install of low-cost items and kit for fifty dollars (refundable against installation cost of items recommended in audit)	Yes
11	Residential Rebates	Energy efficient lighting and clothes washers	Yes
12	Residential Appliance Recycling	Pick-up and environmental disposal	Yes
13	Residential New Construction	New buildings	No
14	Residential Solar Siting	Solar orientation, passive design, work on codes	Yes
15	Residential Low & Moderate Income Weatherization	Homes with electric heat and electric hot water, income at or below 150% of the federal poverty level or at or below 80% of median income	Yes

[12] While marketing is addressed for each program, we recommend bundling the programs so that from a customer perspective there are no more than nine options. Although programs will be selected and evaluations performed on the individual programs, for customer communications a simplified menu approach is more appropriate. For a model of how the menu approach works, go to http://www.pge.com/index.html. This site divides into "For my Home," and "For my Business." Then programs are listed branching from these two options. The programs as they appear to the customer are constructed to make sense from the logic of customer communication and the logic of efficient program administration, rather than as many individual programs.

Program 1. Commercial and Industrial Peak Reduction

Approximately 10,000 South Bend, Indiana area customers of I&M are taking part in a demonstration of new metering technologies. In this effort, I&M is collaborating with the Indiana Utility Regulatory Commission (IURC) and the Indiana Office of Utility Consumer Counselor (OUCC).[13] The pilot is also part of an initiative with General Electric. The pilot is a deployment of "smart grid" technologies, and is expected to be a precursor to eventual system-wide implementation of the technologies. Currently, the pilot is limited to homes and businesses located west and northeast of downtown South Bend, Indiana.

GE smart meters, which are digital meters connected to a two-way radio frequency communications network provide immediate feedback information both to the customer and to the utility company.[14] The smart meter technology supports:

- Time-of-use prices, where the cost of electricity is lower during off-peak periods and higher during times of peak use,
- Direct load control, a feature that allows automatic adjustments to central air conditioning units during periods of peak demand during summer months in exchange for price incentives on electric rates, and
- The ability to pre-pay for electricity service.

The company will also work with homebuilders to install advanced energy controls in fifty new homes. For the South Bend pilot, all systems will be in use by the second quarter of 2009 and will be evaluated for one year.

For this program, we focus on load control, although clearly the new smart grid technologies offer the opportunity to explore development of several other kinds of customer service initiatives, including time of use pricing. A load control program is a dispatch program. In a dispatch program, a switch can be engaged to send a signal which directly reduces load. Direct load control is an important approach to peak reduction because it offers low cost to the company and is dispatchable.

Rationale

Load (KW) constraints are one of the most costly events a utility encounters. During peak times when demand escalates and there is a problem with meeting demand with additional generation supply (either physically or at reasonable cost), the cost per kW to the company can escalate exponentially. For this reason, in these situations load control is essential to control costs and insure service.

Participation and Measures

Measures are shown below.

Table 18. Measures – C&I Peak Reduction

Measures
DLC – Non Res AC

[13] I&M and the OUCC worked collaboratively to define the scope of the program, select the technology, develop programs, design experimental tariffs, and will work together to measure the results.
[14] The project includes General Electric's ENMAC system. ENMAC is a fully integrated, advanced network management system that automates the real-time management, monitoring and control of electrical distribution networks.

Projected participation by year is shown in the table below.

Table 19. Estimated Participation and Savings – C&I Peak Reduction

Potential participants				10,290
Per participant savings (kWh):				0
Per participant savings (kW):				9.5
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	206	2.0%	-	1,964
Year 2	515	5.0%	-	4,910
Year 3	617	6.0%	-	5,882
Year 4	720	7.0%	-	6,864
Year 5	823	8.0%	-	7,846
Cumulative	2,881	28.0%	-	27,466

Marketing Plans

Since DLC will proceed with the roll out of new meters following the model of the South Bend pilot, marketing will likely be targeted to specific areas within the I&M Indiana service territory. Marketing should take advantage of current concerns for mitigating climate problems by emphasizing a green marketing theme and can include the following elements:

- Proposed marketing efforts are to include mention of the program in any communications with Commercial, Industrial, and Institutional customers regarding energy efficiency program options such as bill inserts, recognition window stickers for participating businesses, customer service representatives, and promotion using the I&M website.
- The program can involve key customer account managers to interact with customers regarding the benefits of the program.

Program Tracking Considerations

Direct load control is data intensive and load management data is precise. When load events are called either for capacity shortages or as tests, the systems self-validate. Care needs to be taken to insure the collection of data elements sufficient to show the baseline condition at the time an event is called and the response to the call as a kW effect. The duration of each event for evaluation purposes should also last long enough to show the affected units back on line to demonstrate there are no unexpected effects.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to I&M for offering this program to customers involves budgets for:

- A participant incentive of $250 each summer (5 monthly payments of $50).
- Cost of equipment prorated to the DLC effort ($100) plus the cost of connecting the controlled equipment ($150).

Cost to the participants is to accept the temporary load control when incidents are called.

Table 20. Estimated Five-Year Program Budget - C&I Peak Reduction

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$50,000	$0	$0	$0	$0	$50,000	2%
DSM Staffing		$44,000	$44,000	$66,000	$66,000	$88,000	$308,000	10%
Program Monitoring & Evaluation		$15,000	$15,000	$15,000	$15,000	$15,000	$75,000	2%
Variable Program Costs								
Incentives (paid annually to participants)	$250	$51,500	$180,250	$334,500	$514,500	$720,250	$1,801,000	58%
Delivery & Other	$303	$62,315	$155,788	$186,643	$217,800	$248,958	$871,503	28%
Total Budget		$222,815	$395,038	$602,143	$813,300	$1,072,208	$3,105,503	100%

Program 2. Residential Peak Reduction

Approximately 10,000 South Bend, Indiana area customers of I&M are taking part in a demonstration of new metering technologies. In this effort, I&M is collaborating with the Indiana Utility Regulatory Commission (IURC) and the Indiana Office of Utility Consumer Counselor (OUCC).[15] The pilot is also part of an initiative with General Electric. The pilot is a deployment of "smart grid" technologies, and is expected to be a precursor to eventual system-wide implementation of the technologies. Currently, the pilot is limited to homes and businesses located west and northeast of downtown South Bend, Indiana.

GE smart meters, which are digital meters connected to a two-way radio frequency communications network provide immediate feedback information both to the customer and to the utility company.[16] The smart meter technology supports:

- Time-of-use prices, where the cost of electricity is lower during off-peak periods and higher during times of peak use,
- Direct load control, a feature that allows automatic adjustments to central air conditioning units during periods of peak demand during summer months in exchange for price incentives on electric rates, and
- The ability to pre-pay for electricity service.

The company will also work with homebuilders to install advanced energy controls in 50 new homes. For the South Bend pilot, all systems will be in use by the second quarter of 2009 and will be evaluated for one year.

For this program, we focus on Residential load control, although clearly the new smart grid technologies offer the opportunity to explore development of several other kinds of customer service initiatives, including time of use pricing. A load control program is a dispatch program. In a dispatch program, a switch can be engaged to send a signal which directly reduces load. Direct load control is an important approach to peak reduction because it offers low cost to the company and is dispatchable.

Rationale

Load (KW) constraints are one of the most costly events a utility encounters. During peak times when demand escalates and there is a problem with meeting demand with additional generation supply (either physically or at reasonable cost), the cost per kW to the company can escalate exponentially. For this reason, in these situations load control is essential to control costs and insure service. The Residential water heaters are included not to deal directly with peak calls (the residential AC serve that purpose) but to reduce the rebound effect from the residential air conditioners as they come back into service following a peak call.

[15] I&M and the OUCC worked collaboratively to define the scope of the program, select the technology, develop programs, design experimental tariffs, and will work together to measure the results.

[16] The project includes General Electric's ENMAC system. ENMAC is a fully integrated, advanced network management system that automates the real-time management, monitoring and control of electrical distribution networks.

Participation and Measures

Measures are shown below.

Table 21. Measures – Residential Peak Reduction

Measures
DLC – Residential AC
DLC – Residential Hot Water

Projected participation by year is shown in the table below.

Table 22. Estimated Participation and Savings - Residential Peak Reduction

Potential participants				234,850
Per participant savings (kWh):				0
Per participant savings (kW):				0.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	4,697	2.0%	-	4,274
Year 2	11,743	5.0%	-	10,686
Year 3	14,091	6.0%	-	12,823
Year 4	16,440	7.0%	-	14,960
Year 5	18,788	8.0%	-	17,097
Cumulative	65,759	28.0%	-	59,841

Marketing Plans

Since DLC will proceed with the roll out of new meters following the model of the South Bend pilot, marketing will likely be targeted to specific areas within the I&M Indiana service territory. Marketing should take advantage of current concerns for mitigating climate problems by emphasizing a green marketing theme and can include the following elements:

- Proposed marketing efforts are to include mention of the program in any communications with customers regarding energy efficiency program options such as bill inserts, recognition window stickers for participating homes, media coverage of how to manage electric bills, customer service representatives, and promotion using the I&M website.
- Residential communications for the program can reach out to customers with high bill complaints and to customers with payment problems as well as to general promotion to customers concerned with keeping costs low and interested in mitigating global warming.

Program Tracking Considerations

Direct load control is data intensive and load management data is precise. When load events are called either for capacity shortages or as tests, the systems self-validate. Care needs to be taken to insure the collection of data elements sufficient to show the baseline condition at the time an event is called and the response to the call as a kW effect. The duration of each event for evaluation purposes should also last long enough to show the affected units back on line to demonstrate there are no unexpected effects.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to I&M for offering this program to customers involves budgets for:

- A participant incentive of $25 each summer (5 monthly payments of $5).
- Cost of equipment prorated to the DLC effort ($100) plus the cost of connecting the controlled equipment ($150).

Cost to the participants is to accept the temporary load control when incidents are called.

Table 23. Estimated Five-Year Program Budget – Residential Peak Reduction

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$30,000	$0	$0	$0	$0	$30,000	0.1%
DSM Staffing		$44,000	$44,000	$66,000	$66,000	$88,000	$308,000	1.3%
Program Monitoring & Evaluation		$15,000	$15,000	$15,000	$15,000	$15,000	$75,000	0.3%
Variable Program Costs								
Incentives (paid annually to participants)	$25	$117,425	$411,000	$763,275	$1,174,275	$1,643,975	$4,109,950	17.5%
Delivery & Other	$288	$1,350,388	$3,376,113	$4,051,163	$4,726,500	$5,401,550	$18,905,713	80.7%
Total Budget		$1,556,813	$3,846,113	$4,895,438	$5,981,775	$7,148,525	$23,428,663	100.0%

Program 3. Renewables and Demonstrations

This program contains five program elements: Solar photovoltaic, solar hot water, ground source heat pumps, LED streetlights[17], and the "Go Deep" project. Each of these program elements is currently non-cost-effective and together, the set is not cost-effective. However, this program in included in the recommended programs for three reasons. First, it is a source for a small number of technology demonstration projects that can be used for promoting interest in energy efficiency. This can include a small number of solar demonstration projects at schools, a ground source heat pump demonstration and sponsoring a few homes for the "Go Deep" project. In addition, LED streetlights are starting to become available – a demonstration in a small parking lot could be used to demonstrate this new technology.

Since most people are interested in "Green" programs, these examples will fit with and encourage this interest. Second, each of the demonstrations is at the edge of current technology in its area. This will keep key company staff current in solar, ground source, and "Go Deep" technologies. Third, each of these has sufficient scale possibilities that make them sufficiently powerful to address climate change and, at the same time running these demonstrations will place the company in with companies in a leadership role in developing these technologies.

Rationale

Each of these program elements push technology beyond current cost-effective limits, but, at the same time, present coherent pathways towards the future of energy efficiency applications. The "Go Deep" project is based on a German model using a "passive house" strategy. The goal is to reduce energy use by eighty percent in existing homes. The principles of this approach include tight super-insulated homes with a thick building envelope and high performance windows and doors. According to the organizer of the "Go Deep" project, Linda Wigington, "Our housing is facing a crisis of obsolescence, and we have a lion share of existing houses that need to be dealt with to reduce energy in the near term." In this approach structure and appliances are parts of the solution as is "how a family lives in a house." "Go Deep" is a national project in which individual utilities sponsor a small number of homes in the 1,000 home pilot. Early results suggest that attaining the savings goal is possible, and the focus is on system replacements and increasing efficiencies.

[17] Although some cities are now putting in large numbers of LED streetlights, MEEA is currently recommending them on a demonstration basis for use in parking lots that have cobra-headed lights with shorter (about twenty feet high) poles. The LED units snap in to replace the old cobra bulb, making use of the existing cobra head and the existing poles. MEEA informally estimates an approximate current payback in the Midwest of about nine years. AEP is a MEEA member, and so may contact Jay Wrobel, Program Director (312) 587-8390, extension 16, for information on specific brands and current costs in developing a demonstration pilot.

Participation and Measures

Measures are shown below.

Table 24. Measures and Incentives – Renewables and Demonstrations

Measure/Program Element	Measure Number	Incentive Amount
Solar PV	R-1	100%
Solar Hot Water	R-39	100%
Ground Source Heat Pump	R-20	100%
Go Deep	Demo	100%
LED Streetlights	Demo	100%

Because this is a promotional and R&D program there will be only a very small number of projects each year.

Table 25. Estimated Participation and Savings - Renewables and Demonstrations

Potential participants				10,000
Per participant savings (kWh):				3,579
Per participant savings (kW):				1.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	5	0.0%	17,895	7
Year 2	5	0.0%	17,895	7
Year 3	5	0.0%	17,895	7
Year 4	5	0.0%	17,895	7
Year 5	5	0.0%	17,895	7
Cumulative	25	0.0%	89,475	33

Marketing Plans

These projects will be used to create interest in energy efficiency through public demonstration projects and to provide referrals to the other programs.

Program Tracking Considerations

Since these are demonstration programs data collection will focus on technical documentation of each project.

Detailed Budget Plans

An estimated five-year budget for this program is provided below.

Table 26. Estimated Five-Year Program Budget - Renewables and Demonstrations

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$25,000	$0	$0	$0	$0	$25,000	4%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	17%
Program Monitoring & Evaluation		$20,000	$20,000	$50,000	$20,000	$50,000	$160,000	24%
Variable Program Costs								
Incentives	$7,590	$37,950	$37,950	$37,950	$37,950	$37,950	$189,750	29%
Delivery & Other	$7,000	$35,000	$35,000	$35,000	$35,000	$35,000	$175,000	27%
Total Budget		$139,950	$114,950	$144,950	$114,950	$144,950	$659,750	100.0%

Program 4. Commercial and Industrial Incentives

This program targets only commercial, industrial and institutional accounts. The program is a totally custom program, designed to develop exceptionally productive energy savings opportunities in cooperation with the customer. Each project will be specially designed. The incentive will be thirty percent of incremental cost. It is expected that projects will need to be carried out in narrow time windows as dictated by conditions specific to the customer's operations and that evaluation will consist primarily of short term instrumentation and spot metering. For the first nine months of each program year, no project may be allocated more than ten percent of the measures budget allocated for this program. The hurdle rate for projects under this program will be set to insure only the most cost-effective projects are selected so as to insure cost recovery.

Rationale

Some commercial and institutional customers will offer special opportunities for energy savings, either brought to I&M by the customer (or the customer's ESCO), or as identified by company account representatives and engineers. By providing a thirty percent cost share in co-developing projects, plus a thirty percent "buy down," customer projects will be likely to move forward. Experience will show whether a thirty percent buy down is enough to attract projects. If this percentage proves too low (based on response to the program) the percentage buy down will be raised. Experience with similar projects in the Northeast has led utilities to offer 90 percent to 75 percent buy downs in this program sector. The hurdle rate (payment for savings) for the program will be set to insure I&M only acquires cost-effective projects.

Participation and Measures

Measures are shown below.

Table 27. Measures and Incentives – C&I Incentives

Measure	Measure Number	Incentive Amount
Custom Program – designed to meet a selected cost-benefit ratio	Custom	Thirty percent (30%) of cost of study to develop project proposal and thirty percent (30%) of energy efficiency improvements

Because of the custom nature of the project, there will not be a large number of participants in any one year.

Table 28. Estimated Participation and Savings - C&I Incentives

Potential Participants				4,000
Per participant Savings (kWh):				247,284
Per Participant Savings (kW):				40.6
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	5	0.0%	1,236,420	203
Year 2	10	0.0%	2,472,840	406
Year 3	10	0.0%	2,472,840	406
Year 4	15	0.0%	3,709,260	610
Year 5	15	0.0%	3,709,260	610
Cumulative	55	0.0%	13,600,620	2,235

Marketing Plans

This program is in every respect a custom program. An example of this type of program is NSTAR Electric's Compressed Air Leak Detection and Remediation Program (www.compressedairchallenge.org & www.nstaronline.com/business/energy_efficiency). Also see Pacific Power's Energy FinAnswer and Energy FinAnswer Express programs at www.pacificpower.net/Navigation/Navigation925.html. It is expected that these will be high return projects in terms of savings achieved. As a program control tool, for the first nine months of each program year, funds to any one participant will be capped at ten percent of program funds allocated to incentives for this program.

Program Tracking Considerations

Data requirements will vary with the specifications for each project. In some cases, utility billing meter information is capable of the level of detail required to assess program impacts. In other cases, spot metering or other types of assessment may be required. In any case, the program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc. It is expected that evaluations will primarily take the form of short term instrumentation and spot metering with engineering review. Since these are custom projects, it will be particularly important in insure provision is made to assess the kWh and/or kW condition that constitutes the baseline, and then measure the change due to the DSM improvements.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to I&M for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- A customer incentive of thirty percent to defray the cost and energy study and improvements.

Costs to participating customers include the remainder of energy study cost to develop project proposals, provision for staff involvement in developing and monitoring the project, and the remainder of equipment costs.

Table 29. Estimated Five-Year Program Budget – C&I Incentives

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$30,000	$0	$0	$0	$0	$30,000	2%
DSM Staffing		$44,000	$44,000	$44,000	$44,000	$44,000	$220,000	14%
Program Monitoring & Evaluation		$40,000	$80,000	$80,000	$120,000	$120,000	$440,000	27%
Variable Program Costs								
Incentives	$14,840	$74,200	$148,400	$148,400	$222,600	$222,600	$816,200	51%
Delivery & Other	$2,000	$10,000	$20,000	$20,000	$30,000	$30,000	$110,000	7%
Total Budget		$198,200	$292,400	$292,400	$416,600	$416,600	$1,616,200	100.0%

Program 5. Commercial and Industrial Rebates

This program targets non-residential customers eligible for prescriptive measures. These will include commercial, industrial, and institutional customers. For-profit, non-profit and public agencies (such as schools) will be included.

Rationale

Rebates are straightforward reimbursements of a portion of customer cost of specific rebated energy efficiency items. Many customers have concerns about the high first cost associated with some of the larger energy efficiency investments (e.g. HVAC systems or energy management systems). I&M's proposed incentives will help remove that barrier. Some customers may also need technical assistance to determine what equipment is appropriate for their facilities. I&M will help address that problem by pre-qualifying ESCOs and then making the list of pre-qualified ESCOs available to interested customers. As an example of this program type, NYSERDA's EnergySmart(SM) Commercial/Industrial Performance Program (CIPP) is implemented entirely by ESCOs. Since the program started in 2004, the number of qualifying ESCOs in New York State has increased significantly, thus facilitating program implementation. ESCO involvement will provide customers with technical expertise to determine what equipment is most appropriate for them, as well as energy savings monitoring.

Participation and Measures

Representative measures are shown in the table below. Measures may be added or deleted from the prescriptive list as information is gained during program planning and administration. The incentive level for these measures is twenty-five percent.

Table 30. Measures and Incentives – C&I Rebates

Measure	Measure Number	Incentive Amount
Energy Saving Lighting Measures	C-17, C-18, C-19, C-20	25%
Motors/Drives/Pumps	C-11, C-12	25%
Energy Star Transformers	C-14	25%
Refrigeration Efficiency	C-10	25%
Efficient Vending Machines	C-31	25%

A rigorous analysis of program cost effectiveness is presented in the next section but all of the measures included in this program are cost effective based on the measure specific benefit-cost ratio (see Table 14) except for measure C-20. LED traffic lights (C-20) were included because the benefit-cost ratio was close to one.

Projected participation by year is shown in the table below.

Table 31. Estimated Participation and Savings - C&I Rebates

Potential Participants				42,400
Per participant Savings (kWh):				17,025
Per Participant Savings (kW):				2.7
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	424	1.0%	7,218,600	1,148
Year 2	848	2.0%	14,437,200	2,296
Year 3	1,272	3.0%	21,655,800	3,444
Year 4	1,696	4.0%	28,874,400	4,592
Year 5	2,120	5.0%	36,093,000	5,741
Cumulative	6,360	15.0%	108,279,000	17,222

Marketing Plans

I&M will need to advertise this program during its initial stages, and also will need to actively recruit ESCOs to work in its service territory. We recommend some general advertising, primarily in the form of brochures and mailings targeted to potential program participants. I&M should work directly with business associations and contact some customers through account representatives. The budget below provides for some general advertising at business events, as well as brochures and premiums. The incentive level for the program is recommended at twenty-five percent.

Program Tracking Considerations

The program manager should insure that the vendor managing this program has an excellent tracking system and provision should be made to gather in-service date and technical data about equipment being replaced as well as the energy savings measures that will replace old equipment.

Detailed Budget Plans

An estimated five-year budget for the Commercial and Institutional Rebate Program is provided below. The anticipated cost to I&M for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- A customer incentive to defray the cost of an energy audit for those customers, although the primary strategy will be for ESCO development of audits.
- Incentives for installing energy efficient equipment.

Costs to participating customers include the remainder of equipment and installation costs.

Table 32. Estimated Five-Year Program Budget – C&I Rebates

	Cost per Participant	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**5-Yr Total**	**Percent of Total**
Fixed Program Costs								
Implementation & Other Annual Cost		$50,000	$0	$0	$0	$0	$50,000	1%
DSM Staffing		$44,000	$44,000	$66,000	$88,000	$88,000	$330,000	3%
Program Monitoring & Evaluation		$10,000	$7,500	$80,000	$7,500	$80,000	$185,000	2%
Variable Program Costs								
Incentives	$1,350	$572,400	$1,144,800	$1,717,200	$2,289,600	$2,862,000	$8,586,000	86%
Delivery & Other	$130	$55,120	$110,240	$165,360	$220,480	$275,600	$826,800	8%
Total Budget		$731,520	$1,306,540	$2,028,560	$2,605,580	$3,305,600	$9,977,800	100.0%

Program 6. Commercial and Industrial Retro-Commissioning Lite

This program targets commercial and institutional customers with a usage profile that indicates a possible high value from retro-commissioning. Although direct requests may also be received, typical the program begins off-site with a scan of billing records using EZ Sim or a similar tool. This screening process will select a pool of buildings for which it looks like retro-commissioning is highly likely to produce substantial energy savings. Building commissioning is a process that is associated with new buildings; a quality assurance process that is followed to facilitate new buildings performing as designed. Retro-commissioning applies a similar process to existing buildings. The goal is insure that a building operates efficiently and effectively. The focus of this pilot program is in insuring efficient operation, rather than on upgrading equipment. The program conducts a low-cost "tuning" of electricity related building systems. The tuning typically involves control systems such as energy management systems that may be improperly programmed, or controls that are out of calibration. When problems are identified and demonstrated, they may have major economic effects. When this type of problem exists, retro-commissioning resolves such problems at low cost.

There is single measure, retro-commissioning. This project will also feed participants towards the Commercial & Institutional Prescriptive Measures Program and the Commercial & Institutional Incentives Program.

Rationale

Most buildings have never been commissioned, so the commissioning of an existing building may be able to identify and correct high priority operating deficiencies and verify proper operations. The focus will typically be on energy-using equipment, lighting, and controls. Further, this program is designated as "retro-commissioning lite," since it will involve engagements of about $4,000 per building[18], rather than the $10,000 to $52,000 associated with full retro-commissioning.[19] The objective will be to find the best buildings for the program. These will be buildings with significant energy problems that can be easily detected and easily fixed. Energy savings will be documented by engineering calculations and evaluated using EZ Sim. The persistence of energy savings will also be tested.

Participation and Measures

Measures are listed below.

Table 33. Measures and Incentives – C&I Retro-Commissioning Lite

Measure	Measure Number	Incentive Amount
Retro Commissioning Engagement	C-4	$2000 (50%)

[18] This is per building; an individual project may have more than one building.
[19] See Haasl &Terry Sharp, A Practical Guide for Commissioning Existing Buildings. Washington, DC: Office of Building Technology, State and Community Programs, US Department of Energy. Prepared by Portland Energy Conservation, Inc. and Oak Ridge National Laboratory, April 1999.

Because it will take some time to put the program in place and to reach the targeted customers, we plan for participation in the program's first year to be lower than in subsequent years, and expect that many of the first year participants are likely to be smaller businesses with more flexibility in their decision making.

Table 34. Estimated Participation and Savings – C&I Retro-Commissioning Lite

Potential Participants				42,400
Per participant Savings (kWh):				20,316
Per Participant Savings (kW):				3.4
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	424	1.0%	8,613,984	1,430
Year 2	848	2.0%	17,227,968	2,860
Year 3	1,272	3.0%	25,841,952	4,290
Year 4	1,696	4.0%	34,455,936	5,721
Year 5	2,120	5.0%	43,069,920	7,151
Cumulative	6,360	3.0%	129,209,760	21,452

Marketing Plans

We recommend some general advertising within the business community, primarily in the form of brochures and mailings targeted to potential program participants; also coordination with business associations. The budget below provides for some general advertising at business events, as well as brochures and premiums. Since this program will operate using internal prescreening, direct contacts to selected businesses and institutions will also be useful. Air Advice is currently running a similar program for the Oregon Energy Trust.

Program Tracking Considerations

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc. The major concern will be for complete and accurate documentation of "before" and "after" energy use and demand impacts. In addition, a way to monitor the duration of energy savings and demand reduction.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- Incentives for installing energy efficient equipment20. (Incentive amounts are based on the average incentive given in NYSERDA's EnergySmartSM CIPP program, discounted to allow participation by smaller commercial customers.)

Costs to participating customers include the remainder of equipment costs.

[20] Incentive amounts are based on the average incentive given in NYSERDA's EnergySmartSM CIPP program, discounted to allow participation by smaller commercial customers. The average CIPP program participant receives $17,000 in incentives. We have discounted that number to $9,750.

Table 35. Estimated Five-Year Program Budget – C&I Retro-Commissioning Lite

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$50,000	$0	$0	$0	$0	$50,000	0%
DSM Staffing		$44,000	$44,000	$44,000	$44,000	$44,000	$220,000	2%
Program Monitoring & Evaluation		$10,000	$7,500	$80,000	$7,500	$80,000	$185,000	1%
Variable Program Costs								
Incentives	$2,000	$848,000	$1,696,000	$2,544,000	$3,392,000	$4,240,000	$12,720,000	97%
Delivery & Other	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$952,000	$1,747,500	$2,668,000	$3,443,500	$4,364,000	$13,175,000	100.0%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 7. Commercial and Industrial HVAC

This program was designed on the premise that much commercial, industrial, and institutional Heating Ventilation and Cooling is not operating as planned. A typical assignment envisioned in this program is to do on-site testing of HVAC units, and review their operation as an integrated building system. For example, out of twelve rooftop units, it is likely that two will be operating out of specification due to improper installation, subsequent damage to units, or problems with controls. In the case of a large school, built in sections over time, it would not be unusual to find adjacent units, some cooling and some heating, and other units damaged while most units are performing as designed.

Rationale

Most buildings have never had a focused look at the working of the HVAC systems. This program will deploy HVAC specialists to test units and make recommendations for their efficient operation as a building system. This will primarily involve repair of units and control adjustments, but may also involve recommendations for modification to air circulation within buildings.

Participation and Measures

Measures are listed below.

Table 36. Measures and Incentives – C&I HVAC Optimization

Measure	Measure Number	Incentive Amounts
Small HVAC units	C-2	25%

Participation is indicated in the table below.

Table 37. Estimated Participation and Savings – C&I HVAC Optimization

Potential Participants				25,100
Per participant Savings (kWh):				11,233
Per Participant Savings (kW):				1.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	251	1.0%	2,819,483	484
Year 2	502	2.0%	5,638,966	969
Year 3	753	3.0%	8,458,449	1,453
Year 4	1,004	4.0%	11,277,932	1,937
Year 5	1,255	5.0%	14,097,415	2,421
Cumulative	3,765	15.0%	42,292,245	7,264

Marketing Plans

It is likely that company representatives can help develop lists of buildings that will be likely candidates for this program. In addition, there should be coordination with business associations. The budget below provides for some general advertising at business events, as well as brochures and premiums.

Program Tracking Considerations

This is an applied technical program that will be dependent on the quality and completeness of technical drawings and brief technical explanation provided by the program staff. Evaluation will rely on this information and may also involve spot metering and (where applicable) billing analysis.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- Incentives to cover HVAC inspection and evaluation of air flows where necessary.

Costs to participating customers include the remainder of costs (for repairs to HVAC equipment and remodeling to permit better airflow within buildings).

Table 38. Estimated Five-Year Program Budget – C&I HVAC Optimization

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$50,000	$0	$0	$0	$0	$50,000	2%
DSM Staffing		$44,000	$44,000	$44,000	$44,000	$44,000	$220,000	8%
Program Monitoring & Evaluation		$10,000	$7,500	$80,000	$7,500	$80,000	$185,000	7%
Variable Program Costs								
Incentives	$570	$143,070	$286,140	$429,210	$572,280	$715,350	$2,146,050	83%
Delivery & Other	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$247,070	$337,640	$553,210	$623,780	$839,350	$2,601,050	100.0%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 8. Commercial and Industrial Audit

This program is targeted to food service facilities and grocery store/supermarkets. It consists of refrigeration improvements, improvements to refrigeration to reduce load, and restaurant commissioning audits (designed to optimize controls and limit energy losses in food service facilities). The program will also serve as a feeder to Program 5, C&I Rebates.

Rationale

There are consistent energy savings to be obtained from food service facilities (primarily restaurants) and the refrigeration end-use in grocery stores and supermarkets. There are three DSM measures in this program, listed in the table below.

Participation and Measures

Measures are listed below.

Table 39. Measures and Incentives – C&I Audit

Measure	Measure Number	Incentive Amount
Restaurant Audit	C-28	25%
Refrigeration Tune-Up	C-29	25%
Refrigeration Casework	C-30	25%

Participation is indicated in the table below.

Table 40. Estimated Participation and Savings – C&I Audit

Potential Participants				2,470
Per participant Savings (kWh):				20,595
Per Participant Savings (kW):				2.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	25	1.0%	514,875	73
Year 2	49	2.0%	1,009,155	143
Year 3	74	3.0%	1,524,030	216
Year 4	99	4.0%	2,038,905	289
Year 5	124	5.0%	2,553,780	362
Cumulative	371	15.0%	7,640,745	1,084

Marketing Plans

It is likely that company representatives can develop lists of buildings that will be likely candidates for this program. In addition, there should be coordination with business associations. The budget below provides for some general advertising at business events, as well as brochures and premiums.

Program Tracking Considerations

This is an applied technical program that will be dependent on the quality and completeness of technical drawings and brief technical explanation provided by the program staff developed on-site for each project. Evaluation will rely on this information and may also involve spot metering and (where applicable) billing analysis.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- Incentives to cover audits and tune-ups.

Costs to participating customers include the remainder of costs (for repairs to HVAC equipment and remodeling to permit better airflow within buildings).

Table 41. Estimated Five-Year Program Budget – C&I Audit

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$50,000	$0	$0	$0	$0	$50,000	8%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	18%
Program Monitoring & Evaluation		$10,000	$7,500	$80,000	$7,500	$80,000	$185,000	30%
Variable Program Costs								
Incentives	$610	$15,250	$29,890	$45,140	$60,390	$75,640	$226,310	37%
Delivery & Other	$130	$3,250	$6,370	$9,620	$12,870	$16,120	$48,230	8%
Total Budget		$100,500	$65,760	$156,760	$102,760	$193,760	$619,540	100.0%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 9. Commercial and Industrial New Construction

This program targets new commercial, industrial, and institutional construction. The program provides rebates for developing projects that are at least thirty percent more efficient than current building code. Incentives are offered to project owners or, for government buildings, to the design team. These incentives will cover fifty percent of the incremental cost difference between standard and energy efficient equipment, or the amount of the incentive will be enough to decrease the incremental cost to a 1.5 year payback, whichever is less. The focus of this program is on integrated design. Prospective vendors should be asked to propose a method of determining incremental cost for I&M review. As a control tool, for the first nine months of each year, no project may be allocated more than ten percent of the budget allocated for efficiency improvements for this program.

This program is based on National Grid's Design 2000 Plus program. For comparison, Western Mass Electric's (WMECo's) Energy Conscious Construction program covers most costs plus, for larger and complex projects, provides design assistance.[21] National Grid's Design 2000 Plus program initially covered 60 to 90 percent of incremental cost plus a comprehensive design approach for larger and complex projects.[22] More recently, as a mature program, National Grid Design 2000 Plus now covers 75 percent of incremental cost.[23] The program will follow the Advanced Buildings System approach developed by the New Buildings Institute.[24]

Rationale

This program is designed to overcome first cost barriers by providing incentives that cover the incremental cost, and to provide information to project developers and design teams.

Participation and Measures

Measures are listed below.

Table 42. Measures and Incentives – C&I New Construction

Measure	Measure Number	Incentive Amounts
Design Assistance	C-9	50% of Incremental Cost

[21] See: www.wmeco.com/business/saveenergy/energyefficiencyprograms.
[22] See: www.aceee.org/utility/9angriddesign2000.pdf.
[23] See: www.nationalgridus.com/masselectric/business/energyeff/4_new.asp.
[24] See: http://www.advancedbuildings.net/index.htm. Note that leading programs are adopting the NBI approach.

Projected participation is shown in the table below.

Table 43. Estimated Participation and Savings - C&I New Construction

Potential Participants				424
Per participant Savings (kWh):				56,171
Per Participant Savings (kW):				5.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	8	2.0%	449,368	41
Year 2	11	2.5%	617,881	56
Year 3	13	3.0%	730,223	66
Year 4	14	3.3%	786,394	71
Year 5	23	5.5%	1,291,933	117
Cumulative	69	3.3%	3,875,799	352

Marketing Plan

The target of the marketing effort will be the project owners and the design teams. Programs of this type usually involve direct personal relationship building, training sessions or seminars, direct marketing, and meetings.

Program Tracking Considerations

New construction projects present a particular challenge for program tracking since there is not an actual baseline building to compare to the new structure. This means that the contrast to baseline conditions will require simulation software that can model the incremental energy efficiency improvements. The specific assumptions built-in to the model should be recorded so that they are evident, and the simulation software package employed must be in general use for DSM applications in which current practice (as built) conditions are used to develop the energy savings that derive from the measures installed. Simulation software is required to take sometime complex interaction effects into account.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to I&M for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- Incentives for the installation of recommended measures as demonstrated through the provision of receipts by the customer.

Costs to participating customers include the customer share of the costs of covered measures and equipment and installation costs.

Table 44. Estimated Five-Year Program Budget – C&I New Construction

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$20,000	$0	$0	$0	$0	$20,000	2%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	11%
Program Monitoring & Evaluation		$10,000	$7,500	$80,000	$7,500	$80,000	$185,000	18%
Variable Program Costs								
Incentives	$9,520	$76,160	$104,720	$123,760	$133,280	$218,960	$656,880	65%
Delivery & Other	$500	$4,000	$5,500	$6,500	$7,000	$11,500	$34,500	3%
Total Budget		$132,160	$139,720	$232,260	$169,780	$332,460	$1,006,380	100.0%

Program 10. Residential Whole House

This program includes the two residential energy assessment options that are carried out remotely, by mail or Internet and an on-site audit with direct installation of minor measures. In both remote options, a residential customer can conduct a residential energy assessment using a computerized home energy auditing program. The remote audit program is the same for both the Internet and mail options, and works by linking to actual billing data for the residential account. The remote program is open to all customers and free to all customers. However, the program will work best for electric heat customers and this is the focus of the remote audit program. In addition, for electric heat customers who complete the remote audit, I&M will send a small kit of energy efficiency items (shown in the first column of Table 23). As a more advanced option, the program will also offer an on-site audit for I&M's electric heat customers for a $50 fee, as discussed below. The savings in the remote elements of this program are computed based on the items in the kit, and no savings is assumed for the remote audit step.

Rationale

The remote elements of this program are open to all residential customers at no charge to provide easy access to energy efficiency recommendations tailored to the home. Since it is conducted by Internet or mail, it can be done to suit a customer's schedule. The remote elements are an entry-level degree of customer engagement, providing a way for customers to begin to get direct information on what they can do to make their home more energy efficient.

For homes with electric heat, the separate program element for an on-site energy audit with direct install of minor measures provides the option of a higher level in-home audit for a small fee, *refunded if audit recommendations are implemented*. The on-site audit program element targets households in existing single family homes and condos and (with a different permission structure) for multifamily dwellings. The program includes an on-site audit and encourages households to save electricity through the installation of energy efficiency measures. The audit, for example, might recommend air sealing, insulation, and other measures.

The On-Site Audit with direct install program element will provide households with a walk-through examination of their home by a trained auditor/contractor using standard audit software for identifying existing conditions related to electric energy usage. The auditor will identify specific energy saving opportunities that could be installed by the contractor upon approval of a job scope by the customer. The contractor will convey energy saving tips during the walk-through, and attempt to be comprehensive in their assessment of opportunities regardless of their particular specialization. Customers will pay $50 of the audit cost, and have their audit cost credited to their bill if they proceed with installation of *at least one* of the recommended measures. The recommendations of the auditor are expected to be standard measures associated with whole house weatherization, such as ceiling insulation, wall insulation, air sealing, etc.

At the same time, during the walk-through audit, the contractor will install the measures in the Direct Install Kit at no cost to the customer and additional low-cost measures (see table). At the conclusion of the site visit, customers will be provided with a check list of preliminary recommendations from the audit, to be followed within one week by a full report generated by the audit software. The program will take credit for kit measures after degrading the kit savings for expected installation rates. Expected installation rates of 80 percent for CFL's, 60 percent for showerheads, and 75 percent for aerators were used to calculate program savings for the mailed kits. Savings from the onsite audit are only counted for installed measures at the time of the audit and recommended measures subsequently installed and rebated. There is a fifty percent incentive for recommended measures beyond those directly installed during the audit.

The package of direct install measures is modeled after Wisconsin's Home Performance with Energy Star program with emphasis on their E-Saver Kit component, which includes these measures plus a programmable thermostat, but only included one CLF.[25] Programmable thermostats have recently become controversial (see Appendix). To overcome problems with programmable thermostats, the program will focus on easy-to-read, easy-to-use equipment and provide customer education.

The remote elements provide easy access to energy saving information tailored using computerized energy use information and an electronic protocol. The on-site audit with direct install of minor measures program element provides a step up to an on-site audit. This program element, in addition, may serve as a predecessor to a full Home Performance with Energy Star program, providing a framework to work with contractors to develop Home Performance with Energy Star, if such a program is desired in the second program cycle.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 45. Measures and Incentives – Residential Whole House

Measures – Remote Program Elements	**Measure Number**	**Incentive Amount**
CFLs (4)	R-32	100%
Showerheads (2) and Aerators (3)	R-36	100%
Hot Water Thermometer	Kit Add-In	100%
Refrigerator Thermometer	Kit Add-In	100%
Measures – On-Site Program Element		
All of Remote Program Elements plus:		
Wall Insulation	R-21	50%
Ceiling Insulation	R-16	50%
Programmable Thermostat	R-15	50%
Duct Sealing	R-6	50%
Refrigerant Charge Check	R-6	50%
House Sealing	R-18	50%
CFLs (12 additional)	R-32	50%
Electric Water Heater Wrap & Pipe Wrap	R-35	50%

All of the measures included in this program are cost effective based on the measure specific benefit-cost ratio (see Table 13) except for measures R-6 and R-18. Given the relatively close to one benefit-cost ratio of these measures,

[25] State of Wisconsin Department of Administration Focus on Energy Statewide Evaluation, Evaluation of the Home Performance with Energy STAR Whole House Component, April 24, 2003.

the imprecise nature of the measure screening, and the importance of peak savings associated with each of these measures, they were included in the program design.

There is no cost in the remote program elements to participating customers for the remote audit and kit. There is a $50 fee for the on-site audit, however this is credited to the bill if at least one program recommended measure is installed (recommended measures will be supported by the company at a 50% rebate).

Projected participation by year is shown in the table below. Ninety-two percent of all participants are expected to be remote only with the remainder receiving the on-site audit.

Table 46. Estimated Participation and Savings - Residential Whole House

Potential Participants				69,455
Per participant Savings (kWh):				726
Per Participant Savings (kW):				0.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	1,389	2.0%	1,008,414	266
Year 2	2,778	4.0%	2,016,828	531
Year 3	4,167	6.0%	3,025,242	797
Year 4	4,862	7.0%	3,529,812	930
Year 5	4,862	7.0%	3,529,812	930
Cumulative	18,058	26.0%	13,110,108	3,454

Marketing Plans

I&M will need to actively market this program in customer communications, such as bill stuffers. Employees can also make customers aware of this program if they contact the company about energy efficiency or a need to lower bills. The remote program elements are low-involvement lead-in programs that will help develop prospects for other programs.

In developing the kit for the remote program elements, strategic attention should be placed on the kit as a marketing tool. First, insure that the kit items are attractively packaged and that the package itself is attractive. The focus should be on making the kits attractive and interesting as well as technical. Possibly some non-energy but useful health and safety items can be included, as well as helpful literature. Since many customers are more interested in "green" items to try to reduce carbon and save the planet, marketing staff should ask for suggestions and perhaps create a "green" theme. For example, one year the Washington DC Energy Office obtained a tire gauge for inclusion in each kit, donated by a local business. For the basic kit items, it is important to consider the value of paying a bit more for "higher end" better performing and better looking items. Again, the kit is part of the marketing and promotion of this program. The kits should also be available at cost from the company's website.

The on-site program element represents a step up in engagement and commitment for an on-site energy audit that can lead to full weatherization retrofit with a fifty-percent level of support from the utility company. As noted above, the on-site element can be developed into a full Home Performance with Energy Star program for the second program cycle.

Program Tracking Considerations

The program elements in this program (remote and on-site) are packaged programs provided by a vendor. All data requirements should be part of the program database.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to I&M for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- Direct program costs, including a vendorized Internet/mail-in energy assessment program.
- Direct program costs for the audit/direct install vendor.

There is no cost in the remote program elements to participating customers for the remote audit and kit. There is a fifty dollar fee for the on-site audit, however this is credited to the bill if at least one program recommended measure is installed (recommended measures will be supported by the company at a 50% rebate).

Table 47. Estimated Five-Year Program Budget – Residential Whole House

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$20,000	$0	$0	$0	$0	$20,000	1%
DSM Staffing		$44,000	$44,000	$44,000	$44,000	$44,000	$220,000	11%
Program Monitoring & Evaluation		$10,000	$7,500	$80,000	$7,500	$100,000	$205,000	10%
Variable Program Costs								
Incentives	$68	$94,730	$189,460	$284,189	$331,588	$331,588	$1,231,556	60%
Delivery & Other	$20	$27,780	$55,560	$83,340	$97,240	$97,240	$361,160	18%
Total Budget		$196,510	$296,520	$491,529	$480,328	$572,828	$2,037,716	100.0%

Program 11. Residential Rebates

The Residential Rebates program is focused on rebates for CFLs and Energy Star Appliances (Energy Star Clothes Washers).

The promotion will provide rebate coupons to I&M customers toward the purchase of CFLs, LEDs, and Energy Star clothes washers. The coupon approach gives the I&M program administrator direct control over where coupons will be made available and for which sales outlets.[26]

The dollar amount for the appliance incentive for this promotion is *lower than might be expected* based on industry experience in prior years. This is due in part to recent changes in the Energy Star program and the overall success of the Energy Star strategy as demonstrated by the gradual increase in energy efficiency of base case (non-Energy Star) equivalent products. This is also why refrigerators and dishwashers are not included among the appliances for which rebates are provided.

For clothes washers, MEEA utilities have been using a $75 to $100 rebate, however this amount includes an arranged manufacturer rebate of $25 to $50. According to a September 2006 Consortium for Energy Efficiency (CEE) report, Alliant Energy provided a $50 rebate for vertical axis and a $100 rebate for horizontal axis clothes washers. To communicate a consistent message, the rebate for clothes washers is set at $100. Efficiency Vermont provided a $50 rebate for a CEE Tier 3a clothes washer and $25 for a room AC. The Long Island Power Authority clothes washer rebate is $15, $35, or $50 to customers along with a $50 clothes washer rebate for builders who install a clothes washer with a modified energy factor (MEF) of 2.0 or higher.[27] National Grid provides a $100 clothes washer rebate for washers with MEF of 1.8 or higher. United Illuminating and Connecticut Light & Power both provide a $20 or $50 clothes washer rebate. Sacramento Municipal Utility District (SMUD) has clothes washer rebates at $75 and $125 depending on CEE tier level.

[26] The coupon approach is available as a "packaged" approach through Energy Federation Incorporated (EFI), which can also provide coupon processing services (www.efi.org). WECC administers several similar programs. Marketing and promotional plans for this program area have been developed collaboratively through the Consortium for Energy Efficiency (CEE). Part of the reality of this kind of program is the need to work through a program vendor. The vendor offers a full package of features, one of the most important of which is contact with the national offices of big-box and other chain stores. Indiana Michigan Power may also want to explore making promotions available through locally owned and operated stores. Big-box stores are already primed and looking for cooperation with utilities and program vendors in this area will already have relationships with national offices of the big-box stores that can be activated for Indiana Michigan Power. For lighting promotions, Wal-Mart has announced a major CFL initiative designed to introduce at least one CFL to each of its 100 million US customers over the next few years. In initiating this campaign, Wal-Mart has devoted additional shelf space to CFLs and arranged with GE for an initial 21 percent cut in the price of CFLs. We can expect a number of promotions for 4-packs, 6-packs, 12-packs, an increasing variety of bulb types, and possible additional price reductions. Although this initiative has received major buzz, other stores, such as Home Depot and Lowe's are implementing similar CFL promotions, and a trip to any of these big-box stores will show that extensive shelf space is now dedicated to promotion of a wide variety of Energy Star CFLs. These big-box initiatives are compatible with the lighting promotion design and can be viewed as additional leverage for program efforts. Utilities with current CFL DSM programs have been working with both local and big box retailers, and see any further contributions on the part of manufacturers and retailers in cutting prices and extending promotions as contributing to their programs.

[27] The higher the MEF, the more efficient the clothes washer.

Rationale

The appliance and lighting program elements both improve the product mix in favor of energy efficient technologies for the service territory by promoting the purchase and stocking of efficient replacement units. Appliance promotions are best developed on a national level with participation by utilities and governments. Energy Star has overcome all of the defects of the earlier local or regional promotional programs through a single national program structured to periodically advance program standards and regulate minimum efficiencies. At the same time, it is structured to work with regional marketing initiatives and local promotion.[28]

CFL promotions are also best developed by leveraging national campaigns (such as "Save a Light - Save the World"), including federal investments in marketing and promotion by EPA and the now coordinated efforts developed through utility cooperation with big-box stores.

Participation and Measures

Measures are shown in the table below.

Table 48. Measures and Incentives - Residential Rebates

Measures/Program Element	Measure Number	Incentive Amount
Energy Star Clothes Washers	R-28	$100 per unit
Energy Star CFL Instant Coupon	R-32	$1
Energy Star CFL 2-Pak Coupon	R-32	$2
Energy Star CFL 4-Pak Coupon	R-32	$4
CFL 6-Pak Coupon	R-32	$6
CFL 8	R-32	$8
LED Holiday Light Strings	NA	Up to 3 free if 3 or more traded in

LED Holiday Light Strings, the last measure listed in Table 48 is included as a promotional item, and is not part of Measure R-32 or a tested measure. The Holiday Lighting Exchange has proven to be a very well accepted part of the energy efficiency efforts in California and Alaska. In California it helps focus public attention on the greater energy efficiency effort. In the California programs (run throughout the state) in the month of December the utilities include LED Holiday Light Strings in their standard CFL exchange programs. Customers may bring in three or more strings of old inefficient holiday lights and exchange them for up to three strings of LED Holiday Lights.[29]

[28] For example, for the history of the residential clothes washer initiative, see Shel Feldman Management Consulting, Research into Action incorporated, and Xenergy incorporated, The Residential Clothes Washer Initiative, A Case Study of the Contributions of a Collaborative Effort to Transform the Market, prepared for the Consortium for Energy Efficiency, June 2001 (http://www.cee1.org/eval/RCWI_eval.pdf).

[29] The new light emitting diode (LED) holiday lights use only 0.04 watts per bulb (compare with 0.4 watts for newer miniature lights or 5 watts per bulb for C7 screw-in lights, or 10 watts per standard bulb). The retail cost of a string of 100 LED lights is approximately three times the cost of a string of 100 miniature lights. To work out a comparison, assume that lights are used five hours per day or one-hundred and fifty hours for a month. For current information, see Questline, "Lighting Up the Holidays: An Energy Cost Comparison" at www.questline.com/Article.aspx?userID=365464&articleID=3457&NL=5439. We thank Betsy Krieg at Pacific Gas & Electric for this updated information. When run as an exchange, we have observed that the majority of strings turned in appear to be the 10 watt and 5 watt bulbs. For strings of 100 bulbs this replacement by 0.04 watt LED bulbs is a major difference for this end use.

Projected participation by year is shown in the table below.

Table 49. Estimated Participation and Savings - Residential Rebates

Potential Participants (yearly)				389,500
Per participant Savings (kWh):				332
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	27,265	7.0%	9,051,980	2,053
Year 2	46,740	12.0%	15,517,680	3,520
Year 3	66,215	17.0%	21,983,380	4,986
Year 4	85,690	22.0%	28,449,080	6,453
Year 5	105,165	27.0%	34,914,780	7,920
Cumulative	331,075	17.0%	109,916,900	24,932

Marketing Plans

Proposed marketing efforts include the use of utility bill stuffers, and coordinated advertising with selected retail outlets. This type of program is best implemented using implementation vendors and the program elements already exist in nationally available programs for utilities to implement, and selection of a regional vendor will provide added value in the form of detailed program and technology knowledge and relationships. A basic assumption in the development of this program is that it is not so much the size of the rebate so much as the existence of a rebate and the skill in developing engaging promotions and long-term relationships with the appliance industry and dealers that will help move the more energy-efficient products.[30, 31]

The basic marketing goals for the appliance program elements come from the Consortium for Energy Efficiency and are provided below:[32]

1. Consumers understand and value the benefits from energy-efficient features.
2. Retail sales force is knowledgeable about Energy Star and considers it a meaningful distinction for making a sale.
3. Manufacturers market and promote energy-efficient products and/or features.
4. Energy efficiency, defined by Energy Star performance levels, becomes a standard feature or is available across all manufacturers' product lines.
5. Energy Star represents the most energy efficient quality products available.

The Energy Star residential lighting promotion will parallel the Energy Star appliance promotion to reach residential customers through retail outlets. The lighting promotion provides direct incentives to consumers to

[30] See the WECC paper on residential appliances at http://www.aceee.org/utility/ngbestprac/wecc.pdf. Note that this paper is for a natural gas clothes washer program, however "lessons learned" regarding relationships and promotion would apply across appliance programs.

[31] A review of rebates offered across the US indicates that most utilities are offering rebates from this kind of marketing and promotional perspective rather than from a direct resource acquisition perspective. See the Database of State Incentives for Renewables & Efficiency, (DSIRE), maintained by the North Carolina Solar Center for the Interstate Renewable Energy Council (IREC) funded by the U.S. Department of Energy (DSIRE) at (http://www.dsireusa.org/library/includes/techno.cfm?EE=1&RE=0).

[32] CEE's National Residential Home Appliance Market Transformation Strategic Plan, December 2000 (http://www.cee1.org/resid/seha/seha-plan.php3).

facilitate their purchase of energy-efficient lights. The incentive is in the form of discounted pricing available for lighting products that carry the Energy Star logo.

This program is justified based on direct energy savings targets but also has a significant market transformation dimension. Generally, throughout the US, the Energy Star program has been affecting the types of lighting products available in stores:

- The relative amount of available lighting shelf space assigned to Energy Star lighting products is increasing dramatically in "big box" stores.
- The quality of CFL lighting has dramatically increased.
- The diversity of CFL styles and applications has greatly increased.
- There has been as sizable decrease in the cost of energy-efficient lighting, and with it an increase in store sponsored promotions featuring price discounts.
- At the same time, there is still variation in lighting quality between manufacturers and types of CFLs.

In this program, I&M will be an active participant in the US Energy Star campaign. Through this participation, it is expected that the company will move more Energy Star lighting into retail stores, help make energy efficient lighting more affordable to its customers, and provide a continuing and responsible guidance and energy efficiency education message to customers.

Incentives will be implemented by coupons, in-store markdowns, or upstream manufacturer buy-downs. A coupon approach is more suitable for a service territory because it gives the program administrator direct control over where coupons are available and for which sales outlets.[33] The lighting promotion program is modeled after a set of promotional programs that is implemented by Energy Federation Incorporated. These programs are sponsored by Connecticut Light and Power, United Illuminating Company, the Cape Light Compact, National Grid, NSTAR Electric, and Western Massachusetts Electric.

Program Tracking Considerations

Data collection and documentation for program purposes and monthly/annual reporting will be included as features of the vendor program "package." Data estimation of the baseline market and market potential for the specific Energy Star appliances promoted should be refined as a part of the vendor services and developed for each product type. Data estimation of the baseline market and market potential for Energy Star bulbs and fixtures in I&M's service territory should be refined as a part of the vendor services and developed for each product type (CFL, type of CFL, CFL pack, LED holiday lights). In addition, for the program evaluation, data collection to compute free riders and spillover effects for computing Net-to-Gross ratios will need to be worked out prior to program implementation, and responsibilities for collecting data inputs will need to be carefully defined along with workable accountability relationships.

[33] An alternative or parallel approach is the "lighting catalog," which can be an extensive catalog of lighting options offered by a fulfillment vendor or a simple option for purchase of limited types of CFLs over the I&M website. For customers not near a cooperating big box or local store, an Internet option is a valuable addition from a customer service perspective. At the same time, there is a 'trade off' since the market transformation dimension of this program is better met by working with existing supply channels and existing retail outlets.

Detailed Budget Plans

As in the other programs, the anticipated cost to I&M for offering this program to customers involves budgets for:

- Administrative costs to develop, advertise, oversee and monitor the program.
- Vendor services for the program vendor (assuming use of existing turnkey program elements).
- Incentives for the installation of approved measures as demonstrated through the provision of coupons collected and processed from the retail outlets.

The cost to participating customers is the customer's share of the cost (cost of product after the rebate).

Table 50. Estimated Five-Year Program Budget – Residential Rebates

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$20,000	$0	$0	$0	$0	$20,000	0%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	2%
Program Monitoring & Evaluation		$10,000	$0	$100,000	$7,500	$80,000	$197,500	4%
Variable Program Costs								
Incentives	$8	$214,848	$368,311	$521,774	$675,237	$828,700	$2,608,871	57%
Delivery & Other	$5	$136,325	$233,700	$331,075	$428,450	$525,825	$1,655,375	36%
Total Budget		$403,173	$624,011	$974,849	$1,133,187	$1,456,525	$4,591,746	100.0%

Program 12. Residential Appliance Recycling

The recycling program improves the in-service technology mix for the service territory by removing energy hog appliances and deleting them from existence in an environmentally friendly way. Appliance recycling is available primarily through two national program vendors, both of which bring the necessary environmentally sound technologies and procedures to the program.

This program targets households with second refrigerators or freezers. The program will provide free refrigerator and or freezer pick up. If a home also has an old AC unit, the AC unit will also be picked up. The contractor will pick up, disable, and recycle the unit(s). Once I&M receives verification that the refrigerator has been recycled, the customer will receive a $30 incentive. This number is based on the amount offered by Nevada power Company.[34]

Rationale

This program targets residential customers with second refrigerators or freezers, preferably those older than 1997. The program is designed to take these inefficient older refrigerators off the market entirely, and to do so in an environmentally-sustainable manner. I&M will pay a $30 incentive to each customer to help persuade them to get rid of the second refrigerator or freezer, and will also cover the cost associated with removing the refrigerator or freezer and recycling its components. As a program option, old window AC units may also be picked up ($20 customer incentive) from homes in which a visit is scheduled to pick up a refrigerator or a freezer. This option is now being developed by the firms that operate this type of program and may be explored with the bidders.

Participation and Measures

Measures are shown below.

Table 51. Measures and Incentives – Residential Appliance Recycling

Measure	Measure Number	Incentive Amount
Refrigeration/Freezer Recycling	R-26	$30
Window AC Unit Recycling	(Optional, may be developed)	$20

Table 52. Estimated Participation and Savings – Residential Appliance Recycling

Potential Participants				136,325
Per participant Savings (kWh):				1,150
Per Participant Savings (kW):				0.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	4,090	3.0%	4,703,500	990
Year 2	5,453	4.0%	6,270,950	1,319
Year 3	6,816	5.0%	7,838,400	1,649
Year 4	8,180	6.0%	9,407,000	1,979
Year 5	9,543	7.0%	10,974,450	2,309
Cumulative	34,082	5.0%	39,194,300	8,246

[34] The $30 incentive is based on the Nevada Power Company incentive, which has elicited a strong positive response from customers. Wisconsin Public Services offers a $50 incentive, but we believe I&M's program will be successful with the lower incentive amount.

Marketing Plans

This program will be marketed directly to consumers through bill inserts, direct mailing materials, and through refrigerator distributors. The program will need to mail information to customers on a regular schedule (twice a year basis, or more frequently as needed to produce the desired participation rates), and through point-of-purchase information at trade ally facilities. The two primary program vendors for this type of program are Appliance Recycling Centers of America, Inc. (ARCA), 7400 Excelsior Blvd., Minneapolis, MN 55426 [952-930-9000] [www.arcainc.com]; and JACO Environmental, Inc. (JACO), 7115 Larimer Road, Everett, WA 98208 [425-290-6291][www.jacoinc.net].

Program Tracking Considerations

The program vendor will be required to supply a detail database sufficient to demonstrate the age and condition of units picked up and also to demonstrate that the units are properly destroyed and recycled. In addition, the database should be sufficient to supply data necessary for program evaluation.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to I&M includes:

- Administrative costs to develop, advertise, oversee and monitor the program.
- Incentive payments to customers of $30.
- Contractor payment.

There are no costs to participating customers.

Table 53. Estimated Five-Year Program Budget – Residential Appliance Recycling

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$20,000	$0	$0	$0	$0	$20,000	0%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	2%
Program Monitoring & Evaluation		$10,000	$0	$100,000	$7,500	$80,000	$197,500	3%
Variable Program Costs								
Incentives	$165	$674,850	$899,745	$1,124,640	$1,349,700	$1,574,595	$5,623,530	94%
Delivery & Other	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$726,850	$921,745	$1,246,640	$1,379,200	$1,676,595	$5,951,030	100.0%

Program 13. Residential New Construction

This is a "beyond Energy Star" strategy for new residential construction. A second program element, Energy Star manufactured homes would have been included except that the relatively small stock and yearly increment of manufactured homes in I&M's Indiana service territory are too small to support a program.[35]

Recent changes in Energy Star and the general success of Energy Star in improving the performance of baseline (Non Energy Star) new homes have negatively affected the cost-effectiveness of the standard Energy Star program. In the Energy Star program, there are many builder pathways (called Building Options Packages) to enable manufacturers to meet Energy Star criteria. Many Energy Star builders, in order to be sure of meeting the Energy Star criterion, now build beyond it. From a utility perspective, supporting "beyond Energy Star" homes is the only viable option to insure cost-effectiveness of this program element.

Energy Star homes are homes that are independently certified and are more efficient, comfortable and durable than standard homes constructed according to local building codes. Energy Star homes feature additional insulation; better windows, doors and bath ventilation; and high efficiency appliances such as furnaces, AC units, heat pumps, and water heaters. These improvements beyond current practice typically cost home buyers a factor of two to three times the actual cost to builders for the energy efficiency improvements. This provides excellent leverage in an upstream program model that can provide something like two to three times the customer value for each dollar of upstream buy down.

The builder pathway indicated in the table above is an example taken from the set of possible pathways – builder options that that will produce a "beyond Energy Star" result. A package such as this is essential to keep the program cost-effective. The incremental cost of $3,000 per home plus a $400 inspection fee in the illustrative measure package represents a generalized measure package.

Incentives for new residential buildings programs vary greatly across utilities. For example, the Eugene Water and Electric Board (EWEB) provides incentives of $250 or $1,000, and other utilities in the Pacific Northwest states provide $1,000, $1,500, or $2,000. NYSERDA and Long Island Power Authority (LIPA) in New York provide incentives from $750 to $3,500 to builders of Energy Star homes. New Hampshire utilities provide up to $3,000. Southern California Edison provides incentives up to $700, depending on climate zone.

Rationale

The Energy Star Plus program element is necessary due to the overall success of the Energy Star concept. Baseline homes have become increasingly energy efficient, enough so that to mitigate the risk of not being cost-effective, program homes must be taken to a beyond Energy Star level of performance.

[35] A manufactured home program could work as a joint utility funded statewide program.

Participation and Measures

Measures are shown below.

Table 54. Measures and Incentives – Residential New Construction

Measures	Measure Number	Incentive Amounts
Energy Star New Home (Building Options Package)	R-25	$1,500
Lighting and Appliance Bonus when 10 energy efficient fixtures and 3 labeled Energy Star appliances are included (or equivalent upgrade)		
Inspection Service Fee		$200

Projected participation by year is shown in the table below.

Table 55. Estimated Participation and Savings - Residential New Construction

Potential Participants				350
Per participant Savings (kWh):				4,222
Per Participant Savings (kW):				1.4
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	35	10.0%	147,770	49
Year 2	70	20.0%	295,540	98
Year 3	105	30.0%	443,310	148
Year 4	105	30.0%	443,310	148
Year 5	105	30.0%	443,310	148
Cumulative	420	120.0%	1,773,240	590

Marketing Plans

For beyond Energy Star homes, only the top income segments are likely to be effectively in the market for very energy efficient new homes. This is particularly so now with problems in mortgage markets and general tightening of credit. The financial incentive is provided directly to homebuilders to help offset the additional cost to build an Energy Star home. This gives the incentive a multiplier of between two and three. This program element is a vendor delivered program requiring an experienced Energy Star program vendor. The program vendor provides all of the detailed knowledge and relationships to put the program in place with a restricted set of measures to reach savings levels significantly beyond Energy Star using a set of builder options packages. While the customer has higher first cost, the customer pays less for energy over the life of the home and on a life cycle basis comes out well ahead financially. The program vendor will also provide the established channels to national builders, establish relationships with local builders, and will come supplied with all manner of promotional materials.

The key, according to the Texas Energy Star program is in promoting the value of the brand to builders who would like to differentiate their product. Marketing methods include:

1. Newspaper and real estate guide ads
2. Signage
3. Marketing materials
4. Builder and subcontractor training and ongoing technical assistance
5. Training in the advantages of Energy Star homes for all the builders, sales staff, realtors, and the lending community.

6. Seminars and literature targeted at consumers. This is a valuable addition to a marketing effort because consumers can create a market pull.

Key points to include in a beyond Energy Star program element are:[36]

1. Establish a single stable multi-year approach. This will give stability to builders and allow the program to grow more readily.
2. Establish a single, simple, and high program standard of efficiency. This is important because it lets builders know where they stand and what is expected.
3. Establish good relationships with area builders and developers.
4. Ensure that staff professionalism, delivery systems, equipment, marketing materials and quality assurance are all of high quality.
5. Maintain strict adherence to specifications based on sound building science and economics to maintain program credibility and consistency.
6. Establish a process for certifying and documenting homes built to requirements.[37]
7. Develop a solid infrastructure of experienced, well-known and respected organizations.
8. Develop targeted incentives that are well coordinated with marketing and other service-related materials.
9. Coordinate with health and safety standards and codes for residential construction.
10. Provide ongoing technical training for builders and subcontractors.
11. Promote builders buy-in into the program by getting them financially invested in the program through advertising, building requirements, and training so they will support all aspects of the program.[38]
12. New construction is an excellent area to review for strategic combination of gas and electric energy efficiency measures.

Program Tracking Considerations

As Energy Star homes, Energy Star Plus homes are certified by HERS raters, and I&M will need to work with the HERS raters and the program vendor to establish a workable data tracking system. There are several models for this system, for example the “Dashboard” system developed by Paragon Consulting Services.

Detailed Budget Plan

An estimated five-year budget for this program is provided below. The anticipated cost to I&M for the beyond Energy Star program element involves costs for:

- Administrative costs to develop, oversee, and monitor the program. A vendor contract to market and deliver the new home program, including funding of HERS raters.
- Cooperative advertising budget as part of an inclusive marketing and promotional budget.
- Incentives to be paid to the builder.

Costs to participating customers include the customer's outlay for any remaining incremental cost of the Energy Star Plus home.

[36] Drawn from Vermont Energy Star Program, managed by Efficiency Vermont.
[37] Texas Energy Star Program.
[38] Texas Energy Star Program.

Table 56. Estimated Five-Year Program Budget – Residential New Construction

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$10,000	$0	$0	$0	$0	$10,000	1%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	10%
Program Monitoring & Evaluation		$15,000	$10,000	$60,000	$10,000	$60,000	$155,000	14%
Variable Program Costs								
Incentives	$1,500	$52,500	$105,000	$157,500	$157,500	$157,500	$630,000	57%
Delivery & Other	$500	$17,500	$35,000	$52,500	$52,500	$52,500	$210,000	19%
Total Budget		$117,000	$172,000	$292,000	$242,000	$292,000	$1,115,000	100.0%

Program 14. Residential Solar Siting

Passive solar design and orientation reduce a home's heating and cooling costs and makes the home more comfortable with better lighting and better internal temperature control. Here we focus on orientation only - reorienting a new home to take advantage of the warmth of the sun (we include in the orientation shifting *existing* plans for windows to place more on the south side of the home and additional passive solar measures may be optionally included).[39] This program differs from the others in that, in addition to assisting with solar siting of individual homes, I&M will work with local, county and state code authorities with the goal of inserting a preference for solar siting into building codes. This provision would require consideration of solar siting, but would not make solar siting mandatory. It would also remove all legal barriers to solar siting.

Rationale

Passive solar orientation places a home on the building site in such a way that the home takes full advantage of the sun's natural heat. With the long side of the home facing to the south, the structure will capture solar heat in the winter and block solar gain in the summer.[40] While there is no need to change the house design, moving windows to the home's south side will enhance its solar performance. If the south-facing window area reaches eight to ten percent of floor area, the home can be called "sun tempered." This is an inexpensive way to gain a substantial and long term energy savings advantage.

A full-fledged "passive solar" home has south facing glass area of 15 to 20 percent of floor area. With this much glass, additional features must be added, such as thermal storage mass and summer shading. Many builders choose to keep the project simple by sticking to the sun-tempered level.

Solar orientation, in itself, can reduce annual home heating costs for a home in Northern Indiana by from ten to twenty percent (extrapolating from a Bonneville Power Administration study for the Pacific Northwest), and, if the home also has air conditioning, reduce cooling costs similarly (based on California studies). If "sun tempering" or fully passive solar improvements are also made, the savings increase. Also, people generally feel more "natural" and comfortable in a home that takes maximum advantage of natural lighting.

Costs for the solar orientation program element will also include staff work with municipalities, counties and state offices to work towards codes that remove all barriers to solar orientation, and require documentation of builder/home owner consideration of solar orientation.

[39] We expect that insuring solar orientation will lead to most homes also increasingly adopting elements of passive solar design, however, for this program we assume only solar orientation.
[40] If, further, south-facing window area is at least ten percent of floor area, the home is "sun tempered" resulting in higher energy efficiency. As a further step, a fully passive solar home will add thermal storage mass and summer shading, and special windows will be used.

Participation and Measures

Measures are shown below.

Table 57. Measures and Incentives – Residential Solar Siting

Measures	Measure Number	Incentive Amounts
Inspection Service Fee	R-23	100% (up to $500)
Solar orientation of new homes		
Work on local, county and state codes	Internal staff work	100% I&M effort

Projected participation by year is shown in the table below.

Table 58. Estimated Participation and Savings – Residential Solar Siting

Potential Participants				350
Per participant Savings (kWh):				1,500
Per Participant Savings (kW):				0.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	35	10.0%	52,500	11
Year 2	70	20.0%	105,000	22
Year 3	105	30.0%	157,500	33
Year 4	105	30.0%	157,500	33
Year 5	105	30.0%	157,500	33
Cumulative	420	120.0%	630,000	131

Marketing Plans

The solar orientation program element is targeted to all markets segments for which new housing is being constructed. Since we limit the focus to solar orientation (while expecting this focus to also increase participation in other solar options), there is no new cost to the builder or buyer for this feature. The aim of the codes effort will be to have codes changed to require that builders and home buyers actively consider the advantages of solar orientation in placement of homes on lots and to insure that local, county, and state codes remove all barriers to solar orientation. There are no substantial customer costs for orienting a home on a lot to take natural advantage of energy supplied freely by the Sun, though it is expected that once builders and home owners consider solar orientation, it will lead towards rapid adoption of "sun tempered" and fully passive solar designs.

Program Tracking Considerations

For the solar orientation program element, a careful process evaluation of the company's effort to improve municipal, county and state codes will provide necessary documentation of effort. For individual homes affected by this program, there should be a certification as to proper solar siting, and of other aspects of passive design to the extent they are included.

Detailed Budget Plans

An estimated five-year budget for this program is provided below. The anticipated cost to I&M for the Solar Siting program element involves costs for:

- Administrative costs to develop, oversee, and monitor the program.
- Cooperative advertising budget as part of an inclusive marketing and promotional budget.
- Incentives
- Costs to work with municipal, county and state government codes organizations.

Table 59. Estimated Five-Year Program Budget – Residential Solar Siting

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$10,000	$0	$0	$0	$0	$10,000	2%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	23%
Program Monitoring & Evaluation		$15,000	$10,000	$60,000	$10,000	$60,000	$155,000	32%
Variable Program Costs								
Incentives	$500	$17,500	$35,000	$52,500	$52,500	$52,500	$210,000	43%
Delivery & Other	$0	$0	$0	$0	$0	$0	$0	0%
Total Budget		$64,500	$67,000	$134,500	$84,500	$134,500	$485,000	100.0%

Program 15. Residential Low and Moderate Income Weatherization

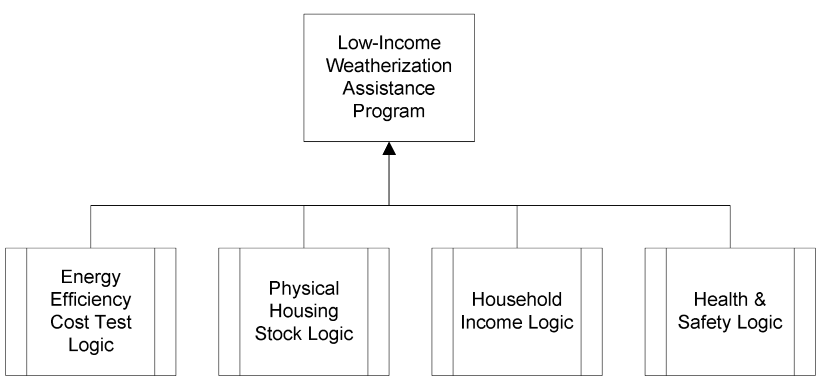
This program will serve residential customers. There are two program elements, based on household income. The first program element is the Residential Low Income Program which will serve customers up to an including 150 percent of the Federal Poverty Level. It is modeled on the federal Weatherization Assistance Program (WAP) and the Indiana Weatherization Assistance Program. The second program element is to serve income limited households from 150 percent of the Federal Poverty Level to 80 percent of the state median household income (this is the upper limit of eligibility for public housing under federal Department of Housing and Urban Development regulations). It is modeled on the "Gap" programs now implemented by many US electric and gas utilities to assist households with income deficiencies, but above the cut off level for low income programs. The two program elements will be identical except for the income cut offs to determine eligibility.

It is expected that the homes served by these program elements will be primarily single family owner occupied homes and manufactured owner occupied homes. However, and although the permission structure is different, and typically much less work can be done in a rental unit than in an owner-occupied home, we recommend that rules be developed for inclusion of apartments and rental units in this program.

Rationale

Low-income programs are different from traditional DSM programs. They are a special case in that they attempt to cover four objectives:

1. Like other DSM programs, a core objective is to provide energy savings (DSM savings).
2. Unlike other DSM programs, a second core objective is to provide repairs necessary to install energy savings improvements in a part of the housing stock that is often old and substandard in comparison to middle and upper income housing.
3. Provide DSM service to customers who otherwise could not obtain DSM improvements due to cost.
4. Due to problems with low-income housing stock, address health and safety concerns.



For these reasons, the prevailing practice in the area of low-income programs is not to focus solely on the "California tests" traditionally used in DSM program review.[41] Instead, commissions have been adopting different

[41] For low-income programs, program cost-effectiveness is a lesser issue, although still an important objective. Because of their particular focus on the special needs of disadvantaged households, low-income energy efficiency programs are generally not held to the same cost-effectiveness criteria as utility energy-efficiency "resource" programs (i.e., they are not judged with a

tests for low-income programs. For example, the DC Commission uses an "Expanded All Ratepayers Test" (incorporating several "non-energy benefits" for low-income programs if the Benefit Cost ratio on the initial test is 0.8 or above; the California commission uses a "Modified Participant Test" and Utility Cost Test (including "non-energy benefits") for screening measures for low-income programs. A measure is accepted into the program if it passes either test. Thus, the Total Resource Cost (TRC) test result for the Southern California Edison Low-Income Energy Management Assistance Program was 0.63 for 2004 and 0.61 for 2005. Similarly, the TRC for Pacific Gas & Electric's Low-Income Energy Partners Program was 0.41 for 2004.

Participation and Measures

The types of weatherization measures to be offered are shown in the table below. This program is free to qualifying participants each year until funds are exhausted.

Table 60. Measures – Residential Low & Moderate Income Weatherization

Measure	Measure Number
Wall Insulation	This program is designed to supplement the Indiana Weatherization Assistance Program and will adopt their measure list and state regulations and procedures.
Ceiling Insulation/Attic Insulation	
Programmable Thermostat	
Duct sealing & Check on Charge Levels & Furnace Filters	
House Sealing	
CFLs (8)	
Showerhead (2.0 GPM) and Flow Restrictors	
Water Heater Blanket	
Primary Window Replacement (if broken or deteriorated beyond repair)	

For developing participation, the Low Income program limit of 150 percent of the Federal Poverty Level has been retained for the new program to facilitate compatibility and cost sharing with the Indiana Weatherization Assistance Program.[42] However, consistent with the direction of current practice, the upper limit for the Moderate Income Weatherization Assistance Program is 80 percent of median household income. This conforms closely to the Department of Housing & Urban Development upper limit of low income used to determine eligibility for public housing.[43]

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strict "total resource cost" test, or TRC). More typically, the focus is on the magnitude of utility bill savings to participating customers, rather than the utility system avoided energy supply costs. Also, low-income programs often include broader "non-energy benefits" (NEBs) such as lowered credit and collection costs and avoided bad debt for the utility, and improved health and safety for customers. See: Kushler, Martin, Dan York & Patti Witte, "Meeting Essential Needs: The Results of a National Search for Exemplary Utility-Funded Low-Income Energy Efficiency Programs." Washington, DC: American Council for an Energy-Efficient Economy, Report Number U053, September 2005.

[42] For methods and advantages of cost coordination, see Hill, Lawrence J. & Marilyn A. Brown, "Estimating the Cost-Effectiveness of Coordinated DSM Programs." *Evaluation Review*, Vol. 19 No. 2, April 1995, Pp. 181-196.

[43] The federal poverty metric, though updated using the Consumer Price Index each year, is a corrupted metric that is based on wildly inaccurate assumptions regarding household composition, availability of foodstuffs, and overlooks significant household costs. Replacing the poverty metric, many states rely at least in part on percentages of median income. The best metric of income insufficiency is developed using the family budget study method, developed by Wider Opportunities for Women and the Ford Foundation. Using the Department of Housing and Urban Development definition of low income (80% of median income) rather than the Department of Health and Human Services definition (60% of median income) goes a long way towards making the eligibility criterion reflect the material reality of household economic situations today.

Table 61. Estimated Participation and Savings - Residential Low & Moderate Income Weatherization

Potential Participants				28,114
Per participant Savings (kWh):				3,714
Per Participant Savings (kW):				1.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
Year 1	422	1.5%	1,567,308	545
Year 2	492	1.8%	1,827,288	635
Year 3	562	2.0%	2,087,268	725
Year 4	590	2.1%	2,191,260	761
Year 5	604	2.2%	2,243,256	779
Cumulative	2,670	1.9%	9,916,380	3,445

As a rough guide, income for Indiana counties served by I&M was analyzed with the following results:

- 16.6 percent of households are between zero and 150 percent of the federal poverty level;
- 26.5 percent of households are between zero and 200 percent of the federal poverty level;
- 28.7 percent of households are between zero and 60 percent of Indiana median household income; and
- 40.1 percent of households are between zero and 80 percent of Indiana median household income.[44]

These percentages are not exact for the Indiana service territory of I&M, but they are close enough to use reliably for estimating eligibility.

Marketing Plans

Marketing for this program is expected to be coordinated with INCAA and the state weatherization program, which already has outreach activity through the sub-grantee agencies. The number of program slots to be allocated to the Moderate Income program is expected to be a matter for continuing decision as economic conditions change. It is very important to have the capability to serve electrically heated homes above the 150 percent of poverty level since the federal poverty measurement system is systematically off by a factor of approximately two, and the situation of a home somewhat above the 150 percent cut off may easily be more difficult than a home just below the 150 percent cut off. The assignment of slots between the Low Income and Moderate Income programs is likely to depend on circumstances that will develop and change. Care will need to be taken to try to insure that the programs are not oversubscribed in any given year.

- The delivery contractor will be responsible for recruitment, taking into account referrals from I&M.
- Proposed marketing efforts include the use of utility bill stuffers for customer education, and mention of the program in communications with customers regarding energy efficiency program options.
- Customer relations and collections staff will be trained to refer customers if they are within the income range and enquire about weatherization or experience payment problems. (And have electric heat.)

Program Tracking Considerations

Data collection and documentation for program purposes and annual reporting will require a tracking system. The selected delivery contractor will be requested to carry out most of the data entry for this system.

[44] Source: Calculated from data in "Hoosiers by the Numbers."

Detailed Budget Plans

An estimated five-year budget for this program is provided below. Costs to participating customers will be customer's time and permitting access to the home for improvements. As with the current low-income programs, attempts should be made to coordinate through INCAA and other sources for program delivery and cost sharing.

Table 62. Estimated Five-Year Program Budget – Residential Low & Moderate Income Weatherization

	Cost per Participant	Year 1	Year 2	Year 3	Year 4	Year 5	5-Yr Total	Percent of Total
Fixed Program Costs								
Implementation & Other Annual Cost		$20,000	$0	$0	$0	$0	$20,000	0%
DSM Staffing		$22,000	$22,000	$22,000	$22,000	$22,000	$110,000	1%
Program Monitoring & Evaluation		$10,000	$10,000	$85,000	$10,000	$90,000	$205,000	2%
Variable Program Costs								
Incentives	$1,585	$668,701	$779,623	$890,545	$934,914	$957,098	$4,230,882	43%
Delivery & Other	$2,000	$844,000	$984,000	$1,124,000	$1,180,000	$1,208,000	$5,340,000	54%
Total Budget		$1,564,701	$1,795,623	$2,121,545	$2,146,914	$2,277,098	$9,905,882	100.0%

PROGRAM COST EFFECTIVENESS

Program cost effectiveness analysis answers the question of would we be better off with the DSM program compared to not having the program. The answer almost always depends on who is asking the question. In other words, better off from whose perspective? Standard DSM cost effectiveness analysis includes five perspectives that will be addressed in this report:

- Total Resource Cost (TRC)
- Societal (a variant of the TRC)
- Participant
- Ratepayer Impact (RIM)
- Utility Cost (also known as Administrator Cost)

A detailed discussion of cost effectiveness methodology, including the standard tests listed above, is included in Appendix B. In this section, we present the results of the cost effectiveness analysis beginning with a discussion of assumptions. Cost effectiveness results are then presented for each perspective and DSM program.

Expected Program Costs

Program budgets over the first five years of program activity are shown for each program in the DSM Programs section. We recommend a minimum of five years for program implementation and tuning for maximum effectiveness. Program budgets include the cost of incentives and other program specific expenses including evaluation. They also include costs for fully loaded program staffing, administration and overhead.

Fully loaded staffing costs were calculated using assumptions regarding FTE required for program administration multiplied by the cost per FTE. A weighted average cost per FTE of $88,000 was calculated assuming a 4-to-1 ratio of support to managerial labor requirements. Fully loaded labor cost assumptions of $80,000 for support and $120,000 for managerial staff were used in the calculation.

The program budgets presented in this report include all program-specific fixed and variable expenses paid by the program administrator. It is important to understand that actual expenditures will vary from planned expenditures in their timing and distribution between specific DSM programs. For this reason it is important for the program administrator to have flexibility in the administration of DSM program funding without having to obtain approval from the Public Utility Commission.

We recommend that flexibility include the following:

1. Roll over unspent funds within program budgets at end of year to categories within the same program in the next year.
2. Reallocate program funds across line items within a program.
3. Shift up to 25 percent of total budget among approved programs at any time within a program year.

Having some flexibility in the administration of program funding will assist in the management of programs and enable staff to fine tune efforts for maximum resource effectiveness.

Miscellaneous Program Assumptions

Energy savings expected from the program are based on the designs and assumptions presented earlier in this report. Key assumptions affecting the annual savings and program cost effectiveness are shown in Table 66 on page 83. Most of the items listed in Table 66 were addressed in the DSM Program section. The savings life is calculated from the life of individual measures weighted by program savings and represents the duration of energy savings flowing from a participant in the program. The net-to-gross ratio captures the effect of free riders, participants in the program who would have installed the energy efficient measures without the program. Higher ratios imply a lower rate of free riders in the program.

Avoided Costs

The avoided or marginal cost associated with a reduction in energy and demand is of primary importance when evaluating the cost effectiveness of DSM programs. These costs represent the value of avoided electric loads. I&M's avoided costs are the reduction in the cost of supplying kWh and kW compared to what they would have been without the reduction in loads and include all incremental energy, transmission and distribution costs, as well as, the cost of avoided capacity. These costs vary by time of day and month. Avoided costs estimates shown in the table below were derived from information provided by I&M.

Table 63. I&M Avoided Costs

Real Levelized Avoided Cost							
Savings Life	Energy ($/kWh)		Capacity ($/kW/month)	Savings Life	Energy ($/kWh)		Capacity ($/kW/month)
	On-Peak	Off-Peak			On-Peak	Off-Peak	
1	$0.0296	$0.0264	$6.07	16	$0.0388	$0.0342	$6.92
2	$0.0303	$0.0275	$6.13	17	$0.0392	$0.0345	$6.98
3	$0.0313	$0.0283	$6.18	18	$0.0396	$0.0349	$7.03
4	$0.0321	$0.0290	$6.24	19	$0.0400	$0.0352	$7.09
5	$0.0331	$0.0297	$6.29	20	$0.0404	$0.0355	$7.15
6	$0.0338	$0.0302	$6.35	21	$0.0408	$0.0358	$7.21
7	$0.0345	$0.0308	$6.40	22	$0.0412	$0.0362	$7.27
8	$0.0351	$0.0312	$6.46	23	$0.0415	$0.0365	$7.33
9	$0.0357	$0.0316	$6.51	24	$0.0419	$0.0368	$7.40
10	$0.0362	$0.0320	$6.57	25	$0.0423	$0.0372	$7.46
11	$0.0366	$0.0324	$6.63	26	$0.0427	$0.0375	$7.52
12	$0.0371	$0.0328	$6.69	27	$0.0431	$0.0378	$7.58
13	$0.0375	$0.0331	$6.74	28	$0.0435	$0.0382	$7.64
14	$0.0380	$0.0335	$6.80	29	$0.0438	$0.0385	$7.71
15	$0.0384	$0.0338	$6.86	30	$0.0438	$0.0385	$7.71

Cost Effectiveness Results

In this section, we present the findings of the cost effectiveness analysis which provides a systematic comparison of the program benefits and costs discussed in previous sections. Results are shown for the five perspectives mentioned at the beginning of this section.

The Societal and TRC perspectives are the broadest of the cost effectiveness tests. As the name implies, TRC shows the total cost of the resource relative to supply side resources. Since environmental externalities were not considered, the TRC and Societal only differ with respect to tax credits paid to the participant. Such credits lower the TRC but are considered a transfer payment from the perspective of the Societal Test. The Participant Test shows the economics of program participation from the participant's perspective and reflects benefits from lower bills and incentive payments. Elements of program design, such as incentive payments, can greatly impact participant economics. For most programs the lost revenue calculation in the RIM Test exceeds the avoided cost of supply causing the programs to fail the RIM Test. The Utility Cost Test reveals that when only costs paid by the program administrator are considered, the cost of the acquired resource is generally lower than the TRC unless the utility pays for the full cost of installation. From a TRC perspective, all but three of the programs are cost effective.

Other Assumptions

Free-riders, program participants who would have installed the measure without the program, are measured through the net-to-gross ratio. A ratio of 1.0 assumes no free-riders. Most programs assume 5 to 10 percent free-riders, net-to-gross ratios of 0.95 to 0.90, respectively. These assumptions are based on subjective professional opinion. Accurate estimates are beyond the scope of this study and involve specialized research that can cost several hundred-thousand dollars. There is debate over the appropriateness of including free-riders without also including free-drivers, an opposite and offsetting impact.

Currently Recommended Programs

We initially formulated our slate of DSM programs from the results of our market assessment, a review of best practices and our own experience. All programs turned out to be cost effective except for the following five programs: Renewables and Demonstrations, C&I Retro-Commissioning Lite, C&I HVAC Optimization, Residential New Construction, and Residential Low and Moderate Income Weatherization. Of these, we are recommending the Renewables and Demonstrations program and the Residential Low and Moderate Income Weatherization program despite the cost effectiveness results.

We have chosen to recommend a Renewables and Demonstrations program because the solar potential has been demonstrated in this report to represent a large energy resource that could be tapped into to meet a significant amount of future demand. The solar resource is also technically mature and readily deployable. These and other issues that go beyond the scope of this report argue for a Renewables and Demonstrations program. Also, conditions may change in the future which cause solar or other renewable technologies to become cost effective.

Our recommendation is to implement the following programs:

Commercial and Industrial Peak Reduction	Residential Peak Reduction
Renewables and Demonstrations	Residential Whole House
Commercial and Industrial Incentives	Residential Rebates
Commercial and Industrial Rebates	Residential Appliance Recycling
Commercial and Industrial Audit	Residential Solar Siting
Commercial and Industrial New Construction	Residential Low and Moderate Income Weatherization

The budget and savings impacts of recommended programs are provided in Table 64.

Table 64. Energy Savings and Annual Budget for Recommended Programs

Year	Cumulative kWh Savings (millions)	Program Budget (millions $)	Cost per Customer	Percent of Revenue
1	25.8	6.0	$ 14.94	0.7%
2	70.1	9.9	$ 23.03	1.1%
3	131.6	13.3	$ 30.00	1.5%
4	210.8	15.4	$ 33.85	1.7%
5	306.3	18.7	$ 40.00	2.0%

Recommended programs result in an overall TRC benefit-cost ratio of 1.6 including direct and indirect program expenses and are expected to achieve 306 million kWh in annual savings after five years of operation. The annual budget for recommended programs increases with program implementation efforts, reaching $18.7 million in Year 5. Spending on recommended programs reaches $40 per customer, 2.0 percent of total annual revenue in program Year 5. These figures include direct and indirect program expenses.

The first five years of program operations are estimated to generate $59.2 million of NPV over the life of the savings using the TRC perspective, approximately $6.8 million on an annual basis.[45] Indirect program expenses that support the overall DSM effort should be planned for that are not included in the program specific cost benefit analysis. For example, if it does not already exist at I&M, a program tracking system should be acquired or developed. We estimate that annual expenditures of approximately $650,000 should be allotted for the following types of expenses:

- School energy education program (educational work in schools with students, including provision of kits) ($100,000)
- Computer systems development, including household energy audit capability ($150,000)
- Program research and development ($50,000)
- Staff development and professional organizations ($200,000)
  - Certification of two staff in evaluation
  - Attendance at various professional conferences and training seminars
  - Membership in CEE and E-Source
- Umbrella DSM Marketing and Customer Awareness ($150,000)

The portfolio cost-effectiveness reported above includes these general DSM expenses in the results.

Demand side management spending and savings information reported to the Energy Information Administration (EIA) is shown in Table 65 for utilities with between 200,000 to 1,000,000 customers. Spending levels reported for 2005 have been adjusted to 2007 dollars. The results show a wide range of spending and savings. Spending per customer ranges from less than $1 to nearly $95 on the high end. When expressed as a percent of revenue, DSM spending ranges from less than one-tenth of a percent to over four percent. Energy savings ranges from two-tenths

[45] The NPV for the portfolio of programs is calculated by summing the NPV of recommended programs shown in Table 67 and subtracting indirect program expenses. Dividing the result by the weighted life of recommended programs (13.5 years) yields an estimate of NPV on an annual basis.

of a percent of kWh sales to over 10 percent. The spending levels per customer recommended in this action plan are higher than the average spending per customer reported in Table 65 but well within the range of spending, a reasonable result for a utility beginning to ramp up its DSM effort.

Table 65. Comparison of DSM Program Spending and Savings

Name of Utility	Ownership	DSM Spending per Customer	kWh Saved as % kWh Sales	DSM Spending as % Revenue
El Paso Electric Company	Investor Owned	0.39	0.2	0.0
Aquila Inc	Investor Owned	0.46	0.0	0.0
Cincinnati Gas & Electric Company	Investor Owned	0.98	0.9	0.0
Pennsylvania Electric Co	Investor Owned	3.44	0.1	0.2
Metropolitan Edison Co	Investor Owned	3.78	0.0	0.2
Colorado Springs City of	Municipal	4.41	0.4	0.3
Entergy Gulf States Inc	Investor Owned	4.85	0.0	0.1
Tucson Electric Power Co	Investor Owned	4.92	1.1	0.2
Salt River Project	Political Subdivision	5.75	0.5	0.3
Kentucky Utilities Co	Investor Owned	6.39	0.2	0.3
Indianapolis Power & Light Co	Investor Owned	7.46	0.3	0.4
San Antonio City of	Municipal	7.62	0.1	0.3
PSI Energy Inc	Investor Owned	8.00	1.5	0.4
Southwestern Public Service Co	Investor Owned	8.69	0.4	0.3
Sierra Pacific Power Co	Investor Owned	9.90	0.4	0.3
Central Maine Power Co	Investor Owned	12.10	0.1	1.6
Omaha Public Power District	Political Subdivision	12.15	0.1	0.7
Louisville Gas & Electric Co	Investor Owned	12.41	0.5	0.7
Avista Corp	Investor Owned	14.30	9.4	0.9
Nevada Power Company	Investor Owned	15.10	0.9	0.6
Idaho Power Co	Investor Owned	15.81	1.3	1.0
NorthWestern Energy LLC	Investor Owned	18.74	4.5	1.2
Commonwealth Electric Co	Investor Owned	20.06	5.5	1.5
Wisconsin Power & Light Co	Investor Owned	22.13	3.6	1.1
Northern States Power Co	Investor Owned	22.35	5.1	1.3
Tampa Electric Co	Investor Owned	25.96	3.1	0.9
Gulf Power Co	Investor Owned	26.66	5.4	1.2
Public Service Co of NH	Investor Owned	32.37	2.8	1.4
Hawaiian Electric Co Inc	Investor Owned	33.58	0.4	0.8
Narragansett Electric Co	Investor Owned	38.66	6.4	1.9
MidAmerican Energy Co	Investor Owned	39.91	2.4	2.0
Sacramento Municipal Util Dist	Political Subdivision	40.23	10.7	2.1
Austin Energy	Municipal	50.99	4.8	2.0
Seattle City of	Municipal	55.26	9.3	3.5
Western Massachusetts Elec Co	Investor Owned	55.96	8.5	2.8
Boston Edison Co	Investor Owned	62.88	8.5	2.3
United Illuminating Co	Investor Owned	80.06	9.0	3.2
Interstate Power and Light Co	Investor Owned	92.73	2.6	4.1
Average		23.09	2.92	1.11
Note: Values are for total residential and commercial customers at utilities with 200,000 to 1,000,000 customers.				

Source: US DOE Energy Information Administration Form 861

Table 66. Program Assumptions

Program Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Program Name	C&I Peak Reduction	Res Peak Reduction	Renewables & Demonstration	C&I Incentives	C&I Rebates	C&I Retro Comm. Lite	C&I HVAC Optimization	C&I Audit	C&I New Construction	Res Whole House	Res Rebates	Res Appliance Recycle	Res New Construction	Res Solar Siting	Res Low & Moderate Income
Electric savings (kWh)	0	0	3,579	247,284	17,025	20,316	11,233	20,595	56,171	726	332	1,150	4,222	1,500	3,714
Installed incremental cost	$250	$250	$9,450	$49,457	$5,402	$4,000	$2,274	$2,433	$19,030	$102	$20	$165	$3,000	$500	$1,585
Savings life (years)	15.0	15.0	30.6	10.0	14.4	5.0	5.0	5.5	25.0	10.2	4.2	5.0	25.0	60.0	16.0
Net to gross ratio	1.00	1.00	1.00	0.75	0.80	0.90	0.80	0.95	0.95	0.75	0.85	0.85	1.00	1.00	1.00
Incentives	$250	$25	$7,590	$14,840	$1,350	$2,000	$570	$610	$9,520	$68	$8	$165	$1,500	$500	$1,585
Tax Credits	$0	$0	$2,340	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Participant Cost after Incentives and Tax Credits	$0	$0	$0	$34,617	$4,052	$2,000	$1,704	$1,823	$9,510	$34	$12	$0	$1,500	$0	$0

Table 67. Program Cost Effectiveness Results

Program Number:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	C&I Peak Reduction	Res Peak Reduction	Renewables & Demonstration	C&I Incentives	C&I Rebates	C&I Retro Comm. Lite	C&I HVAC Optimization	C&I Audit	C&I New Construction	Res Whole House	Res Rebates	Res Appliance Recycle	Res New Construction	Res Solar Siting	Res Low & Moderate Income
Recommended Program? (0=No / 1=Yes)	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1
B/C Ratios (Forefront Model)															
Utility Test	2.6	1.4	0.1	2.3	4.1	1.7	2.6	2.2	2.3	2.0	3.5	1.2	1.4	1.2	0.7
TRC Test	3.5	1.8	0.2	1.3	1.4	1.0	0.9	1.1	1.4	1.9	2.2	1.4	0.9	1.2	0.7
RIM Test	2.8	1.9	0.1	0.7	0.9	0.7	0.8	0.7	0.8	0.7	0.7	0.6	0.8	0.6	0.5
Societal Test	3.5	1.8	0.1	1.3	1.4	1.0	0.9	1.1	1.4	1.9	2.2	1.4	0.9	1.2	0.7
Participant Test	10.9	2.0	1.6	2.5	1.8	1.6	1.4	2.1	2.3	3.7	3.9	2.8	1.5	3.6	2.4
Other Measures (Forefront)															
Total Resource Cost (TRC)															
Net present value (thousands of $)	17,924	25,022	(471)	703	10,045	(419)	(512)	83	583	1,666	7,381	1,600	(139)	92	(2,780)
Real levelized cost ($/kWh)	NA	NA	0.4437	0.0368	0.0352	0.0456	0.0491	0.0395	0.0341	0.0294	0.0222	0.0348	0.0774	0.0501	0.0973
Breakeven levelized cost ($/kWh)	NA	NA	0.0714	0.0475	0.0497	0.0446	0.0450	0.0426	0.0487	0.0556	0.0478	0.0475	0.0702	0.0611	0.0660
Participant															
Net present value (thousands of $)	6,069	13,853	124	3,409	21,771	13,478	2,534	845	1,491	4,317	16,005	8,463	565	477	5,060
Average NPV per participant	2,107	211	4,954	61,979	3,423	2,119	673	2,277	21,604	239	48	248	1,345	1,135	1,895
Simple payback (years)	1	1	1	5	8	4	6	4	6	1	1	1	9	1	1
Electric Rate Payer Impact (RIM)															
Net present value (thousands of $)	12,242	20,009	(595)	(1,657)	(4,103)	(6,634)	(1,722)	(605)	(636)	(1,202)	(5,291)	(4,465)	(395)	(282)	(7,100)
Lifecycle revenue impact ($/kWh)	(0.0001)	(0.0001)	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000
Utility Cost (Electric)															
Net present value (thousands of $)	11,855	11,169	(523)	1,750	25,980	8,161	3,454	616	1,087	1,796	9,883	876	401	92	(2,780)
Real levelized cost ($/kWh)	NA	NA	0.4844	0.0210	0.0122	0.0257	0.0176	0.0198	0.0215	0.0274	0.0135	0.0405	0.0495	0.0501	0.0973

PROGRAM EVALUATION

Program evaluation has to be scaled to meet the size of the programs to be evaluated and the information needs of the company, the Commission, and of other parties likely to be interested in program results. I&M might want to consider a continuing collaborative or stakeholder advisory group to follow program implementation and to receive and discuss ongoing evaluation reports. Such groups help surface issues prior to formal regulatory review of evaluation results and can help structure a stable transition along the DSM cycle from program planning through program implementation and evaluation, and then back through program planning and a new cycle of DSM and DR programs. There are currently very different perspectives on the appropriate level of effort for DSM process evaluation and DSM impact evaluation. Process evaluation documents program implementation, conformance of the program as actually implemented with the program plan, barriers to implementation that are encountered (and how they are dealt with), and tells the story of program delivery. Impact evaluation provides quantitative assessment of results in terms of conserved kWh and reduced demand (kW). Some say that evaluation effort should be eighty percent on impact and twenty percent on process evaluation. Some argue that these percentages should be reversed. These different perspectives are linked to the different logics of two paradigms for understanding DSM/DR programs, and are briefly discussed in this section of the report. However, regardless of the merits of the two perspectives, we recommend I&M focus on impact evaluation for this DSM cycle.

As a first DSM cycle is begun, it is clear that impact evaluation must be given a priority over process evaluation so that quantitative results are available on a timely basis to document energy and demand achievements, provide the necessary basis for calculating actual cost-effectiveness of programs, and demonstrate the soundness of program effort and results to justify full cost recovery. At the same time, process evaluation can also be quite useful for early detection of variance of program operation from program plans, for documentation of barriers encountered by programs, and for providing both early warning of problems and the ability to respond quickly to fix problems before they become major.

Approaches to Program Evaluation

Throughout the 1980's DSM program evaluation was fairly straightforward and simple. In the early to mid-1990's DSM evaluation became much more abstract and complex as more emphasis and larger investments were made, especially in expanding methods of impact evaluation and determination of elaborate inputs for assessing free riders, free drivers, and net-to-gross ratios. In some respects this can be viewed as an example of over-elaboration and over-spending on evaluation, trying to develop precise answers to questions that might have been better left unasked or simply discussed verbally given the wide variance in results due to underlying assumptions.

When the utility industry largely retreated from serious DSM programs in order to prepare for the years of deregulation, and during the turmoil of cutbacks and restructuring of the deregulation era, evaluation continued to develop in California, the Northeastern states, and the Pacific Northwest where DSM efforts continued. As we return to serious DSM effort across the nation, we come back to a somewhat different context than was left in the older DSM effort that ended in the emergence of deregulation. In states such as California, Iowa, and Nevada there has been a recent turn of emphasis toward *gross energy savings* rather than *net energy savings*, as the drivers for DSM have shifted away from the least cost planning paradigm of the 1980s to the "green" and "mitigation of global warming" paradigm of today. Where this movement appears to be going is towards much less concern with free riders, free drivers, and net-to-gross ratios. Instead the focus is on attaining physical changes of certain magnitudes, where the cooperative efforts of the US Environmental Protection Administration, the US Department of Energy, big box stores, state energy offices, and others are seen as welcome leverage toward accomplishment of physical goals rather than as factors that detract from utility DSM cost recovery. The "green" and "mitigation of global warming" paradigm has an apocalyptic flavor -- the goal is to accomplish definite physical results by certain targets, all sectors of society are expected to cooperate in attainment of the targets, and the effort is more similar to the model of wartime mobilization of production during World War II than to the economic model of the 1980s California Cost Tests. The vision is wider than the narrow model offered by the Total Resource Cost test (TRC), and the cost of failure is not reduced cost recovery but editing of societal health, welfare, and survival in a Darwinist sense.

It is important to recognize that the leading edge of thought in the area of DSM program design and evaluation is moving on toward the "green" and "mitigation of global warming" paradigm, and to participate in this discussion. However, a first DSM program and evaluation cycle is not the place to vigorously incorporate this paradigm change. By the second or third cycle, parties will be thoroughly familiar with the different perspectives and will have gained a practical sense of program effects -- if the new paradigm appears relevant and viable at that point in time, it is the likely direction to go. It is also unlikely that regulators will be ready to move to the new paradigm quickly. If there is to be a movement in the Midwest toward the new paradigm, it should be done carefully and cooperatively with state commissions and other concerned parties, step by step, as it seems authentic and reasonable to do so. While we need to recognize where leading program design and evaluation thinking are going, the first DSM cycle evaluation should be guided by the old California Cost Tests, and in particular the Total Resource Cost test (TRC) and the Societal Test.[46]

Evaluation Work Plans

Independent evaluators are generally engaged through issuance of Requests for Proposals (RFPs). The discussion below provides a summary of the recommended DSM Monitoring & Verification (M&V) plans for each DSM Program. These are not complete plans, but they outline the type of M&V commitment that will be required to conservatively demonstrate results with high confidence and to meet industry practice standards using the traditional paradigm of the California Cost Tests and the framework developed for integrated resource planning.

[46] These are defined elsewhere in this report.

When an evaluation RFP is issued, the bidders will reply with proposals. The proposals are essential draft evaluation work plans that try to meet the terms of the RFP and the substantive requirements for evaluation. Once, once an evaluation firm is selected, the typical first billable activity is a "kick-off" meeting with the key utility managers and staff (and the collaborative or stakeholder advisory group, if there is one), followed by a redesign of the evaluation work plan to take into account information provided by the utility and any changes in program goals, administration, timing, and regulatory direction.

As a practical matter, we recommend that instead of a single initial Work Plan covering the full first program cycle, evaluation planning be approached in a staged manner with certain key decisions made up front about how each program evaluation will be approached over the entire contract period. Detailed planning would be only through the end of the first program year and the evaluation reports based on the first program year evaluation. The reason for this recommendation is that the programs and the policy environment for a first program cycle are still evolving. The evaluation consultant can then, under company (and collaborative, if there is one) direction, make a similar detailed program for each subsequent year.

Evaluation Work Plan Template (for each program)

The following elements should be requested from the selected evaluation team for each program to be evaluated:

1) Approach -- What is the general evaluation approach for the program (general discussion of evaluation approach, including research objectives, researchable questions, methodological framework, and high-level schedule)?
2) Verification—In a new DSM effort contractor staff may not be initially up to speed, so a essential responsibility to protect ratepayer dollars will be to insure that the right measures are installed, that they are properly installed, that there are no obvious "lost opportunities" (for example where a door sweep is installed but a broken window is not repaired). While much of this responsibility can be placed on contractors (see point 11 in this list for QA/QC), there is also a key role for the evaluator in inspecting contractor reported installations (for example, if a contractor reports replacing eighty-five ceiling lights in a supermarket, there should be an opportunity for the supermarket to appear in a random sample for which the evaluation verifies the bulb count and insures they are still in place).
3) Impact evaluation -- How will first year gross energy savings and gross demand reduction values be determined? If a deeming process is proposed for the first year, how will the process be carried out and when will results be available?
4) Free Riders/Drivers and Net-to-Gross -- How will NTG be assessed for this program for the first program year? How will data gathering for NTG be scheduled for the first program year, and when will results be available? Will the evaluation team research and develop deemed values for per unit kWh and kW for use the first year, or until actual measurements can be completed? Will the evaluation team's plan for development of deemed results include review of regional results from neighboring jurisdictions? If the California DEER database or values used in the Pacific Northwest or the Northeast are used, will they be adjusted, and if so, how?
5) Baseline -- What kind of market baseline will be established for this program? What approach will be used? When will a market baseline be completed?
6) Metrics -- What are the metrics to be collected for the program?
7) Tracking System -- When will the program vendor's tracking system be reviewed? When will a report on the program vendor's tracking system for the program be ready?
8) Budget -- what is the planned evaluation budget for each year? Demonstrate that the total across programs is within the spending cap for the evaluation effort. How does the evaluation budget for this program fit as part of the total evaluation budget, and what criteria are used to allocate evaluation budget among program evaluations?

9) Jobs -- How will the evaluation track job creation associated with the program? What is the count of jobs created directly by hiring people to work on the program and the evaluation? What is the count on persons from out-of-state who are assigned to a base in the service territory? Which jobs (and percentage of personnel expenditure) will be filled from staff and new hires in I&M's service territory and outside I&M's service territory? What classification system should be used? When will a report on jobs be available? Note that this is not proposed as a sophisticated or broad based economic impact study.
10) Program Theory -- What is the program theory for this program? When will a program theory and logic model be available?
11) QA/QC -- How is quality control and/or quality assurance implemented for this program? When will a report program on QA/QC be available?
12) Process Evaluation -- What will be the approach to process evaluation for this program? What will be the elements of the process evaluation? When will the process evaluation be completed?
13) Reporting -- How will monthly or quarterly reporting of work in progress, goals and results, barriers encountered, changes in program and/or evaluation direction be reported? Monthly and/or quarterly evaluation reporting should be uniform across programs.
14) Year One Details for each program (Note that the details could be in a separate section of the Evaluation Work Plan, or be collected in a separate document).
    a. Specific tasks and sub-tasks
    b. Detailed schedules
    c. Detailed discussion of sampling, data collection, data cleaning, and analysis methods
    d. Project and management milestones
    e. Identification of staff resources
    f. Detailed cost breakdowns
    g. Dates of deliverables
15) Evaluators may see some commonalities and opportunities for evaluation work across certain programs. "Cross-cutting" evaluation work plans should be welcomed if they appear reasonable and workable.

Evaluation Budget

In the recommended program budget for each program, evaluation costs are shown for each year, with the costs quite different from year to year. Generally, it is difficult to get a solid evaluation of a DSM program for under $80,000, though in some cases evaluation costs have been lowered to fit better with number of cases served by a program. Also, evaluation works best if the evaluator is on-board when the programs begin. The pattern in the budget tables permits evaluator involvement beginning as the first program year begins, with two full scale evaluation reports of the five year program cycle – one towards the middle of the cycle and one at the end. While in the earlier DSM era it was common to select different evaluators for different programs, it is suggested that the RFP for evaluation permit evaluators to propose which programs they will evaluate. This would result in the selection of one or two evaluation teams to cover all programs. This gives the evaluator(s) the ability to work across program evaluation budgets and will yield a more even, efficient, and more capable evaluator involvement.

Program 1. Commercial and Industrial Peak Reduction

Load control programs, particularly direct load control programs are self-documenting every time a load event is called. The basic level evaluation for a Direct Load Control, Demand Reduction (DR), program is an engineering review. Often an engineering review is sufficient. In the engineering review, the evaluation will produce load shape impacts for selected curtailment events, and curtailment events will be interpreted with reference to I&M's load duration curve. The evaluation will include reference to I&M internal planning and will recommend, if economic, further ramp up in load control programs.

A second level of evaluation is provided by analytic study of customer data using regression analysis. Sometimes this is seen as a detailed engineering review (particularly if the persons conducting both analyses are engineers) and sometimes it is seen as a separate quantitative analysis that goes beyond the engineering review (the second level analysis is often carried out by evaluators who have a background in business analysis, social sciences, or mathematics and statistics). The primary goal of the impact evaluation effort is the estimation of demand reductions during load control events. Depending on the metering options available, this may be based on samples or on complete data. As with all evaluations, it is very important to establish baseline conditions (for this program, the absence of a load event) so that the program produced and "no program" results can be contrasted to demonstrate the quantitative program effect(s).

Typically for evaluation of a DR program, the evaluator will build a dataset of hourly load data for a sample (or all cases, if metering is available) of program participants over a defined monitoring period. This hourly data is combined with hourly weather data to estimate load shapes at different temperatures. Load shapes from typical days are then compared with load shapes from load event days. This data is then analyzed in a regression analysis in which the measured hourly kW load is the dependent variable. The regression controls for weather and other conditions so as to provide a clean contrast of expected customer load at a given hour under the "no program" alternative with the customer load under program conditions when a load event is called. Analysis is on a per customer level, so can be scaled to estimate effects from a sample to a population or to estimate the effects of different levels of increased participation, using assumptions about the remaining portions of the target markets that could be recruited into the program.

Generally, it is reasonable to assume a 100 percent net-to-gross ratio in DR projects because there is no reason for the customer to reduce load at the time of a load event, except that the event is called and the customer is a participant in the program: *there are no free riders*. Also, spillover may occur, but it is generally more reasonable to consider spillover to be zero for most DR programs (unless the program design is specially oriented to create spillover) than to spend any dollars on evaluation to determine a quantitative value for spillover. The use of free rider, free driver, and net-to-gross assumptions of this kind is typically best discussed with and, if possible, cleared by the commission in advance so there is no surprise if a DR evaluation introduces these assumptions in place of spending dollars on a measurement effort to develop estimates of free riders and free drivers.

Data gathering for this type of analysis is based on the use of whole building demand meters or the use of data loggers on specific equipment. For I&M, for the South Bend pilot, all systems will be in use by the second quarter of 2009 and will be evaluated for one year. The pilot is a deployment of “smart grid” technologies with two-way communications, and is expected to be a precursor to eventual system-wide implementation of the technologies, so it is expected that the data gathering for the DSM evaluation will be based on the capabilities of the metering equipment installed in the pilot.

The C& I Peak Reduction program is a ramp-up of the South Bend pilot, so both program and evaluation should be informed by the results of the pilot as it goes forward. The evaluation should explicitly show all other sources of cost coordination/cost-justification for this project so that only the incremental piece due to the direct load control is assigned to the C&I Peak Reduction program. Because the pilot has been cost-justified on the basis of several factors in addition to direct load control, the cost of metering for the DSM program analysis is *only that portion of technology costs that is not covered by these other factors* (other factors, such as ability to institute several forms of time differentiated rates in addition to direct load control).

Program 2. Residential Peak Reduction

This program is operationally a near-mirror-image of the C&I Peak Reduction Program (Program 1), and the evaluation is carried out in the same manner. Note that while the residential project proposes primarily AC recycling (like the C&I Peak Reduction program), it also contains an electric domestic hot water (DHW) component. The DHW calls are planned to follow the AC load events to partially offset the resumption of AC load.[47] As with the C& I Peak Reduction program, it is reasonable to assume a 100 percent net-to-gross ratio in DR projects because there is no reason for the customer to reduce load at the time of a load event, except that the event is called and the customer is a participant in the program: *there are no free riders*.

The Residential Peak Reduction program is a ramp-up of the South Bend pilot, so both program and evaluation should be informed by the results of the pilot as it goes forward. The evaluation should explicitly show all other sources of cost coordination/cost-justification for this project so that only the incremental piece due to the direct load control is assigned to the program. Because the South Bend pilot has been cost-justified on the basis of several factors in addition to direct load control, the cost of metering for the DSM program analysis is *only that portion of technology costs that is not covered by these other factors* (for example, other factors such as automatic turn on/turn off for student accounts in off-campus housing and for households in areas with consistent billing problems, automatic theft and tampering protection features, and ability to institute "pay in advance" pricing, ability to institute several forms of time differentiated rates in addition to direct load control).

Program 3. Renewable and Demonstration

This program contains four program elements: Solar photovoltaic, solar hot water, ground source heat pumps and the “Go Deep” project. Each of these program elements is currently non-cost-effective and together, the set is not cost-effective. The first three of these are usually classed as renewable energy projects rather than DSM, while the fourth is an advanced DSM program design.

The renewable technologies are included because the DSM/DR paradigm is shifting from the traditional model of the 1980s to a "green" and "mitigate global warming" paradigm which deploys both traditional DSM and DR measures and renewable technologies. From the perspective of this paradigm, large scale deployment of renewable

[47] This is not necessary for the C&I Peak Reduction program (Program) since the end of the business day will generally mean no need to offset AC units coming back on line following an event.

technologies is an essential part of DSM -- the larger DSM goals implied by the paradigm cannot be accomplished without rapid deployment and expansion of green technologies. Currently, the authorization for renewable technology projects comes separately from authorization for traditional DSM and is not subject to the same cost tests used in the 1980s least cost planning framework. In most states, renewable technologies are championed by the governor or by key legislators. Also, most states provide limited demonstration programs rather than full scale programs. This is expected to change with the recent extension of federal tax credits for renewable projects, the removal of the residential cap on tax credits, and the provision for utility benefit from tax credits. However, for this first program cycle, a small number of demonstrations is projected for each year, split among these renewable technologies and the "Go Deep" advanced DSM research and demonstration projects.

For the current effort, these projects are covered under marketing, promotion, and communication of DSM to the extent that they cannot be cost-justified under the California Cost Tests or by other independent authorizations.

Since this program is directed to demonstration programs, it will have an integrated process and impact evaluation centered on description of experience with each project. For the solar projects, part of the impact evaluation will be a documentation of site adequacy for solar installation. Direct pre and post metering will also be used to demonstrate the effects of the technology demonstrations. The process evaluation will look for any unintended side effects as well as the expected direct effect, assess perceptions of the demonstration using a mini-survey approach, and document any problems with the installation. The process evaluation will also address problems of ongoing maintenance and care for the equipment. For the "Go Deep" demonstration homes, evaluation will track with current and ongoing assessments of "Go Deep" as sponsored by other utilities, and the attempt to document attainment of effective and efficient approaches to achieve eight percent (80%) savings in the residential sector.

Program 4. Commercial and Industrial Incentives

This program targets only commercial, industrial and institutional accounts. The program is a totally custom program, designed to develop exceptionally productive energy savings opportunities in cooperation with the customer. Each project will be specially designed as will each impact evaluation.

Site-specific project evaluation will combine engineering calculations with limited short-term data logging or spot metering. Evaluation for this program will have to be kept simple, but adequate to satisfy needs the customer, plus I&M's and the Commission's need for defensible evaluation results. Typically in these contexts, measurement is direct and short so as not to interfere with production. For each project selected for verification, a verification plan will be developed for the site, depending in part on the measures (EEM complexity, technologies, anticipated interactive effects), the project estimated value of energy conserved, and site review including site specific and institutional constraints.

For each project site selected, there will be a pre-installation site review, a site-specific plan detailing how measurements will be taken (with assumptions), any pre-installation M&V effort as required by the plan (to establish the baseline), post-installation M&V (with post-installation metering), and development of a post-installation M&V report.

Analysis will follow the International Performance Measurement and Verification Protocols (IPMVP) under options A (Partially Measured Retrofit Isolation), B (Retrofit Isolation), C (Whole Facility), and D (Calibrated Simulation) as suitable under IPMVP to the specific measures installed at specific sites. In cases in which preferred IPMVP options might require high cost and in cases in which IPVMP options are not possible due to production constraints, practical engineering analysis satisfactory to the facility management and the utility may be substituted. A major force operative in these projects is the need not to interfere with production and limitations imposed by facility management. While these factors can limit measurement options, they also insure conservative design and projects that are virtually certain to perform as planned.

The process evaluation will be a short "story of the program experience," citing encounter with program barriers and incremental learning from the different projects. The overall program evaluation will summarize results over the sites and characterize the savings due to the program. Spot or short-term metering is expected to determine baseline and post-installation energy use.

Free riders, spillover, and net-to-gross considerations will be addressed by a short survey approach for all projects, complemented by a small set of in-depth interviews for each project (since the number of projects for this program is expected to be small). If the number of projects expands, a stratified sampling approach may be used.

For custom projects, the documentation developed by the program implementer (company staff or a program vendor of ESCO) is extremely important. Documentation of characteristics of any equipment removed as well as new equipment installed is essential, along with date and time of all activity. As with all impact evaluations, quantitative documentation of the base case ("No Program") condition is essential to enable direct comparison with the program condition. This means that the evaluator must work alongside the program implementer because the base case will no longer be available for measurement after the installation is carried out. Based on experience, facility management generally requires the least intrusive, but adequate for practical purposes, approach to measurement, which is often direct "before and after" assessment. Typically measurement for these kinds of projects is best performed by a seasoned engineer with industry experience.

Program 5. Commercial and Industrial Rebates

This program targets non-residential customers eligible for prescriptive measures. These will include commercial, industrial, and institutional customers. For profit, non-profit and public agencies (such as schools) will be included. The rebate program will require elements of both process and impact evaluation. The primary impact evaluation method will be engineering review of the gross savings as projected by the program vendor. For each project selected for verification, a verification plan will be developed for the site, depending in part on the measures (EEM complexity, technologies, anticipated interactive effects), the project estimated value of energy conserved, and site review. For each project selected, there will be a pre-installation site review, a site-specific plan detailing how measurements will be taken (with assumptions), any pre-installation M&V effort as required by the plan (to establish the baseline), post-installation M&V (with post-installation metering), and development of a post-installation M&V report. Analysis will follow the International Performance Measurement and Verification Protocols (IPMVP) under options A (Partially Measured Retrofit Isolation), B (Retrofit Isolation), C (Whole Facility), and D (Calibrated Simulation) as suitable under IPMVP to the specific measures installed at specific sites. The IPMVP procedures provide for a range of measurement options. For example, most lighting measures can be assessed by means of direct engineering analysis using inputs such as operating hours, the characteristics of new lighting equipment and of the equipment replaced. However, other technologies may require pre/post direct metering and/or statistical regression analysis. The final Evaluation report will summarize results over the sites and characterize the yearly savings due to the program. Spot or short-term metering is expected to determine baseline and post-installation energy use in most cases.

Evaluation of retro-commissioning will look particularly at savings claims and test the duration of energy savings. For the most part, evaluation in this area involves an engineering review. However, for selected sites where measurement is possible an evaluation approach with baseline, post treatment, and subsequent year measurement may be employed. The case pre-screening will also be included in the evaluation. It is likely that retro-commissioning will be evaluated using building modeling in Easy-Sim™.

Free rider, free driver, and net-to-gross considerations will be based on short surveys, backed up by a small number of interviews at selected sites. Analysis may be based on a stratified random selection of cases or on all cases.

Program 6. Commercial and Industrial Retro-Commissioning Lite

This program is planned to make use of a method of detecting outliers that would be likely candidates for retro-commissioning. Retro-Commissioning Lite is planned to involve inspection of systems for optimization of setting of controls. Evaluation of retro-commissioning will look particularly at savings claims and test the duration of energy savings. For the most part, evaluation in this area involves an engineering review. However, for selected sites where measurement is possible an evaluation approach with baseline, post treatment, and subsequent year measurement may be employed. The case pre-screening will also be included in the evaluation. It is likely that retro-commissioning will be evaluated using building modeling in Easy-Sim™.

Free rider, free driver, and net-to-gross considerations will be based on short surveys, backed up by a small number of interviews at selected sites. Analysis may be based on a stratified random selection of cases or on all cases.

Program 7. Commercial and Industrial HVAC Optimization

This program involves inspection and adjustment of existing HVAC equipment. For example, out of twelve rooftop units on a building, perhaps two are far out of adjustment. If possible, both operation under baseline conditions and operation of the optimized equipment should be monitored through spot metering and careful documentation of any fixes should be recorded. The overall performance of HVAC equipment should take into account normal variation of internal loads and also variations due to weather. The evaluator should propose the length and type of monitoring required and specify the type of monitoring equipment to be used. It is expected that evaluation will minimize intrusion on building operations by relying primarily on a calibrated hourly building simulation model. The model will be calibrated either to baseline conditions or to customer billing records. Inputs to the analysis are expected to also include spot power and outdoor temperature readings and interval end-use metering data (to the extent available). Results will be based on a traditional "pre/post" design and calculated using a statistically adjusted engineering model.

Free rider, free driver, and net-to-gross considerations will be based on short surveys, backed up by a small number of interviews at selected sites.

Program 8. Commercial and Industrial Audit

This program is limited to food service facilities) and grocery store/supermarkets. It consists of refrigeration improvements, improvements to refrigeration to reduce load, and restaurant commissioning audits (designed to optimize controls and limit energy losses in food service facilities). Evaluation will consist of engineering reviews contrasting before and after conditions, and supplemented by spot measurements. Modeling (simulation) software may be employed.

It is reasonable to assume zero free riders for this type of program since in the absence of a program, inefficient use of energy typically continues for years. Free rider, free driver, and net-to-gross considerations will be based on short surveys, backed up by a small number of interviews at selected sites.

Program 9. Commercial and Industrial New Construction

This program targets new commercial, industrial, and institutional construction. New construction presents a problem for the usual evaluation methods because there is no base case available for direct measurement. For this reason, the evaluation approach typically taken is building simulation modeling. The "as-built" program buildings are compared using a simulation program to the imaginary buildings that would have been constructed in the "No Program" situation. Gross energy savings results are developed as difference between the "as-built" and "No Program" model runs. Model runs generally involve many iterations until final models are developed. This is International Performance Measurement and Verification Protocol (IPMVP) Option D (Calibrated Computer Simulations), assisted by information from the DOE website, onsite survey and verification of selected buildings, and the possibility of limited data logger monitoring. The evaluation plan will provide the specifics of the instrumentation for the datalogger, calculation methods, and assumptions.

Free rider, spillover, and net-to-gross estimates are developed using surveys and interviews.

Program 10. Residential Whole House

This program includes the two residential energy assessment options that are carried out remotely, by mail or Internet and an on-site audit with direct installation of minor measures. The remote audits are available (free) to all customers of I&M and the on-site audits for electric heat customers only (with a $50 fee that can be credited to installation of recommended measures that are installed subsequent to the on-site audit).

For the remote audit program using the Internet and mail-in forms, energy savings claims will be limited to the low-cost measures sent out to accompany audit results. This is an engineering calculation. It will be checked using a mini-survey approach to develop information on installation rates to modify results by developing free rider, spillover, and the net-to-gross ratio. Energy savings claims will be limited to direct install items.

Evaluation of the on-site audit program element will be based on the audit record, directly installed low-cost measures, and subsequent documentation of rebates for items recommended during the audit. Free riders, spillover, and the net-to-gross ratio will be developed from survey results and interviews, both based on systematic random samples of participants. The interviews will also be used to develop process evaluation insights. Vendor staff will also be interviewed for the process evaluation. While the remote audit will be open to all customers, evaluation of this program will focus on customers with electric heat. Customers without electric heat will not be sent the kit items but will be direct toward rebate programs.

For homes that receive only low-cost measures with small savings potential, impact evaluation will make use of an engineering analysis. If there are a sufficient number of electrically heated homes for which the on-site audit leads to adoption of major measures, results will be assessed using a Statistically-Adjusted Engineering (SAE) billing analysis approach, or the Princeton Scorekeeping Method (PRISM).

Program 11. Residential Rebates

The Residential Rebates program focuses on rebates for CFLs and for Energy Star Appliances (Clothes Washers).

For lighting measures, the evaluation approach will be to verify the CFL wattage and CFL life of all rebated units according to vendor/brand specifications. Also to verify the typical wattage of incandescent bulbs replaced by CFLs (the basic assumption is that all CFLs will replace an incandescent bulb of equivalent luminosity; other assumptions will be taken from the national Energy Star program, as listed on their website). Results will be quantified according to standard M&V protocols to estimate the annual and lifetime energy savings. The evaluation report will present these results and report the distribution of CFLs by brand, model, and wattage. The program may be required to document light bulbs replaced, for example, through a limited light-bulb exchange, a survey, or direct inspection, or a combination of these approaches.

For appliances, the evaluation approach will be to gather complete technical descriptive information to identify each Energy Star appliance rebated (brand, model, characteristics). Results will be quantified using industry standard M&V calculations for each appliance type. An attempt will be made to gather similar technical information on machines replaced. The evaluation report will summarize this information and calculation results to document energy savings.

The evaluator will review program records and independently check program savings calculations maintained in the program tracking system. It is important to place a directive to the program vendor to document the specific technical features of equipment replaced and equipment rebated as a standard program procedure.

Program 12. Residential Appliance Recycling

For the residential appliance recycling program element within this program (for refrigerators, freezers and room air conditioners), the program vendor will be required to maintain a tracking database containing all of inputs required to develop gross energy savings. There are two primary national vendors for this program element and both have the required expertise with relevant tracking databases. Since the equipment is recycled, it is possible to gather complete information on all required technical data. The evaluator will also examine and report on safe equipment disassembly and recycling of components. The free rider, spillover, and net-to-gross information for this program element will be developed from participant surveys and interviews, both based on random samples of program participants.

Program 13. Residential New Construction

For the "Beyond Energy Star" program element, the primary method of evaluation will be an engineering review of program records, since Energy Star qualification will be certified by the program. Savings calculations will follow the International Performance Measurement and Verification Protocol (IPMVP) Option D (Calibrated Computer Simulations), assisted by information from the DOE website, onsite survey and verification of a few selected homes, and limited data logger monitoring. An evaluation plan will provide the specifics of the instrumentation for the datalogger, calculation methods, and assumptions. An equivalent comparison group will also be used to provide a meaningful contrast from which to develop program impacts.

Program 14. Residential Solar Siting

For solar orientation and review of construction to include simple elements of workable passive solar design, it may be assumed that there are zero free riders, first because while home builders have some knowledge of passive solar they do not use it in practice, and second because the focus of the program is on codes as well as individual homes. To the extent that the program is successful in modifying codes at a city or county level, or at the state level, all results will be new energy savings. This evaluation will emphasize process evaluation, to document the efforts at working to establish better codes, and will also require review of selected sites to insure solar orientation and elements of simple passive design were properly developed.

Program 15. Residential Low and Moderate Income Weatherization

This is a whole house weatherization retrofit program for low and moderate income homes with electric heat. There are two program elements, one for homes to and including 150 percent of poverty to match the Indiana Weatherization Assistance Program, and the other for homes from 150 percent of poverty to 80 percent of Indiana median household income. The two programs are identical. They will be separately evaluated. M&V will follow a traditional non-equivalent control group design using utility energy usage and billing records and either PRISM^{TM} or regression modeling, with an equal number of treated and similar untreated homes.

Other Considerations in Support of Program Evaluation

Three other areas should be developed to support program evaluation. These are a protocol for monthly program reporting, customer satisfaction metrics, and standardization of net-to-gross methods.

Protocol for Monthly Program Reporting

To assist in I&M's management of programs and to provide a stream of current information to the evaluation team, the vendor for each program should be required to submit a monthly report to the I&M Program Manager for each program containing the following information[48]:

(1) Month, date, program name, name of person responsible for the report.

(2) Brief description of the program, including program goals and objectives (this will repeat each month unless the program is changed). If there is a change in program description, goals, objectives, program elements or measures, please call attention to the changes and describe them clearly and completely.

(3) Program budget and expenditures (see table below):

Budget and Expenditures	**Actual Monthly Expenditures**	**Cumulative Expenditures To Date**	**Total Budget**	**(Over) Under**	**Variance $**	**Variance %**
Total						
Admin						
Marketing						
Program Implementation						

(4) Program energy and demand impacts. These will be based on program assumptions (see table below):

Energy Demand Impacts	**Projected Monthly Goals**	**Actual Monthly Goals Achieved**	**% of Goals Achieved**	**Projected Total Program Goals**	**Cumulative Program Goals Achieved To Date**	**% of Goals Achieve**
Coincident Pk kW						
Annual kWh						
Lifecycle kWh						

(5) Describe and discuss whether the program is reaching its projected performance goals as stated in the program work plan. Discuss separately for program administration activities, program marketing/promotion/communication activities, and program implementation activities accomplishments as compared with projected goals and objectives established for program related activities for the report period. Where possible describe work activities in both quantitative and qualitative terms. In particular, please describe all barriers encountered and if project goals have not been met, explain the reasons why and what steps have been taken to ensure that the project is back on schedule, and will be completed by target date.

(6) Describe all customer disputes or complaints and how they have been resolved.

(7) Describe any staff or subcontractor/consultant changes.

[48] This list is slightly modified from current California monthly program reporting requirements.

Customer Satisfaction Metrics

Customer satisfaction for each program is best assessed using a system of continuous mini-surveys. Mini-surveys are "mini" in three ways:

- First, they typically have no more than ten or twelve questions (and may have less) so they are easy to answer and not a burden for the customer.
- Second, all of the questions (or almost all) are answerable with a "yes/no," "0/1," or a percentage type response. This permits use of small sample theory.
- Third, the sample sizes are small, perhaps 30-60 completed satisfaction survey forms in each survey wave for a program.

However, they typically repeated every quarter so that a time series tracking record of responses to the individual satisfaction question can be developed and graphed. This provides an easy to deploy method of assessing customer satisfaction on a continuous basis that is able to detect changes that might require management response. Since the tracking is continuous, the feedback is in the form of a periodic management report with graphs.

Typically, customer satisfaction is best surveyed by an independent third party such as a marketing firm or an independent evaluator. Surveys may be conducted by phone or mail, or a combination. Because the response format for the questions is constrained, small sample theory can be used and the sample sizes will be small for each survey wave, but the waves will be repeated quarterly. The survey questions will be tailored separated for each program. A comparison group, not participating in programs, may also be employed.

For each survey wave (and with the exception of programs with a small number of customers) the goal will be a completed sample size of at least 30-60 (not more than 60). By repeating the same survey with new customers each quarter, the customer satisfaction results will cumulate to much larger samples over a year and over the five year horizon developed in the plan, so statistical confidence, significance, and power are all addressed over time. Also, by keeping a few common questions across all surveys, a general assessment of customer satisfaction in the whole DSM effort is possible. Where the number of units completed per quarter is less than 30, it is reasonable to attempt to survey all treated units.

Standardization

Different evaluation contractors may have different preferences for the approaches taken to develop information for determining free riders, spillover, and net-to-gross information. It will be important for I&M to standardize these approaches across programs, until such time as the Indiana Commission establishes guidelines for this area. Final determination of methods in this area is likely a commission decision, but commissions tend to ask for a record to be established, demonstrated, and fully discussed before arriving at a result.

APPENDIX A. METHODOLOGY

At the root of most DSM analysis there is some form of energy usage model. The model often used in larger multi-utility DSM planning, synthesizes estimates from demographics applied to engineering prototypes. This approach is easy to apply to individual measures and to small groups of measures where the result of all the measures is small relative to the total energy sales. But the simple synthesis approach becomes unstable where a large or comprehensive technical potential is contemplated because the simple sum may not include measure interactions, and can result in inflated savings estimates. Also demographic information and market penetration information are more accurate applied to large regions, but lack precision when applied to smaller regions. Under this circumstance, the cumulative errors due to lack of precision can compound into large errors.

Therefore, in this case, where a technical potential will be derived from a maximum application of a wide variety of interacting measures and applied to a relatively small region, we have opted to approach the estimate with a "calibrated engineering model". With this approach we will true the models to the current actual energy sales by fitting a relatively simple algebraic model to the recorded energy use (and demand) and the associated average monthly temperatures. This approach has the strong advantage of starting the analysis from a verifiable energy use situation. Another significant advantage of this approach is that it is somewhat empirical, and the data fitting process will reveal large unusual energy use situations, if they exist. Finally, it is particularly important to be able to establish a reasonably bounded estimate of the aggregate energy under conditions representing the full technical potential, which requires the explicit treatment of measure interactions afforded by the engineering modeling approach.

Within conditioned spaces, heating and cooling energy will be influenced by lighting and other internal gains and by large scale refrigeration. This results in an interaction of energy savings measures. Another form of measure interaction is related to changes in thermal conversion efficiency. Whenever there is a load reduction measure, the net realized energy savings will also be dependent on an assumed thermal conversion efficiency. Where a thermal conversion efficiency is changed at the same time as a load reduction, the result is interactive, and it is important to consider the effect of both measures simultaneously. In this case, where a wide range of efficiency and load reduction measures will be applied, it is particularly important to be able to deal with measure interactions in an orderly way.

The model has been devised and structured with explicit variables to express in physical or engineering terms, the measures and treatments involved in attaining the full technical potential. This includes variables for conversion efficiency, load reductions and thermal and electrical solar energy measures. The model will also estimate the changes in peak demand associated with the applied efficiency measures. The following discussion will be in two parts: the first part for the energy model, and the second part for the demand model.

Energy Model

Nature of the Data

A brief review of the energy sales and the associated average temperature, as illustrated in Figure 20 and Figure 21, shows that the daily average energy use has a close relationship to temperature.

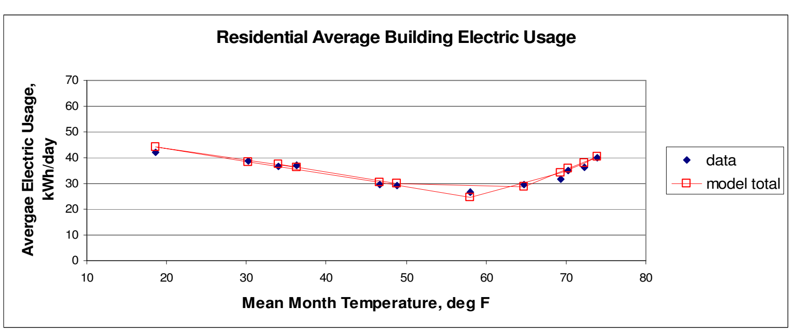

Figure 20. Existing Single Family

Figure 20 was derived from a random sample of residential single family units older than four years. This model is intended to characterize the energy use in the largest portion of the residential sector. There are other similar models for the three other smaller portions of the sector. In general, these models of average performance fit quite closely with an R-square usually in excess of 95 percent. This figure shows clearly the increased energy use at higher temperatures for air conditioning. And it also shows increased average energy use at low temperatures for heating, mostly by customers with electric furnaces. Note that at average temperatures in the range of 45-55 deg F, there appears to be no heating or cooling. Energy use at these temperatures is mostly the residential base load: lights, plugs, hot water.

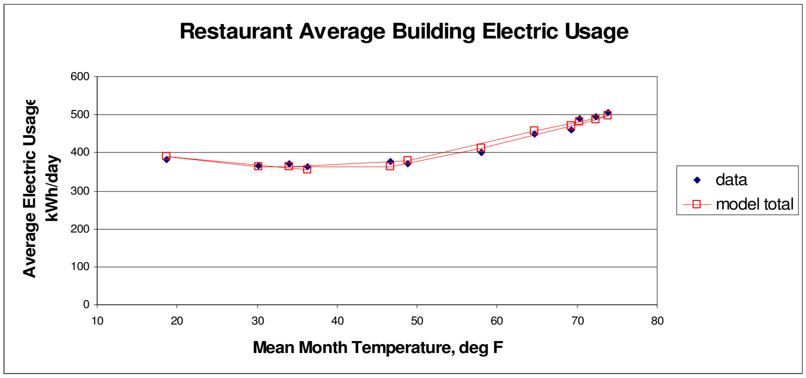

Figure 21. Restaurant

Figure 21 was derived from all the available billing histories of customers classified as Restaurant. The model and the data fit quite closely here. The average restaurant shows an increased energy use with temperature associated with air conditioning and mostly with refrigeration. There appears to be little electric heating. In Figure 21 most of the energy use appears to be restaurant base load, typically interior refrigeration, lights, and ventilation.

Energy Model Structure

For energy modeling purposes, customers were subdivided into segments as described in the Market Assessment section of this report. An engineering model was fitted to usage, appliance and end-use saturation levels, and temperature data. The models applied in each of the segments are all similar and represent six very fundamental end-uses:

- Heating
- Cooling
- Hot Water
- Lighting
- Internal Uses, Plugs, Cooking, Dishwasher
- External Uses, Outdoor Lights, Washer, Dryer

Note that the fundamental end-uses distinguish between internal and external electric energy use. This is for the purpose of estimating measure interactions between the heating and cooling end-uses and the electrical energy use within the conditioned space. Lighting and internal uses are assumed to occur within the conditioned envelope.

Model Inputs

Some of these end-uses are dependent on weather variables. The heating and cooling end-uses depend on average monthly temperature; the hot water end-use depends on the average monthly inlet water temperature, and lighting depends slightly on calendar month and day length. The thermal and electrical solar energy benefits depend on the average monthly solar. The other end-uses are assumed constant from month-to-month. For weather dependent inputs the models use the inputs shown in Table 68.

Table 68. Weather Inputs to Modeling

End-use	Inputs
Heating	Monthly average temperatures and long-term average month temperatures
Cooling	Monthly average temperatures and long-term average month temperatures
Hot Water	Monthly long-term average Inlet water temperatures
Lighting	Seasonal lighting usage factors

Beyond the weather inputs are the inputs pertaining to the distribution and operation of the energy using systems, listed in Table 69. These are the variables that are changed in the process of fitting a model to the data. It is noteworthy that the relatively few systems inputs are sufficient to fit a model so closely to the data, but that lies in the nature of fitting the averages of hundreds or thousands of sites.

Table 69. Residential Energy Model Inputs

	Existing Housing		New Construction	
Model Input	**SF**	**MF**	**SF**	**MF**
Customers - Percent of Sector	82%	13%	4%	0%
Water Heat Saturation	36%	72%	41%	79%
Hot Water Use Gallons per Day	65	55	65	55
Tank Loss btu/degree hour	4	4	4	4
Hot Water Tank Set Temperature	130	130	130	130
Hot Water Tank Efficiency	100%	100%	100%	100%
Space Heat Saturation	17%	23%	12%	17%
Space Heat Efficiency	1.20	1.10	1.40	1.70
Space Heat Set Temperature	64	62	60	58
Space Heat Use btu/degree hour	450	250	420	250
Lights kWh/day	6.23	2.70	5.50	2.40
Lights and Misc Saturation	100%	100%	100%	100%
Kitchen Use kWh/day	9.90	4.29	9.71	4.24
Kitchen Use Saturation	100%	100%	100%	100%
Washer, Dryer and External kWh/day	3.64	1.23	3.57	1.56
Washer, Dryer and External Saturation	100%	100%	100%	100%
Space Cooling Saturation	92%	92%	100%	100%
Space Cooling Set Temperature	64	65	67	67
Space Cooling Use btu/degree hour	450	250	420	250
Space Cooling Efficiency	2.10	2.10	2.20	2.10

This model is very simple in an attempt to be reasonably transparent and reviewable. It admittedly does not include many well known second order effects, such as variation of heating COP with temperature. However, the simple treatment of energy use in terms of first order effects is sufficient to the principal purposes here, which are: 1) to be able to true-up the model to the current energy use, and 2) to be able to estimate a physically reasonable energy use assuming conditions of full technical potential.

Separation into End-Uses

The total energy use is partitioned into the six fundamental end-uses by a combination of empirical discovery and engineering calculation, however simple.

The heating and cooling end-uses are empirically derived through the fitting of the model to the energy versus temperature slope in the usage and temperature data. The hot water end-use is explicitly calculated from water usage, inlet water temperature, and storage loss assumptions.

During weather neutral months such as April and May, these models empirically show the total building base load. But the models cannot go further and separate that total base load into its constituent end-uses: hot water, lighting, internal loads, and external loads.

The further separation of end-uses is done by removing the explicitly calculated hot water end-use and partitioning the remaining base load (lighting, internal loads, and external loads) on the basis of US national electric energy end-use splits. For the residential sector as a whole and for most of the commercial analysis categories there are published end-use splits on the average energy use for a full range of end-uses.

For this analysis appropriate items from the full range of end-uses are aggregated into the three fundamental end-uses used in this analysis: lighting, internal uses, and external uses. From these aggregated end-uses two ratios are developed, internal usage/lighting and external usage/lighting. These two ratios are then used in the models to maintain the appropriate relationships between lighting, internal uses, and external uses.

Usage Normalization

For planning purposes, usage data is normalized to the average 30-year temperatures for the service area. Figure 22 shows the actual temperatures in the test year and the long-term average temperatures.

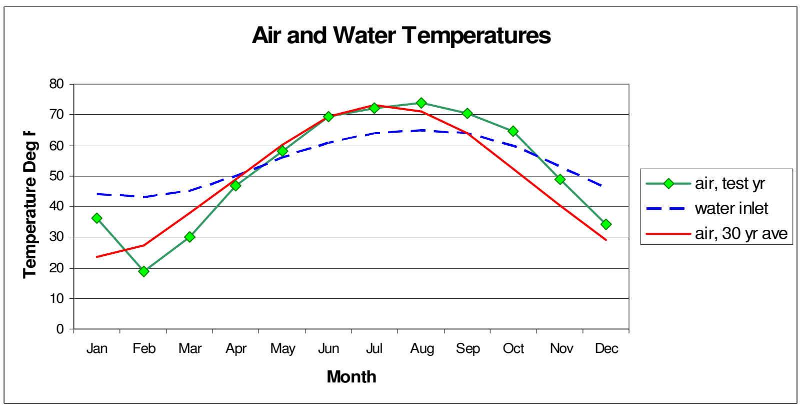

Figure 22. Air and Water Temperatures

In Figure 22, it is evident that the test year, green, is close to the 30-year average, red. The water temperature in Figure 22 refers to the ground water temperature which is used in the end-use models for hot water heating energy. In this case, the 30-year estimate of the groundwater temperature is assumed the same for the test year.

Perspectives on Energy

For perspective and review, the average daily energy use by end-use category and by month for each of the sixteen analysis categories is shown graphically at the end of this appendix.

Demand Model

Available Data

I&M made available hourly load data by rate class for 2006. This analysis proceeded from a load metered sample worked to an estimate of the total system load, and to the load of the principal customer sectors. Loads that we excluded from the analysis include the direct sales to municipalities and industrial transport.

This load analysis first derived the total residential and total non-residential coincident peak load for each hour of the peak day for each month for the analysis period, 2006. This analysis is the benchmark to which this demand model is trued up.

But first it is important to note that the demand model developed here estimates the average demand for a particular hour for each month. The average hourly demand from this model is quite different than the peak day hourly load for the same hour and month in the I&M System Peak Day Load Analysis. They are almost as different as apples and oranges because the hourly demand is born of the monthly average and the peak hourly load comes from the monthly extreme and includes transmission and distribution losses. The initial analysis showed that the shape of the peak day load curves provided an opportunity to empirically modify and tune the timing of the predicted demand.

Demand Model

The demand model is driven by the energy model. For each end-use and for each month, the energy model estimates the average daily energy use, kWh/day. The demand model then takes the estimated daily energy use and distributes it among the twenty four hours of the day.

The objective of this demand model is to estimate the average distributed hourly demand for a large number of customers. The concept of distributed demand assumes that thousands of the same device, (stove water heater, computer, etc) will be turning on and off according to use at random times within the hour of interest. The contribution of any one of these devices is the full load power*duty cycle for the hour. For example, if a 1400 watt toaster is on for one-tenth of the hour, the distributed demand is 1400 watts times 0.1 hours, or 140 watts. In essence, the distributed demand is the energy used in the hour.

The distribution from daily energy use to hourly is done by means of "demand distribution functions". The demand distribution function consists of twenty-four hourly demand factors that specify the fraction of the daily energy use that occurs in each hour. Figure 23 and Figure 24 show the hourly demand factors empirically derived from this analysis and applicable to the residential customers.

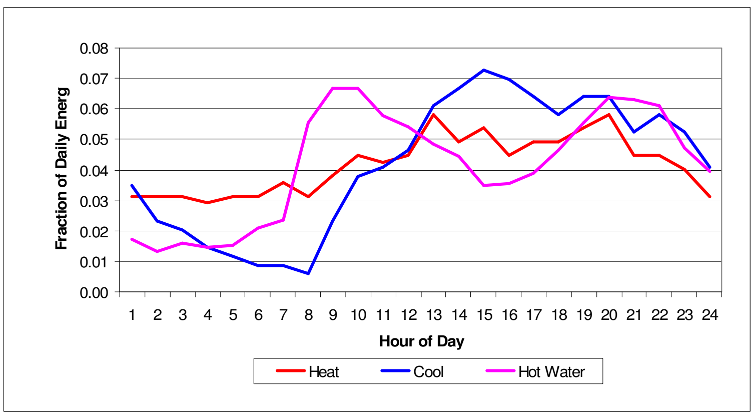

Figure 23. Residential Hourly Demand Factors for Heating, Cooling and Hot Water

Notice in Figure 23 that the cooling demand factor is greatest at about 3-4 PM when the cooling energy for each hour reaches about 7 percent of daily average cooling energy. Similarly, the hourly demand factor for heating appear to be maximum at 9 AM when the hourly demand factor is between 0.06 and 0.07. Hot water demand is known to be bi-modal occurring in the morning and late evening.

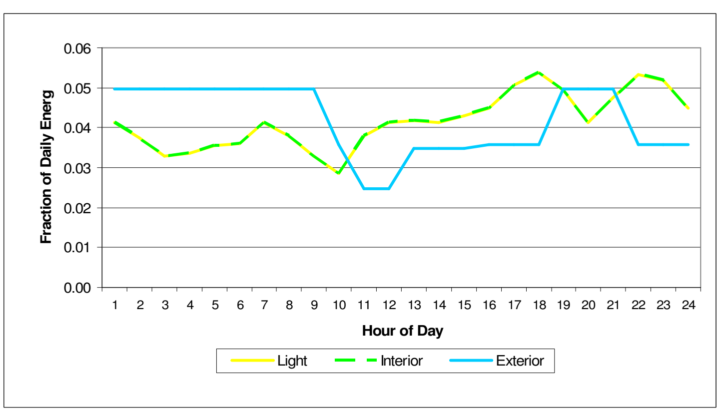

Figure 24. Residential Hourly Demand Factors for Lighting, Interior and Exterior Loads

Notice in Figure 24 that the interior loads and lighting have the same hourly demand factor and work toward a daily peak in the evening hours. The exterior load here consists of washer and dryer activity and some exterior lighting. Washers and dryers are considered here to be external loads because most of the energy is discharged outside as in the case of dryers. Or because the load may occur in an attached space such as a basement or wash porch that is not directly part of the conditioned space, as in the case of washers.

In the model there is a set of hourly demand factors for each of the six end-uses for each of the 16 analysis categories. In principal quite a lot of unique demand specifics. But in practice the comparison of the modeled demand and the de-rated peak day load curves was done at a much aggregated level. For example the de-rated commercial peak day load was compared hour by hour to the sum of the demand estimated in the twelve commercial analysis categories. In this comparison, the data is not detailed enough to distinguish one commercial load from another. Therefore, there is a set of hourly demand factors for each of the six end-uses, and these are used in all twelve of the commercial analysis categories. The commercial hourly demand factors are shown in Figure 25 and Figure 26.

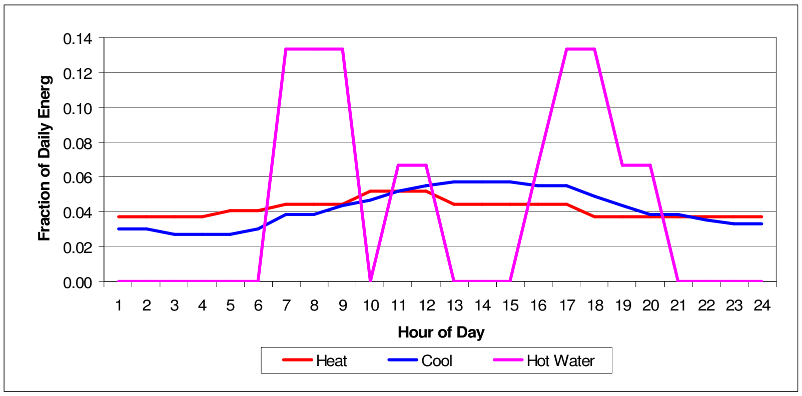

Figure 25. Commercial Hourly Demand Factors for Heating, Cooling and Hot Water

There is very little electric heating or water heating in the commercial sector, and the demand factors for these end-uses find minimal use. In Figure 25 the demand factors for cooling are the most important.

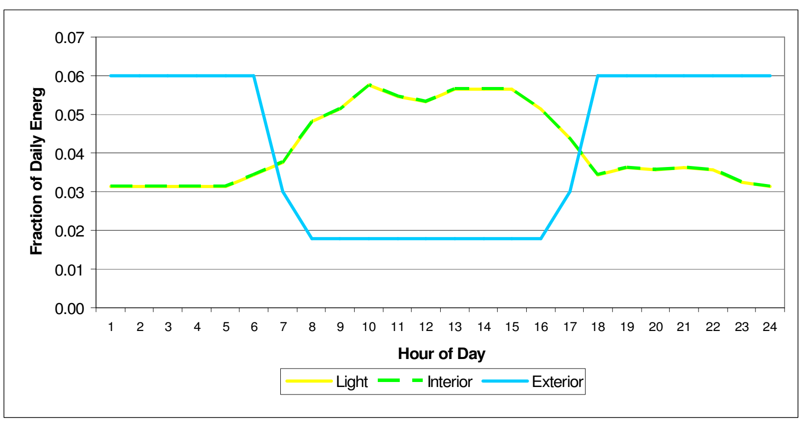

Figure 26. Commercial Hourly Demand Factors for Lighting, Internal and External Loads

In Figure 26, the hourly demand factors for the exterior loads express the fact that these loads are principally exterior lighting which is on at night. The hourly demand factors of principal importance are those for the lighting and interior loads which are assumed to be the same.

Truing the Demand Model

The demand model is ultimately trued against the coincident peak day. And ultimately, the truing process requires a temperature adjustment to simulate peak load instead of average demand conditions.

The first step in the demand true-up is to adjust the non-weather end-uses, lighting, internal loads, external loads, and hot water. The adjustment consists of modifying the hourly demand factors for these end-uses until the modeled sum of the non-weather end uses is close to that observed from the load study. This comparison is best done when heating and cooling are at a minimum. Once the hourly demand factors are so adjusted they are then used to represent the non-weather load throughout the year and especially in the heating and cooling situations. Figure 27 shows a close comparison between the demand estimated by the model and the demand from the load study for the sum of the non-weather load.

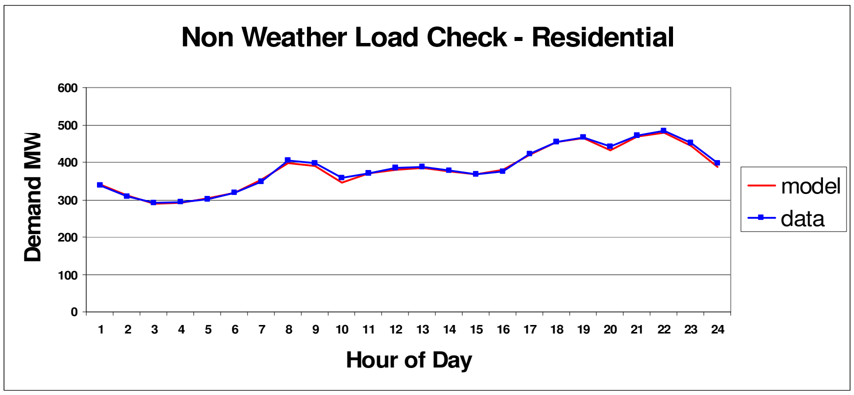

Figure 27. Base Load True-Up – Residential, October

The next step in the true-up is for cooling. In this case the model is compared to the load study for a maximum cooling month and the hourly load factors for each of the cooling months are adjusted for best fit between the model and load study. It has been found necessary to derive a different load factor curve for each cooling month because the actual dynamics of the cooling vary from month-to-month. For example cooling in May never carries over into the small hours of the morning as does cooling in August.

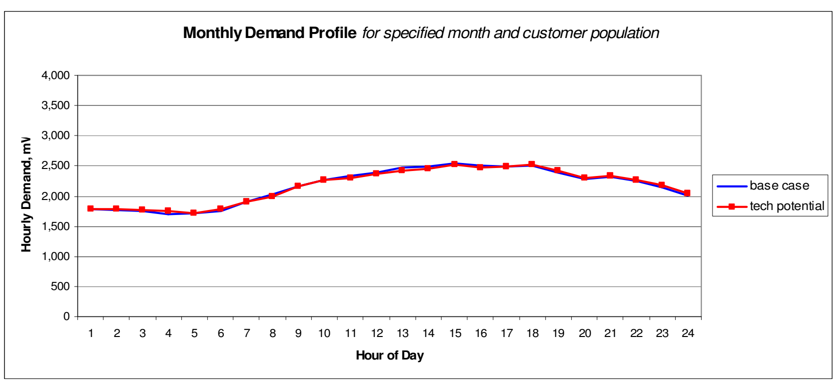

Figure 28. Cooling True-Up – All Customers, August

Figure 28 shows a close comparison between the demand estimated by the model and the demand from the load study after this cooling true-up step.

The final demand true-up step is for heating. In this case the model is compared to the load study for the heating months and a separate heating load factor curve is derived for each month from the best fit between the model and load study.

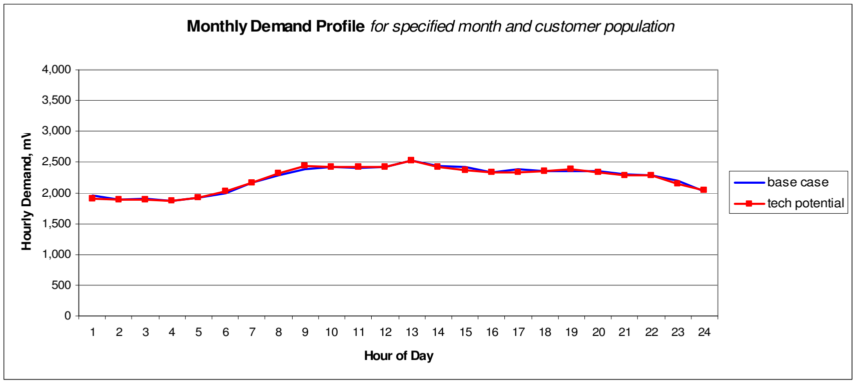

Figure 29. Heating True-Up – All Customers, January

Figure 29 shows a close comparison between the demand estimated by the model and the demand from the load study after this heating true up step. Through these true-up steps, the most significant hourly demand factors are derived and the demand model can now estimate the average daily demand versus hour for each month.

Estimating the Coincident Peak Day Load

There is a relationship between the coincident peak day load versus hour and the average day demand versus hour produced by this model. To estimate the coincident peak load, the energy model is driven by peak monthly temperatures instead of average monthly temperatures.

This model will estimate the change in average hourly demand for each month simulating any group of efficiency measures or all the measures used to express full technical potential. This month by month change in hourly average demand will be reported as the demand impact. As such, this demand impact does not include effects of transmission and distribution losses that will be in the financial analysis to both energy and demand.

Estimating the Technical Potential for Demand Savings

This model will estimate the change in average hourly demand for each month corresponding to any group of efficiency measures or all the measures used to express full technical potential. This month by month change in hourly demand will be reported as the demand impact. As such, this demand impact does not include effects of transmission and distribution losses that will be in the financial analysis to both energy and demand.

APPENDIX B. COST EFFECTIVENESS METHODOLOGY

Cost effectiveness analysis refers to the systematic comparison of program benefits and costs using standardized measures of economic performance. In this report, cost effectiveness is discussed at both the technology level and the program level. The assumptions and approach used to calculate technology and program cost effectiveness are presented in this appendix. Much of the material in this section is taken from the *California Standard Practice Manual: Economic Analysis of Demand Side Management Programs and Projects, October 2001* (SPM 2001),[49] which has broad industry acceptance.

Technology Cost Effectiveness

It is desirable to consider some measure of a technology's cost effectiveness in the preliminary stages of program design. This allows program planners to subjectively tradeoff cost and other attributes of energy efficiency measures (EEM) when considering possible program designs. Cost effectiveness analysis is less precise at the technology screening stage because estimates of energy savings and costs at the measure level are subject to a great deal of variance due to interaction with other measures and actual program implementation. Still, measure cost effectiveness provides a useful metric for consideration along with the many other factors outlined in the Program Plans section of this report.

What is needed at the technology or measure level is a simple measure of cost effectiveness that does not require assumptions of avoided resource cost, rebates, program delivery cost and other program level details. Levelized Cost (LC) provides such a measure by expressing the cost of a measure in annual terms per unit of energy saved. This allows an easy way to compare and rank order the cost effectiveness of measures. The formula used for the LC calculations in this report is presented below:

LC=DCosts / DSavings

$$DCost = \sum_{t=1}^{N} \frac{IC_t + OM_t}{(1+d)^{t-1}} \qquad DSavings = \sum_{t=1}^{n} [(\Delta EN_t) \div (1+d)^{t-1}]$$

where:

LC	=	Levelized cost per unit of the total cost of the resource (dollars per kWh)
IC	=	Incremental cost of the measure or technology
OM	=	Annual operation and maintenance cost
DCost	=	Total discounted costs
DSavings	=	Total discounted load impacts
ΔENit	=	Reduction in net energy use in year t
N	=	Life of measure
d	=	Discount rate

Although not suited for fuel substitution and load building programs, LC provides an easily calculated way of comparing measures. Measure cost, savings, useful life, and discount rate are the only assumptions required for calculating LC. Real levelized cost refers to LC expressed in constant dollars (i.e., without inflation).

The formula used in Microsoft Excel to approximate LC is as follows:

LC = (OM-PMT(d,N,IC))/EN

where PMT is the payment function in Excel and the other terms are defined as above.

[49] Prepared by the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC). All formulas and discussion are based on the SPM 2001. Formulas have been modified to remove peak savings, multiple costing periods, and otherwise adapted to be relevant for use with this project.

For example, using a real discount rate of 6.6 percent, a measure life of 18, an incremental cost of $200, and annual savings of 100 kWh with no annual O&M, results in real levelized costs of $0.1931.[50]

Program Cost Effectiveness

The discussion of program cost effectiveness is meant to provide a general overview of the standard tests consistent with the calculations in the SPM (2001). Actual cost effectiveness analysis was run using DSMore software from Integral Analytics. DSMore returns benefit-cost ratios and other results for the perspectives represented in the standard tests. Contact Integral Analytics (http://www.integralanalytics.com/) for information and documentation regarding DSMore software.

Many additional assumptions over and above those required for calculating EEM cost effectiveness must be made when calculating program cost effectiveness. Cost effectiveness of energy efficiency programs involves describing the economic impact of the program from the perspective of various groups. This analysis requires detailed program budgets and design elements such as rebate levels and other program features. Perspectives, also called tests, presented in this report are listed in the table below along with the primary benefits and costs used to compute cost effectiveness.

Table 70. Benefits and Costs by Cost Effectiveness Test

Cost Effectiveness Test	Benefits	Costs
Utility Cost (also known as Administrator Cost)	Avoided energy costs (net)	Program expenses paid by utility including incentives
Participant	Reduced energy bill Incentive payments Tax credits Decreased O&M costs	EEM installation Increased O&M costs
Ratepayer Impact	Avoided energy costs (net)	Lost revenue (net) Program expenses
Total Resource Cost (TRC)	Avoided energy costs (net) Tax credits Decreased O&M costs	EEM installation Program expenses Increased O&M costs
Societal (variant of TRC)	TRC benefits plus non-energy benefits less tax credits	TRC costs plus non-energy costs

Reference to "net" indicates that the load used to measure the benefit or cost is net of free riders. EEM installation includes all incremental costs to acquire and install an EEM. Program expenses include all costs related to delivery of the program and include staffing and overhead, advertising, incentive payments, administration fees, and monitoring and evaluation expenses.

Various measures of the economic impact are available for each perspective. The two primary measures we will use in this report are listed below:

- Net Present Value
- Benefit-Cost Ratio

In addition to the economic criteria listed above, other criteria may be unique to a given perspective. For example, simple payback of investment is often cited as an important criterion from the participant perspective. Each of the perspectives is discussed in detail below including the assumptions and formulas required to calculate the measures of economic impact. Each of the cost effectiveness tests are discussed below.

[50] The values used in the example are not meant to represent actual assumptions. See the Energy Efficiency Measure Assessment section for specific assumptions, including the discount rate.

Utility Cost Test

The Utility Cost Test (also known as Administrator Cost Test) measures the cost of acquired energy savings considering only the costs paid by the utility. Benefits are similar to the TRC Test but costs are more narrowly defined. Its primary purpose is for assessing resource acquisition from the perspective of the utility. In this sense, it is similar to the Participant Test in that the test provides a measure of cost effectiveness from a single perspective that does not include all costs.

Benefits included in the calculation are the avoided cost of energy supply. Net loads are used for the purpose of calculating avoided cost of energy benefits. The costs include all program expenses including incentive payments for EEM installation.

Participant Test

This test compares the reduction in energy bills resulting from the program with any costs that might have been incurred by participants. Other benefits included in this test include incentive payments and tax credits. When calculating benefits, gross energy savings are used rather than reducing savings for free-riders.

The main value of the Participant Test is that it provides insight into how the program might be received by energy consumers. The incentive level required to achieve some minimum level of cost effectiveness, for example, can be useful in program design efforts. It should be noted, however, that consumer decision making is far more complex than reflected by the Participant Test. For this reason, the test should be used as one consideration of likely program acceptance and not an absolute indicator.

Ratepayer Impact Measure Test

The Ratepayer Impact Measure (RIM) Test measures the impacts to customer bills and rates due to changes in utility revenues and operating costs caused by the program. Rates will go down if the change in revenues from the program is greater than the change in utility costs. Conversely, rates will go up if revenues collected after program implementation is less than the total costs incurred by the utility for implementing the program. This test indicates the direction and relative magnitude of the expected change in customer rate levels.

The benefits calculated in the RIM Test are the savings from avoided supply costs. These avoided costs include the reduction in commodity and distribution costs over the life of the program.

The costs for this test are the lost revenues from reduced sales and all program costs incurred by the utility, including incentives paid to the participant. The program costs include initial and annual costs, such as the cost of equipment (either total cost for a new installation or net cost if done as a replacement), operation and maintenance, installation, program administration, and customer dropout and removal of equipment (less salvage value). The decreases in supply costs and lost revenues should be calculated using net savings.

Total Resource Cost Test

The Total Resource Cost Test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs. Of all the tests, the TRC is the broadest measure of program cost effectiveness from the standpoint of energy acquisition. This makes the TRC Test useful for comparing supply and demand side resources.

The primary benefit in the TRC Test is the avoided cost of energy. Loads used in the avoided cost calculation are net of free riders. Tax credits and reductions in annual O&M costs, if applicable, are also treated as a program benefit (or a reduction in costs). Costs used in the TRC calculations include all EEM installation costs, program related costs and any increased O&M costs no matter who pays them. Incentive payments are viewed as transfers between participants and ratepayers and are excluded from the TRC Test.

Societal Test

The Societal Test is the broadest of all of the perspectives and is considered a variant of the TRC. The primary difference between the two tests is that the Societal includes non-energy benefits and costs that are not part of the TRC. Another difference is the treatment of tax credits. While tax credits are counted as a benefit in the TRC test, they are considered a transfer payment between members of society and, hence, excluded from the Societal test.

APPENDIX C. RESIDENTIAL EEM DOCUMENTATION

The purpose of this appendix is to provide documentation of the assumptions used to screen the residential Energy Efficiency Measures (EEM) identified for consideration in this report. Our assumptions are based on references cited throughout this section as well as the direct experience of our team with technologies in the field and actual DSM program evaluations. While not all of the field and DSM program experience can be cited in published works, published references are used to establish a reasonable range of assumptions. The point estimate used within that range is based on our professional opinion. The mapping of EEM to residential DSM programs is shown in the table below by the value listed in each cell. The value represents the percentage of participants installing the measure. Cells with no value mean the measure is not included in the program.

Table 71. Mapping of EEM to Residential Energy Efficiency Programs

Program #			**10**	**11**	**12**	**13**	**14**	**15**
End Uses	**EEM Description**	**EEM Ref #**	**Res Whole House**	**Res Rebates**	**Res Appl Recycle**	**Res New Constr**	**Res Solar Siting**	**Res Low/Mod Income Weath**
1. Customer-Sited Generation	Solar Photovoltaic	R-1						
2. Residential Space Conditioning	Resist to SEER 13 Heat Pump	R-2						
	Resist to SEER 13 Heat Pump	R-3						
	SEER 8 to SEER 13 CAC	R-4						
	SEER 8 to SEER 13 CAC	R-5						
	Refrig Charge/Duct Tune-Up	R-6	0.02					0.50
	Refrig Charge/Duct Tune-Up	R-7						
	SEER 13 to SEER 15 Heat Pump	R-8						
	SEER 13 to SEER 15 Heat Pump	R-9						
	SEER 13 to SEER 15 CAC	R-10						
	SEER 13 to SEER 15 CAC	R-11						
	Efficient Window AC	R-12						
	Cool Roofs	R-13						
	EE Windows	R-14						
	Programmable Thermostats	R-15	0.03					0.50
	Ceiling Insulation (R6-R30)	R-16	0.02					0.50
	Ceiling Insulation (R6-R30)	R-17						
	House Sealing using Blower Door	R-18	0.02					0.50
	House Sealing using Blower Door	R-19						
	Ground Source Heat Pump	R-20						
	Wall Insulation (R3-R11)	R-21	0.02					0.50
	Wall Insulation (R3-R11)	R-22						
	Solar Siting/Passive Design	R-23					1.00	
	Energy Star Manufactured Home	R-24						
	Energy Star Construction	R-25				1.00		
3. Load Management	Eliminate Old Refrigerators	R-26			1.00			
	Set Back HVAC	R-27						
4. Residential Appliances	Energy Star Clothes Washers	R-28		0.02				
	Energy Star Dish Washers	R-29						
	Energy Star Refrigerators	R-30						
	Pool Pumps	R-31						
5. Residential Lighting	Compact Fluorescent	R-32	1.00	0.98				0.60
	Daylighting Design	R-33						
	Occupancy Controlled Outdoor	R-34						
6. Water Heating	Tank/Pipe Wrap and Water Temp Setpoint	R-35	0.02					
	Low Flow Fixtures	R-36	1.00					0.60
	Heat Pump Water Heaters	R-37						
	Tankless Water Heaters	R-38						
	Solar Water Heaters	R-39						
	Efficient Plumbing	R-40						

Solar Photovoltaic (R-1)

This technology consists of a roof or ground mounted solar electric array with a full sun output of 2 kW. Such an array has an area of 200-300 square feet. Electricity from the array is converted to AC by an inverter and the power is immediately used on site with excess fed into the grid. This technology needs full solar exposure and shadows can significantly restrict output. This technology is fully mature, but local builders and building officials are still unfamiliar with it.

Measure Applicability

No local studies have estimated the percentage of housing stock with suitable exposure; for this analysis it is assumed that 35 percent of residential buildings are suitable sites.

Incremental Cost

A system installation usually requires an electrical inspection to verify appropriate wire sizing, disconnects, and grounding. Costs are quite site specific, with most of the costs associated with solar electric panels. In the current supply-constrained 2007 market, costs are $5.00-$7.00/watt peak for the solar cells alone. Installation and balance of system can be expected to add $3.00/watt. For the 2.5 kW array considered here, the total cost will be taken as $20,000[51] or $8.00/watt.

Average Annual Expected Savings

The electrical output for this technology is directly related to the solar intensity. Monitoring studies in this region of the US have shown that 1 kW of installed capacity can yield in excess of 1,100 kWh/yr. For the 2.5 kW array considered here, the annual savings for the I&M service territories is estimated to be 3,300 kWh/yr.

Expected Useful Life

This equipment demonstrated long trouble free service in severe applications such as remote communications, navigation lighting, and road signage. The long-term output of the cells is assumed to decrease with time, but the rate of decrease for current technology is not known. The crystalline and semi-crystalline forms of the technology have already demonstrated degradation of less than 20 percent in 20 years. But earlier thin film forms of the technology have showed shorter lifetimes. The lifetime of new thin film technologies is expected to be of the order of 25 years but it is not known. For these purposes the lifetime is taken as 25 years.[52]

Resistance Electric Furnace to SEER 13 Heat Pump (R-2, R-3)

This measure is designed save heating energy and cooling energy by replacing an existing central air conditioner/electric furnace by a modern heat pump. Most of the savings proceed from replacing resistance heating by a heat pump at more than twice the thermal efficiency. This measure has significant savings, but also significant costs because it involves replacing the whole heating and cooling system, not including ducts.

Measure Applicability

This measure is applicable to about 17 percent of the residential sector that heats with an electric (resistance) furnace.

Incremental Cost

This measure requires replacing the whole heating/cooling system not including ducts. The cost of such a replacement is quite site specific, but can be expected to be a first cost of $10,000 or more. There are two contexts for such a replacement: 1) early retirement in-order to achieve large heating savings, and 2) where the central AC needs to be replaced anyway, the most prudent thing would be to replace with a heat pump because of its significant heating savings. The upgrade to a heat pump can be expected to cost about $5,500-$6,500 more than the AC replacement alone. For this analysis we assume $10,000 as the incremental cost.

[51] The C&RD Database lists the incremental capital cost as $6,000 per kW, which would be comparable for an installed 2 kW system.
[52] The Conservation and Renewables Database lists a measure life of 20 years for standard technology solar PV.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find savings in the range of 6,000 kWh/yr for a single family residence and 4,800 kWh/yr in the multifamily application.

Expected Useful Life

The physical life of this measure is about 20 years, but for the purposes of this analysis we will take 10 years as the useful life of this measure to reflect the application of this measure in an early retirement context.

SEER 8 to SEER 13 Central Air Conditioner (R-4, R-5)

This measure is designed to save cooling energy by preemptively replacing an inefficient old central air conditioner by a modern efficient one. This measure is applied to a gas heated residence.

Measure Applicability

This measure is applicable to existing residential air conditioners, about 79 percent of the residential stock.

Incremental Cost

This measure physically involves replacing the entire air conditioning unit but not the ducts. The cost would be $3,500 at a minimum.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find average cooling of 1,400 kWh for single family residence and 1,200 for a multifamily residence.

Expected Useful Life

The physical life of this measure is about 20 years, but for the purposes of this analysis we will take 10 years as the useful life of this measure to reflect the application of this measure in an early retirement context.

Refrigeration Charge and Duct Tune-Up (R-6, R-7)

This measure is designed to save electric energy by increasing the operating efficiency of the refrigerant system by insuring that it is properly charged. It is common in residential cooling or heat pump systems to have an incorrect amount of refrigerant charge because these systems are usually charged on site during installation. This measure also leads to savings from finding and sealing duct leaks which increases the system distribution efficiency.[53]

Measure Applicability

This measure is applicable to most of the residential stock. Notably even new installations can benefit from this measure.

Incremental Cost

The incremental cost of this measure pays for a visit by a specially trained HVAC technician. For this analysis this cost is taken as $350.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find savings of 1,200 kWh/yr for a heat pump (electrically heated residence) and 300 kWh/yr on a gas heated residence with AC only.

[53] While these measures are theoretically handled by different trades, in practice they are implemented by a specially trained HVAC technician. This combination is efficient from a cooling system perspective and also typically cost-effective.

Expected Useful Life

This is essentially a tune-up measure and is considered here to have a useful life of 5 years.

Upgrade Heat Pump Efficiency from SEER 13 to SEER 15 (R-8, R-9)

This measure is designed to encourage the installation of more efficient heat pump equipment. Rather than installing a heat pump with a SEER of 13, the homeowner is encouraged to install a more efficient heat pump with a SEER of 15.

Measure Applicability

This measure is applicable to new or replacement heat pump installations. In recent years the rate of heat pump installations has increased. For this study we will take this measure as applicable to 25 percent of the new electrically heated residential stock.

Incremental Cost

The incremental cost of $1,050 for single family applications used in this analysis is very similar to the value of $1,062 given in DEER for this measure.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find savings in the range of 600-1100 kWh/yr. For this study, we will take savings of 1110 kWh/yr for single family sites and 700 kWh/yr for multifamily.

Expected Useful Life

The DEER uses an expected useful life (EUL) of 15 years; however, for other heat pump measures the DEER uses 18 years which is similar to the 20 years used in this analysis.

Upgrade Central Air Conditioner from SEER 13 to SEER 15 (R-10, R-11)

This measure is designed to encourage the installation of more efficient central air conditioning equipment. Rather than installing a central air conditioner with a SEER of 13 the homeowner is encouraged to install a more efficient central air conditioner which has a SEER of 15.

Measure Applicability

This measure is applicable to new or replacement central air conditioner installations. Central air conditioners (and not heat pumps) are used by about 74 percent of I&M residential customers. In this study we assume that the replacements in the next ten years are applicable to about 20 percent of residential customers and that efficient central air conditioners are applicable to about 60 percent of new residential construction.

Incremental Cost

The incremental cost of $850 used in this analysis is comparable to DEER's $970 for this measure.

Average Annual Expected Savings

The average annual expected savings from this measure depend significantly on the size of the residence and the thermal integrity of the shell. Simulations of savings using I&M specific information show savings in the range of 250-500 kWh/yr. For this study we will use 520 kWh/yr for single family residences and 350 kWh/yr for multifamily.

Expected Useful Life

The DEER uses an EUL of 18 years, which is similar to the 20 years used in this analysis.

Efficient Window AC (R-12)

An efficient window or room air conditioner saves energy by slightly more efficient operation, and often by use of an internal timer to restrict operation to occupied periods. An equally important consideration in the selection of a room air conditioner is to avoid over-sizing the unit, in which case additional spaces may be unintentionally cooled.

Measure Applicability

This measure is applicable in the residential and small commercial sector where central air conditioning is not used. The I&M market survey finds 16 percent of residences with window AC units. For this analysis, the applicability is taken as 15 percent of the residential sector and 15 percent of the commercial sector.

Incremental Cost

The incremental cost of the more efficient unit will vary with the size of the unit. For this study we will take the average incremental cost to be $150.

Average Annual Expected Savings

The energy savings from this measure will vary considerably with the size of the unit and the particular application. In this study we assume an application where the room air conditioner is used as the primary means of cooling a space that is used through out the cooling season. In the I&M service area the average cooling energy for a small residence is about 2,000 kWh/yr. A properly sized efficient window air conditioner can be expected to save 10 percent of this cooling energy or 200 kWh/yr.

Expected Useful Life

In this study we assume the expected useful life to be 13 years.

Cool Roofs (R-13)

This measure is intended to save cooling energy by reducing the temperature in the attic through attic ventilation and through the use or optically reflective roofs. Recent improvements in roofing have led to roofing in attractive architectural colors that can reflect solar gain almost as well as white or reflective roofs. This reflection of solar gain along with adequate attic ventilation can lower attic temperatures significantly thereby reducing heat gain to the home and also improving the distribution efficiency of any ductwork or distribution fans that are located in the attic space. Attic cooling lowers the thermal gain to the residence below, and it also improves the distribution efficiency of any attic duct work. At least half the cooling savings attributable to this measure proceed from the improved distribution efficiency, and therefore this measure is intended for application where there are attic ducts or distribution fans. This is essentially a site built measure including the installation of roof vents and the installation of several hundred square feet of reflective material to the inside of the roof rafters.

Measure Applicability

This measure is considered applicable to all new roofing applications. It is especially effective for central air conditioning applications with distribution ductwork in the attic. According to the appliance survey 92 percent of residences have central AC, and of these 15 percent are assumed to have attic ductwork. Overall the applicability is taken as 92 percent of the residential sector.

Incremental Cost

The incremental cost for this measure is taken to be the incremental cost of the Energy Star Qualified roofing which is reported to be currently $0.20/square foot, but which is expected eventually to be zero. All other roofing costs and required are ventilation assumed to be unchanged by this measure. For this study we will take the incremental cost to be an average of $0.10/ square foot over the five year planning period. For the average residence, $158.

Average Annual Expected Savings

The savings from this measure proceed from lowered cooling energy by reducing ceiling heat gain. According to DOE, ceiling heat gain accounts for 15-25 percent of the residential cooling load. The radiant barrier has been observed to reduce ceiling heat gain by 16-42 percent. The cool attic strategy also improves cooling distribution efficiency if the cooling ducts or fan unit is in the attic. For this study we will take the average annual savings to be 560 kWh/yr. Savings larger than these will be found in the extreme cases with poorly insulated air conditioning distribution located in the attic spaces.

Expected Useful Life

This measure consists of reasonably durable material installed in an attic. The useful life is assumed to be 12 years.

EE Windows (R-14)

This measure involves increasing window insulation from a U value of 1.1 BTU/sqft/hr deg F to a U value of 0.45. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. So the cost effective application of this measure is to electric heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 23 percent of residential customers that heat with electricity. Of these customers about 5 percent have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17 percent we will assume that half are poorly insulated enough to benefit from this measure. Overall the applicability is taken as 8 percent of the residential sector.

Incremental Cost

We assume a cost of $25 per square foot of window area. DEER uses a value of $28 per square foot of window area, and C&RD uses a value of $16 per square foot. For the average residence considered here with 100 square feet of window upgraded, the cost would be $2,500.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source and the square feet of windows replaced. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations from I&M specific weather data show savings of 900 kWh to 1,300 kWh/yr for electric heated residences and less than 400 kWh/yr for gas heated residences. For this analysis the annual savings will be taken as 1,334 kWh/yr for electric heated residences.

Expected Useful Life

This analysis uses an effective useful life of 25 years, the DEER uses 20 years.

Programmable Thermostats (R-15)

Programmable thermostats save energy by lowering the average daily temperature of the inside of a building. Most of the energy savings is heating energy because that heating thermal load is much larger than the cooling load, but some energy savings in cooling energy will also be realized. Programmable thermostats are commonly sold for self installation. But the installation has the following four important issues that need to be considered.

1. Some thermostats are line voltage thermostats, and there is some shock hazard to the unaware.
2. The first step in programming a thermostat is the system specification. Here the installer tells the thermostat what kind of a system it is controlling. The system type is selected from a list of about 30-50 different system types. This is a non-obvious choice.
3. For system controls there are standard colored wires, but often hookups use non-standard wire. For the mechanically inclined this process is okay but for others it is daunting.
4. Then, after it is installed successfully there is the issue of controlling it to get satisfactory results. Sometimes this needs a guiding hand.

The US DOE is planning to phase out programmable thermostats from the Energy Star program over the next year. The planned phase out is apparently related to recent evaluation studies that found insufficient savings to warrant the Energy Star designation. Proper installation and operation appear to be at the root of the lack of energy savings. We have chosen to leave these devices in our mix of EEMs and feel that with proper installation and setup the technology is sound. Our incremental cost includes the cost of installation over and above the off-the-shelf cost of programmable thermostats. Even with proper installation, there is an ongoing need for a design that is more user-friendly and easier to operate.

Measure Applicability

The I&M Appliance study shows 23 percent of the respondents reported the use of a programmable thermostat. Also the Appliance Study reports 23 percent have electric heating in the form of resistance heat or heat pumps. It is not clear if the reported programmable thermostats were all on electric heating situations. For this analysis one half the electric heating situations, 11.5 percent, are taken as good candidates for a new programmable thermostat.

Incremental Cost

Programmable thermostats cost retail in the range of $50-$100. A utility program may be able to purchase in bulk. It may be necessary to have a range of options which include at least line voltage and low voltage. For these purposes we take $70 as the melded cost of the thermostats.[54] It is assumed here that thermostats will be installed as part of a site visit in a broader program with $25 allocated for installation labor. In total the installed cost will be taken as $120 per thermostat.[55] Some sites with line voltage thermostats may require more than one thermostat.

Average Annual Expected Savings

Thermostat savings are best realized when the set back interval is of the order of 8 hours or longer, and the amount of savings depends on the number of degrees the thermostat is set back. The rule of thumb is one percent heating savings for every degree the thermostat is set back for at least 8 hours. For this estimate a five degree thermostat set back is assumed, leading to heating savings in the average electrically heated home of 500 kWh/yr.

Expected Useful Life

In principal, these thermostats can last for in excess of 20 years, but the backup batteries have a finite life and the programming can be changed or confused. In this case, the effective lifetime will be taken as 10 years.[56]

Ceiling Insulation R6-R30 (R-16, R-17)

This measure involves increasing ceiling insulation from R-6 to the R-30 level. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. So the cost effective application of this measure is to electric heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 23 percent of residential customers that heat with electricity. Of these customers about 5 percent have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17 percent we will assume that half are poorly insulated enough to benefit from this measure. Overall the applicability is taken as 8 percent of the residential sector.

Incremental Cost

We assume a cost of $0.75/square foot of wall area and 1000 square feet of wall space for a total cost of $750. DEER uses a value of $0.757/square foot of wall area. This job includes the cost of providing for adequate attic venting.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations from I&M specific weather data show savings of 1,500 kWh to 2,700 kWh/yr for electric heated residences and less than 400 kWh/yr for gas-heated residences. For this analysis, the

[54] DEER lists the incremental cost as $56.3, and the installed cost as $73.33 per unit.
[55] DEER lists the incremental cost as $73.33 of which $56.37 is equipment cost and $16.96 in labor. This analysis uses $50 for the labor cost which accounts for some of the difference in the costs.
[56] DEER list the EUL as 12 years.

annual savings is assumed to be 1,500 kWh/yr for electric-heated residences and 300 kWh/yr for gas-heated residences.

Expected Useful Life

This analysis uses an effective useful life of 25 years. The DEER uses 20 years.

House Sealing Using Blower Door (R-18, R-19)

This measure applies to residential electrically heated properties. It involves using blower door technology to pressurize the home. Once the house is pressurized, the air leaks are identified and sealed with appropriate materials to decrease heat loss from the building envelope.

Measure Applicability

This measure is applicable to most of the residential stock.

Incremental Cost

The incremental cost of sending a technician to a home and performing a Blower Door test and sealing the identified leaks is assumed here to be $500. By comparison, the C&RD database lists $0.16 per 0.1 air change per square foot which translates to $500 per house with 0.2 air changes per square foot.

Average Annual Expected Savings

An electrically heated home will achieve 1,000 kWh in annual savings according to our modeling, and a gas home will save 200 kWh annually.

Expected Useful Life

The life of the savings for this measure depends on the quality of the materials used especially for the gaskets for the windows and doors. An expected useful life of 15 years is being used. DEER lists 13 years and C&RD 20. We feel 20 years is too optimistic and have chosen a conservative value of 10 years.

Ground Source Heat Pump (R-20)

The ground source heat pump uses the ground as the energy source/sink in a heat pump cycle. This allows the ground source heat pump to operate with about twice the efficiency of a conventional air source heat pump. Because the ground is at a much more stable temperature than the air, resistance backup heat can be avoided. And it also simplifies the operation of the heat pump because defrost is not an issue.

Measure Applicability

This measure is applicable to new electrically heated residential construction and to existing I&M heat pump customers that have suitable sites. The total pool of candidate customers will be taken as 10 percent of residential customers, and we will assume that only 30 percent of these have suitable sites. Overall measure applicability is taken as 3 percent of residential sector.

Incremental Cost

The ground source heat pump is essentially a standard heat pump except that the outdoor unit is replaced by a trenched pipe as a ground heat exchanger a few hundred feet long. The burying of the pipe is highly site specific. In this study the incremental cost will be taken as the cost of the ground heat exchanger only and the remainder of the system will be considered similar in cost to a conventional heat pump. Although the site costs are highly site specific we will take $7,000 as incremental cost.

Average Annual Expected Savings

This measure saves on both heating and cooling relative to the basecase which is a standard heat pump. Using I&M specific weather conditions, the savings relative to a heat pump are 5,382 kWh/yr.

Expected Useful Life

This measure is considered to have a useful life of 25 years.

Wall Insulation (R-21, R-22)

This measure involves increasing wall insulation from R-3 and adding insulation to the R-11 level. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. Therefore the cost effective application of this measure is for electrically heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 23 percent of residential customers that heat with electricity. Of these customers, about 5 percent have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17 percent, we will assume that half are poorly insulated and could benefit from this measure. Overall the applicability is taken as 8 percent of the residential sector.

Incremental Cost

This measure contemplates adding wall insulation to a 2x4 stud wall where there is none. We assume a cost of $1.25 per square foot of wall area. DEER uses a value of $1.32 per square foot of wall area. The DEER values are based on going from an R-0 to an R-13; the equipment costs are given as $0.15 for equipment and $1.17 for labor resulting in the overall cost of $1.32. Our estimate is more conservative. The total installed cost for the home modeled is $1,400.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations from I&M specific weather data show savings of 1885 kWh to 2600 kWh/yr for electric-heated residences and less than 400 kWh/yr for gas-heated residences. For this analysis the annual savings will be taken as 2,100 kWh/yr for electric-heated residences and 400 kWh/yr for gas-heated residences.

Expected Useful Life

This analysis uses an effective useful life of 25 years, the DEER uses 20 years.

Solar Siting Passive Design (R-23)

This measure applies to new construction that can be designed and sited to capture solar gain through windows in-order to displace space heating. In a new building, the cost of proper orientation and of solar design is small to non existent if the orientation and design decisions are made before construction starts.

It is well known that if a new residence is tightly designed thermally, and oriented so that about 75-100 feet of glazing is near south facing, then its heating requirements can be reduced by about 30 percent. Much larger heating reductions have been demonstrated, but then the designs need to become more extreme with respect to south glass and with respect to protection from unwanted summer sun. This measure is intended to represent a "minimum graceful design", yielding the maximum savings with the least departure from a normal residential appearance. Physically, this measure consists of re-orienting and re-distributing glazing that would have been used anyway, and in using proper overhang to provide some summer shade. In passive solar design, the south glazing should usually have a high solar heat gain factor. This is an unusual glazing specification for current residential applications because most residential glazing is intended to reject solar gain for cooling purposes. Passive solar design also includes increasing the thermal mass, such as floor tile, adjacent to south facing glazing. The thermal mass of the existing sheetrock and furniture etc in a building also plays a role in thermal storage. Building codes generally try to discourage excessive glazing and solar gain, but they allow for exceptions where thermal design has been explicitly considered and documented.

Measure Applicability

This measure is applicable to new electrically heated construction with suitable solar exposure. In this study the measure will be applied to the 40 percent of new residential construction that will potentially use heat pumps, and of these 50 percent are assumed to have a suitable solar exposure. The overall applicability of this measure is taken as 20 percent of the residential sector.

Incremental Cost

This measure is considered a minimum passive design, and it essentially consists of a redistribution or reorientation of materials that would have been used anyway. The cost of this measure is taken as the cost for the information or advice necessary to "tune the design to the sun". The cost for this measure is taken here as $500 per building. Not very much needs to be done to capture these minimal passive solar heating savings, especially if it is done at the outset. The context for this incremental cost is assumed to be to a developer for some extra consideration in overall site planning.

In many reported cases of solar design, the cost is many times this and the building is usually much more expensive as well, but these costs are the common costs associated with personalized new construction, not particularly related to solar design.

Average Annual Expected Savings

The annual savings for this measure are considered only for electrically heated residences, though this measure is well suited to gas heated sites as well. For this analysis, the savings are taken as one-third of the electric energy used in typical heat pump-heated residences in I&M territory, 1,500 kWh/yr. These savings have been referenced to a heat pump as base case because it is unlikely that a new electrically heated residence would be built with electric resistance heat. However, relative to the rare case of a new resistance heated building, the savings would be much larger, about 3,000 kWh/yr.

Expected Useful Life

This measure will last the life of the building which can easily be 50 years or more. However for this analysis the measure life is taken as the maximum life used in this analysis, 25 years.

Energy Star Manufactured Home (R-24)

An Energy Star qualified new manufactured home is required to be 15 percent more efficient than a similar home that meets the 2004 International Energy Conservation Code, IECC. The mechanism for estimating Energy Star compliance is through the use of a HERS (Home Energy Rating System) score calculated from a brief estimate of annual energy use. The savings proceed principally from heating, cooling, lighting and water heating savings.

Measure Applicability

This measure is applicable to all new manufactured home construction. But for the purposes of this study the measure is restricted to new residential manufactured all electric construction. In the I&M service area manufactured homes are not a major component of new construction and are estimated here to be 10 percent of new construction.

Incremental Cost

The incremental cost for this measure consists of the increased cost of building components such as insulation, windows, lighting and appliances. This cost is site specific, but for the I&M service areas, the cost is taken as $2,600 which includes the cost of upgrading from resistance heating to heat pump heating. Generally the incremental measure cost for manufactured housing is less than noted for Energy Star site built construction because it is derived from the manufacturing environment where the costs increment is at the OEM level. But in this case, the total incremental cost is greater than for Energy Star site built because it includes the cost of an upgrade from resistance space heat to heat pump space heat.

Average Annual Expected Savings

The savings for this measure are specifically modeled based on an assumed upgrade from resistance heat to a heat pump, because this building stock is predominantly sited where there is no gas service and electric energy is the primary source of space heating. Savings estimates for an Energy Star manufactured home including an upgrade to a heat pump are in the range of 4,500 kWh/yr to 6,000 kWh/yr. For this study these savings are taken as 5,000 kWh/yr.

Expected Useful Life

This measure has a useful life comparable to that of new construction and for this study the life will be taken as 25 years.

Energy Star Construction (R-25)

An Energy Star qualified new home is required to be 15 percent more efficient than a similar home that meets the 2004 International Energy Conservation Code, IECC. The mechanism for estimating Energy Star compliance is through the use of a Home Energy Rating System (HERS) score calculated from a brief estimate of annual energy use. The savings proceed principally from heating, cooling, lighting and water heating savings.

Measure Applicability

This measure is applicable to all new residential construction. But for the purposes of this study the measure is restricted to new residential all electric construction, estimated here to be 40 percent of new construction.

Incremental Cost

The incremental cost for this measure consists of the increased cost of building components such as insulation, windows, lighting and appliances. This cost is site specific, and there is some choice in selecting the package of measures. An initial cost effectiveness screening of this measure showed that the maximum cost effective cost is $3,000. This requires composing a package of only the most cost effective measures. Therefore this package includes the strongly cost effective measures of a flow efficient showerheads and inspection and checkout of heat pump that are not commonly part of the Energy Star package (but should be). Based on the choice of the most cost effective measures, the cost used for this study is $3,000.

Average Annual Expected Savings

The savings from this measure are variable depending on the particular site treatment chosen, but estimates for this region are in the range of 3,000-4,500 kWh/yr. For this study, the savings is assumed to be 4,223 kWh/yr.

Expected Useful Life

This measure has a useful life comparable to that of new construction and for this study the life will be taken as 25 years.

Package Detail New Residential Energy Star Plus

Program planning for an assumed package of energy star plus treatments has used a model of a prototypical all electric participant. Using this model the full package of measures is examined to estimate the energy savings for the individual measures in the package.

The energy star new residential achieves energy savings principally through improvements to the building shell and reductions in interior appliance energy use.

As perspective consider an all electric single storey residence of about 1,900 square feet. This residence is heated and cooled by a SEER 13 heat pump which is the current standard.

The Energy Star package consists of three common sense building steps. First the thermal conductivity of the envelope is reduced by small coordinated improvements to the building shell, better glazing, selective increase to insulation levels, and by attention to air sealing and framing details. Then the performance of the heating cooling systems is improved by duct insulation and testing. Finally, the internal energy use is reduced by using efficient lighting, appliances, and showerheads. None of these improvements is extreme, but taken together these small improvements can result in an approximate 20 percent reduction in annual energy use. This is the core of the Energy Star Plus savings.

Another 5 percent reduction in energy use is possible if the residence is oriented to use solar gain to offset winter heating. And a further 5+ percent reduction in energy use can be achieved through the use of a SEER 15 rated heat pump. Another 10 percent savings is possible through the use of solar hot water heating, and another 10 percent reduction is possible by applying a modest solar PV array. These further reductions are all beyond the core Energy Star package, and only the first, the solar siting, is cost effective currently. The further enhancements from a more efficient heat pump and other solar applications are quite reliable and effective, but beyond the current cost effectiveness horizon.

In practice each building is unique, and slightly different packages of improvements to shell and appliances are selected based on specific circumstances, but the savings will break down approximately as in Table 72. In this example the annual energy use for an all electric residence has been reduced from about 19,400 kWh/yr to about 15,600 kWh/yr, about a 20 percent reduction by core energy star measures alone and another 5 percent through solar siting.

Table 72. Energy Star Plus Residential Savings Example

Efficiency Category	Annual Savings, kWh/yr	How Achieved
Shell Improvements	1,600	20% reduction in thermal loss, shell and infiltration
Hot Water improvements	700	2.0 gpm showerhead
Duct Improvements	585	Insulation and leak testing
Efficient Appliances	945	Efficient light, washer, dishwasher, an average 20% reduction in internal loads
Solar Siting	1,050	Enhanced south glazing

The Energy Star Plus package consists of the efficiency measures noted in Table 73.

Table 73. Energy Star Plus Savings Measures

Shell insulation
Duct insulation and leak testing
Three energy star appliance including efficient lighting and an energy star clothes washer
A 2.0 gpm rated shower head(s) and faucet aerators
Whole house air sealing details

In the case of a residence with gas heat and hot water heating, the efficient appliance and cooling savings are the same with the shell and hot water improvements resulting in gas savings.

Eliminate Old Refrigerators (R-26)

This measure involves creating electric energy savings by collecting and dismantling underused older refrigerators. Ideally only operating or operable refrigerators would be eligible for removal.

Measure Applicability

This measure is applicable to the 28 percent of the residential sector that have more than one refrigerator. Of these only 50 percent are assumed to have an interest in removing a refrigerator. For this study the applicability will be taken as 14 percent of the residential sector.

Incremental Cost

The incremental cost of this measure will be taken as the cost of acquiring and recycling the unit. For this study that cost will be assumed to be $165.

Average Annual Expected Savings

Savings from this measure are dependent on the age of the refrigerator and the location where it is used. Savings estimates for this measure also need to include the zero effects of including operable but not operating refrigerators. Reported savings estimates vary widely from an astonishing 1,900 kWh/yr for C&RD to 413 kWh/yr observed in the Connecticut Appliance Turn-In program. For this program, the savings will be assumed to take the middle road, 1,150 kWh/yr.

Expected Useful Life

The useful life of this measure is the length of time the removed refrigerator would have continued to be used absent the program. There is no reliable research on this and for this program the useful life will be taken as 5 years.

HVAC Set Back (R-27)

This measure is a voluntary set back of both the heating and cooling set points by 3 deg F. This is the average set back for the whole day not just the night set back. This type of set back could lead to slight behavior changes such as different clothing when lounging around or sedentary. The heating and cooling savings from such a simple change can be large, of the order of 2,000 kWh/yr. The savings will be greatest in houses heated by resistance heat, but they will be significant in heat pump houses as well.

Measure Applicability

This measure is applicable throughout the residential sector. But the greatest savings will be where the measure is applied to electrically heated homes which are 23 percent of the residential sector.

Incremental Cost

This measure has essentially no cost. As a token cost here we assume $5.

Average Annual Expected Savings

The savings for this measure depend strongly on the amount of set back and the heating type. Based on I&M specific weather, low savings would be about 500 kWh/yr for a mild set back to a good heat pump, and high savings would be about 2,000 kWh/yr for a five degree set back to an electric furnace. For this study we will take 1,000 kWh/yr as the savings.

Expected Useful Life

This is a temporary measure. The set back strategy may only work for one or two seasons. Accordingly the useful life is taken as 2 years.

Energy Star Clothes Washers (R-28)

This measure involves obtaining an Energy Star clothes washer which is a more efficient clothes washer than a standard clothes washer. This measure has significant water and detergent savings in addition to the electric savings. According to the Environmental Protection Agency, horizontal-axis washing machines can use about 40 percent less water and 50 percent less energy than conventional washers, cause less wear and tear on clothes, and can accommodate large items that won't fit in a top-loader. A typical top-loading washer uses about 40 gallons of water per full load. In contrast, a full-size horizontal axis clothes washer uses between 20 and 25 gallons.

Measure Applicability

This program applies only to customers who have electric water heaters, electric dryers, and who have no high efficiency clothes washer. This applies to 40 percent of I&M customers.

Incremental Cost

The incremental cost for clothes washers vary significantly depending on the features. The value used in this analysis is $400; DEER uses a value of $565.82 and the C&RD lists a value of $245.26. Due to the wide variety of costs for Energy Star clothes washers $400 is a good mid-range value for the purposes of this analysis.

Average Annual Expected Savings

The kWh savings from a clothes washer depend to a significant extent on the source of the water heating and dryer's energy source. If the water heater is a gas water heater the kWh savings are insignificant but if the source is an electric water heater the savings can be substantial. Savings also depend on whether the clothes washer has a built in heat source which some do have. This analysis used 400 kWh. DEER lists 199 kWh and C&RD lists a range from 54 kWh to 509 kWh depending on the model chosen. Savings will be assumed to be 400 kWh because the program will be limited to customers with electric water heat and electric dryers.

Expected Useful Life

The expected useful life used in the analysis is 18 years; however, both DEER and C&RD use 14 years.

Energy Star Dishwashers (R-29)

This measure is defined as the purchase of a new Energy Star dishwasher. By definition Energy Star dishwashers are more efficient than a comparable standard new dishwasher. This measure applies strictly to the improved level of performance, Energy Star versus Standard. An Energy Star qualified dishwashers uses at least 41 percent less energy than the federal minimum standard for energy consumption, which was set in 1994. In this measure the dishwasher being replaced has an EF of 0.46 and is being replaced by a 0.58 EF dishwasher, and has an average usage of 215 washes.

Measure Applicability

The I&M market survey does not address Energy Star dishwashers. For this study, we will take the applicability of these units to be 60 percent of the existing residential sector and all of the new residential sector. In fact, Energy Star dishwashers are a required item in Energy Star new construction.

Incremental Cost

The incremental retail cost for dishwashers, varies depending on the features present in the model chosen. DEER uses a value of $133 and the C&RD lists $6 as the incremental cost; this analysis has incorporated an intermediate value of $50.

Average Annual Expected Savings

The savings from this measure are primarily due to decreased hot water usage. The C&RD lists 119 kWh/yr and DEER lists 72 kWh/yr. This analysis uses 75 kWh per year.

Expected Useful Life

The expected useful life used in the analysis is 10 years. However DEER lists 13 years and C&RD lists 9 years.

Energy Star Refrigerators (R-30)

This measure is defined as the purchase of a new Energy Star refrigerator which is slightly more efficient than a comparable standard new refrigerator. This measure applies strictly to the improved level of performance, Energy Star versus Standard.

It should be noted here that this measure definition will under-count the real savings because the current stock of new refrigerators is much more efficient than the older stock more than 10 years old, and significant savings will result when an old refrigerator is replaced by a new one, even a non-Energy Star one. These savings are a natural part of the background residential usage changes in response to the current standard market and are considered savings that would have happened absent any particular measure. For this particular measure, the measure savings used in program cost effectiveness are only for the Energy Star increment, but the technical potential estimate inherently captures the full replacement savings.

Measure Applicability

This measure is assumed to apply to 90 percent of the residential sector, essentially all of the residential sector for which an Energy Star model is available.

Incremental Cost

The incremental retail cost for refrigerators, vary significantly depending on the features present in the model chosen. The value used in this analysis is $200, DEER uses a value of $135.75 and the C&RD does not list a value due to the variability in the possible costs. Due to the wide variety of costs for Energy Star refrigerator, $200 is a good mid-range value for the purposes of this analysis.

Average Annual Expected Savings

Savings vary by type of refrigerator/freezer configuration and by size. The range is 80-100 kWh/yr. Savings for this analysis will be taken as 100 kWh/yr. These savings are relative to the energy use of a new but non-Energy Star refrigerator. In fact a significant portion of the new refrigerator purchases are to replace old refrigerators, and even a non-Energy Star refrigerator will save about 300 kWh/yr relative to the old refrigerator it replaces.

Expected Useful Life

The expected useful life used in the analysis is 18 years and both DEER and C&RD also use 18 years.

Pool Pumps (R-31)

This measure saves energy by employing a two speed pool pump motor. At the lower speed the pump is still doing a good job of filtering, but it uses about 75 percent less energy. This is typical of the savings from slowing down pumps or fans. While these savings are significant it should be noted that the slower pumping rate can adversely affect pool accessories such as a solar pool heater.

Measure Applicability

This measure is applicable to in ground pools only and is expected to be applicable in less than 5 percent of the residential sector.

Incremental Cost

The incremental cost for this measure consists of the increased cost of a 2 speed pump, ($180) and the increased labor to install it. In a retrofit case the labor is of the order of $300, but in a new installation there is no increased labor. For this study we will take $180 as the incremental cost.

Average Annual Expected Savings

The savings from this measure depend on the degree of flow reduction and the number of hours of reduced flow. A typical power reduction to be expected is 500 watts, and in a full season the duration of reduced flow is 1,000-1,500 hours. For this study we will take the annual savings as 648 kWh/yr.

Expected Useful Life

The expected useful life of this measure is assumed to be 10 years.

Compact Fluorescent (R-32)

This measure consists of substituting compact fluorescent lighting for incandescent lighting. At each socket treated, such a substitution will reduce lighting power by about 80 percent. A full application of this measure consists of converting all the most used lighting fixtures from incandescent to compact fluorescent. Housing audits taken over the last 10 years show that an average house has about 25-45 lighting sockets with an aggregate connected incandescent lighting load of about 2,700 watts. But of this load, only about 10-15 sockets are used for about an average of 5 hours/day, the rest are infrequently used. So it is the ten-fifteen most frequently used sockets that are the primary targets for a whole house lighting conversion. A satisfactory conversion of these most important sockets may require recourse to a variety of bulb styles, powers, and even adapters (such as lamp harps) to facilitate accommodating the CFL to these ten best locations.

Measure Applicability

This measure is applicable in 100 percent of residential sector, but to allow for some existing use of compact fluorescents this study will use 95 percent as the applicability factor for this measure.

Incremental Cost

The cost for this technology continues to decrease, and there are various sales or promotions where the cost may be as low as $1.50/bulb. But for the purpose of this program planning we will assume $2.00/average bulb to cover the costs of larger or outdoor rated bulbs, and another $5.00/bulb for installation or adaptation labor. Full application of this measure, assuming treatment of the 12 most important fixtures in a residence is taken here as costing $24. The C&RD lists $5.73 for the incremental cost and the DEER lists $8.03 for the incremental installed cost, but these sources are out of date.

Average Annual Expected Savings

It is assumed here that the fifteen treated sockets reduce the connected load by 750 watts, and that the average on time for these sockets is 3 hours/day, leading to energy savings of 2.25 kWh/day. This equates to 55 kWh/yr/bulb. The savings listed in DEER range from 20 to 59 kWh/yr/bulb, depending on which CFL is replacing which incandescent bulb. For these purposes the various applications of this measure are assumed to save 55 kWh/yr per bulb, and a total of 660 kWh/yr for replacing 12 bulbs at a single site.

Expected Useful Life

Compact fluorescent bulbs have a life time of 10,000 hours, about 7-10 times as long as the incandescent bulbs they replace. Assuming the average compact fluorescent bulb is used 2,000 hours/yr (5-plus hours/day) gives a conservative estimate of useful life of 5 years. The useful life for the energy savings from this measure will cease in the time frame of 2015-2020 as the new federal lighting standards diffuse into the market.

Special Note

The United States (and many other countries, including China and Australia) is phasing out inefficient bulbs. The US law (Clean Energy Act of 2007) holds that all light bulbs must be 25% to 35% more efficient by 2012 to 2014. Certain bulbs are excluded (those lower than 40 Watts and those over 150 Watts, also specialty lights, appliance lamps, "rough service" bulbs, three-way bulbs, colored lamps, and plant lights). This means that, unless there is significant consumer backlash, traditional 60 Watt and 100 Watt incandescent bulbs will no longer be available, unless the underground economy expands to meet preferences of customers who do not desire to make the change. Also, as we approach the years 2012 through 2014, government pro-CFL promotion, along with promotions by big box stores, advocacy by environmental groups, and climate change organizations, as well as some religious organizations will encourage reliance on CFLs. From a "reasons analysis" perspective, it is likely that people will, more and more say they would have purchased CFLs in the absence of a utility program, or that the percentage of influence of the utility program on their decisions to purchase CFLS will be radically declining. At the same time, just because a law has been put into place does not mean that it is enforceable (for example, some states have progressive building standards, but they are not reflected in current practice). The time will come for utilities to withdraw from the CFL area, at least for 60 Watt and 100 Watt bulbs. We recommend that the CFL programs be continued until it is clear that there is general public acceptance of CFLS, through 2017. However, we suggest that I&M discuss with the Commission a modification of the TRC test for CFLs to emphasize gross energy savings rather than net energy savings (the focus here is on removing the "free rider" label from customers who are jointly influenced). This negotiation is necessary due to the joint influence on purchasing decisions which will become complex as 2012 approaches. If the Commission is unable to agree to move towards gross savings 60 Watt and 100 Watt CFLS, I&M should evaluate the financial risk and terminate the CFL effort earlier.

Daylighting Design (R-33)

This measure is intended to reduce the lighting energy in new residential construction. Daylight has the highest lumens/watt of any light source. A little bit of daylight can go a long way toward lighting a space without introducing as much heat as other light sources. Physically daylighting takes the form of small skylights or clearstories, and high small windows coordinated with light colored interior wall and ceiling surfaces. In practice, good daylighting design involves the avoidance of glare and over lighting as well.

Measure Applicability

This measure is applicable to 100 percent of the residential new construction.

Incremental Cost

This measure is being applied in new residential construction where lighting is a natural consequence of window placement. In this context daylighting design is considered in the distribution of the windows and skylights to make light distribution more uniform and to avoid glare. These design impacts will have minimal cost if they are brought in at the planning stage. For this study the incremental cost is assumed to be $500.

Average Annual Expected Savings

Properly designed daylighting can save almost all the lighting energy used during daylight hours, but not all residences are used during the day. The I&M market assessment shows about 1,800 kWh/yr for lighting in the average residence. The savings will wary widely from site-to-site, but for this study we will take about 40 percent lighting savings, 750 kWh/yr.

Expected Useful Life

Daylighting features integrated into a house during construction will last the life of the house. For these purposes the lifetime will be taken as 25 years.

Occupancy Controlled Outdoor Lighting (R-34)

This measure is designed to save lighting energy by turning on selected outdoor lighting only when occupancy or movement is detected. This measure has a strong security context, but it also is very convenient at entrances, garages, etc, where light switches can only be accessed from inside and lighting is left on for long periods of time in order to provide light for the short time it is actually needed.

Measure Applicability

This measure is applicable through out the existing residential stock.

Incremental Cost

This measure physically involves replacing three frequently used outdoor lights by occupancy controlled lights. It is assumed that a single occupancy controller and light costs $50, and that a full installation consisting of two lights would cost $100.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the type of light that is being controlled. The preferred type of light to control is a compact fluorescent spot light because of its lower power use and long life. But in colder outdoor applications these lights can take from 30 seconds to a minute to come to full brightness which may be unacceptable in some cases. For this analysis, we will assume that 150 watts is being controlled, and that a savings of 5 hours/day is achieved. Annual savings for these purposes is taken as 250 kWh/yr.

Expected Useful Life

For the purposes of this analysis, we will take 10 years as the useful life of this measure.

Tank Wrap, Pipe Wrap, and Water Temperature Setpoint (R-35)

This technology consists of adding insulation around the water heater, checking and resetting the tank thermostat, and replacing leaky shower flow diverters. These measures are principally tank-centric, and can be self installed or by a site visit if the package is part of a broader program. Resetting the tank thermostat is also a safety issue because it can reduce scaling and burns due to too high a set temperature.

Measure Applicability

The applicability for measures of this type is discussed under low flow fixtures. In I&M service territory electric water heat accounts for about 40 percent of water heating, 2/3 of that 40 percent would be eligible for this measure because in some cases the tank cannot be accessed to install a blanket or one has already been installed. As a result the applicability is taken as 25 percent.

Incremental Cost

The cost of this treatment breaks down as $30 for materials and $20 for installation labor. For these purposes the measure cost is taken as $50 because these measures will typically be part of a larger program.

Average Annual Expected Savings

The dwelling savings for these measures is discussed under low flow fixtures. Based on prior experience and evaluation work on other programs it is estimated that the savings would be about 1 kWh per day.[57] For this program we have used the conservative value of 200 kWh/yr savings.

Expected Useful Life

The lifetime of these measures is potentially quite long. For practical purposes the lifetime will be considered limited by the expected lifetime of the hot water tank, 10 years.[58]

Low Flow Fixtures (R-36)

This technology consists of a new showerhead rated at 2.0 gallons per minute (gpm) at 80 pounds per square inch (psi) and a swivel aerator for the kitchen faucet and fixed aerators for the lavatory faucets. The current US standard for showerheads is 2.5 gpm. Measurements of the existing shower flows in building stock show a range of 2.75 gpm to 3.75 gpm with frequent individual cases in excess of 5 gpm. Evaluations have shown that programs that replace with 2.0 gpm heads have greater savings than programs that replace with the standard 2.5 gpm shower heads. Program shower heads should be 2.0 gpm at 80 psi and with a lifetime scaling and clogging warranty. It is important also to be cautions about the use of "pressure compensating" showerheads. These are more prone to clogging and can lead to unintentional increases in flow rate in low pressure situations such as well water systems or older systems with occluded piping. Customer acceptability is an important component in a showerhead program. Customers will remove new low flow showerheads if the quality of the showering experience declines with the new showerhead. Therefore it is important to research and test the showerhead chosen for the program carefully. In addition, the old showerhead must be removed from the premises to decrease the likelihood of having it reinstalled.

Measure Applicability

This measure is applicable to the 40 percent of the residential sector that heat water with electricity.

Incremental Cost

Low flow fixture costs vary widely, and depend on whether the fixtures are purchased retail or in bulk. The costs for a bulk purchase for a showerhead and three aerators also have a wide range, about $8.00-$15.00/set. The most important feature of these fixtures is the long-term acceptability and durability because these factors have a direct impact on the lifetime savings. With a long enough lifetime, this is such a cost effective measure that all prices in the range are quite cost effective. Because the cost of the showerhead varies significantly and quality is so important for this program, it is essential to test, choose and pay the price for a high quality showerhead. This measure is so cost effective that even with a more expensive showerhead the program will still remain cost effective and a quality showerhead will ensure measure persistence. The per-unit-installed cost will be taken as $25/residence.[59]

Average Annual Expected Savings

Field monitoring studies can demonstrate the flow savings, but ultimately the overall savings will be a combination of flow savings and the duration of use. The flow of the showerhead used has a significant impact on savings. This program is designed around a 2.0 gpm showerhead as compared to a 2.5 gpm showerhead. Therefore the savings will be more than the 120–133 kWh per unit listed in DEER. In addition the climate is different and the inlet water

[57] Khawaja S. PhD, and Reichmuth, H. PE., 1997. Impact Evaluation of PacifiCorp's Ebcons Multifamily Program. Pacificorp.

[58] DEER says 15 years for pipe insulation, 9 years for faucet aerators, and 15 years for an efficient water heater so 10 years is conservative. The C&RD lists 10 years for a water heater with a minimum warranty of 10 years.

[59] The DEER Database lists measure costs as $22.946 per unit and $37.946 installed cost

temperature is lower so the savings in this I&M program will be greater. Several studies have measured final savings in terms of electric input to the tank, but usually these studies have included savings from comprehensive treatments including other measures including tank and pipe insulation, kitchen and bath lavatory aerators, tank thermostat set back, and leaky diverter replacement. Savings can very from program to program depending strongly on the choice of showerhead. Savings can also diminish with "takeback" in the event that the new showering experience is longer than the original. Actual savings observed in the comprehensive cases include these takeback effects, and are in the range of 650 kWh/yr to 950 kWh/yr. The savings from a showerhead and aerator change alone are taken as 500 kWh/yr.

Expected Useful Life

The life time of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. For these purposes that lifetime is taken as 10 years.[60] Normally showerheads will last longer but with renovations and changes in ownership a 10 year EUL is a good planning number.

Heat Pump Water Heaters (R-37)

Water heating is one of the largest energy uses in the home. In the case of electrically heated water, the annual water heating energy is about 4800 kWh/yr. The heat pump water heater is essentially a small heat pump drawing heat from the air by cooling and de-humidifying it and injecting this heat into a storage tank. Physically, this measure consists of a small self contained heat pump and a water storage tank and associated pumps and controls.

Measure Applicability

This measure is applicable to the 40 percent of the residential sector with electric water heat. Of these, 50 percent are assumed to have a suitable location for the unit. Overall measure applicability is assumed to be 20 percent of the residential sector.

Incremental Cost

The incremental cost of this measure consists of the cost of the heat pump water heater, water storage tank and installation plumbing and general construction labor. The siting of such a unit is important; it should never be sited in an attic and freezing situations should also be avoided. Therefore, some special site adaptation and plumbing may be necessary. For this study we will take $2,500 as the cost; others report lower costs but we do not think these take adequate account of special site costs.

Average Annual Expected Savings

For this study it is assumed that the heat pump water heater will perform with a coefficient of performance of 2, leading to annual savings of 2,000 kWh/yr.

Expected Useful Life

The useful life of this measure is assumed to be that of a similar appliance, a window air conditioner, 18 years.

Tankless Water Heaters (R-38)

Water heating is one of the largest energy uses in the home. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. This measure saves energy by eliminating the standby energy losses attributable to a hot water storage tank. However these relatively small energy savings are at the cost of a significant demand increase. In the case of gas water heating, this type of measure has greater energy savings and no troublesome demand savings, and the measure makes sense. In the context of a switch from an electric tank to an electric tankless heater, this measure makes no sense.

[60] DEER Database, 2005

Measure Applicability

This measure is applicable in the residential sector only where space is a premium.

Incremental Cost

The incremental installed cost for this measure is $1,500.

Average Annual Expected Savings

The expected savings are 400 kWh per year. But it should be recognized that this type of appliance has a negative demand impact.

Expected Useful Life

This measure's expected useful life is 18 years.

Solar Water Heaters (R-39)

Water heating is one of the largest energy uses in the home. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. Countless demonstration cases have shown that solar energy can supply all or a portion of this heating. The portion of the water heating load assumed by a solar water heater depends on the size of the solar water heater in relation to the size of the load. Field experience has shown that the best combination of system size to load favors the more moderately sized systems that can fully meet the summer water heat load, but that only meet about 40-50 percent of the non summer load. In physical terms, this is a system consisting of about 40-65 square feet of solar collector and an additional 80 gallon heated water storage tank and appropriate pumps and controls.

Measure Applicability

This measure is intended to apply to the 40 percent of residential customers with electrically heated hot water. Of these electric hot water customers, only 50 percent are assumed to have an adequate solar exposure and an adequate roof mounting site. Overall measure applicability is assumed to be 20 percent of the residential sector.

Incremental Cost

The installation of a solar water heating system involves a mix of building skills including plumbing, electrical, roofing and general carpentry. In the general market, a turn key installation for one of these systems is in the range of $5,000 to $7,000. For this study we will take the cost to be $6,000.

Average Annual Expected Savings

The savings from solar water heaters depend on site specifics, principally solar radiation, air temperature, incoming water temperature, and hot water usage rate. Considering these dependencies for the I&M service area, leads to average annual savings for an appropriately sized system of 2,600 kWh/yr.

Expected Useful Life

Solar water heating systems are essentially plumbing fixtures that are certified products (SRCC) and are often inspected by local building officials. A well designed system will have a lifetime in excess of 25 years, even though the system will take some intermediate maintenance such as inspecting the pump and fluid level. This study will take 25 years as the useful life.

Efficient Plumbing (R-40)

This measure saves hot water heating energy by leaving less hot water in the pipes to cool during periods of non-use. Conspicuously, the primary motive for this measure is the amenity benefit of limiting the waiting time for usable hot water at the tap or showerhead; waiting times can be reduced from a significant fraction of a minute to only a few seconds. Physically this measure involves the use of smaller diameter continuous PEX water pipes with no elbows or Tees and the use of carefully sized pipe manifolds. While this measure is tested and viable it involves the use of small diameter piping in a context that is not familiar to the plumbing trade or to building officials. It is therefore considered an emerging technology and will not be included in program recommendations.

Measure Applicability

This measure is applicable to 100 percent of the residential new construction.

Incremental Cost

In large scale use, this measure offers the possibility of actually lowering the cost of hot water plumbing because smaller diameter less expensive pipe is used. But specialized manifolds and system planning are required. Therefore for this study an incremental cost of $500 is assumed.

Average Annual Expected Savings

The savings from this measure have not been widely measured but savings of 10 percent of the hot water end use are reasonable. For this analysis, savings is assumed to be 500 kWh/yr.

Expected Useful Life

This is a very long-lived measure and an expected useful life of 25 years can be assumed.

Sources

DEER: 2004-05 Database for Energy Efficient Resources (DEER) Version 2.01 October 26, 2005 developed by the California Public Utility Commission and the California Energy Commission.

C&RD: Northwest Power and Conservation Council's Conservation Resource Comments Database, which is continually updated as new information becomes available.

APPENDIX D. NON-RESIDENTIAL EEM DOCUMENTATION

The purpose of this appendix is to provide documentation of the assumptions used to screen the Commercial Energy Efficiency Measures identified for consideration in this report. Our assumptions are based on references cited throughout this section as well as the direct experience of our team with technologies in the field and actual DSM program evaluations. While not all of the field and DSM program experience can be cited in published works, published references are used to establish a reasonable range of assumptions. The point estimate used within that range is based on our professional opinion. The mapping of EEM to non-residential DSM programs is shown in the table below by the value listed in each cell. The value represents the percentage of participants installing the measure. Cells with no value mean the measure is not included in the program.

Table 74. Mapping of EEM to Non-Residential Energy Efficiency Programs

Program #			**5**	**6**	**7**	**8**	**9**
End Uses	**EEM Description**	**EEM Ref #**	**C&I Rebates**	**C&I Retro-Com Lite**	**C&I HVAC Opt**	**C&I Audit**	**C&I New Constr**
1. Customer-Sited Generation	Solar Photovoltaic	C-1					
2. C&I Space Conditioning	Small HVAC Optimization and Repair	C-2			1.00		
	Commissioning - New	C-3					
	Re/Retro-Commissioning Lite	C-4		1.00			
	Low-e Windows 1500 ft2 New	C-5					
	Low-e Windows 1500 ft2 Replace	C-6					
	Premium New HVAC Equipment	C-7					
	Large HVAC Optimization and Repair	C-8					
5. Design (new)	Integrated Building Design (new)	C-9					1.00
	Efficient Package Refrigeration (new)	C-10	0.02				
6. Motors and Drives	Electrically Commutated Motors	C-11	0.03				
	Premium Motors	C-12	0.03				
	Variable Speed Drives, Controls and Motor Applications Tune-Up	C-13					
7. Power Distribution	Energy Star Transformers (new)	C-14	0.01				
	Efficient AC/DC Power	C-15					
8. Data Processing	Network Computer Power Management	C-16					
9. Lighting	New Efficient Lighting Equipment	C-17	0.05				
	Retrofit Efficient Lighting Equipment	C-18	0.80				
	LED Exit Signs	C-19	0.25				
	LED Traffic Lights (10)	C-20	0.03				
	Perimeter Daylighting	C-21					
10. Water Heating	Low Flow Fixtures	C-22					
	Solar Water Heaters	C-23					
	Heat Pump Water Heaters	C-24					
11. Cooking and Laundry	Energy Star Hot Food Holding Cabinet	C-25					
	Energy Star Electric Steam Cooker	C-26					
	Pre-Rinse Spray Wash	C-27					
	Restaurant Commissioning Audit	C-28				0.80	
12. Refrigeration	Grocery Refrigeration Tune-Up and Improvements	C-29				0.20	
	Refrigeration Casework Improvements	C-30				0.20	
13. Other	VendingMiser®	C-31	0.05				

Solar Photovoltaic (C-1)

This technology consists of a roof or ground mounted solar electric array with a full sun output of 40 kW. Such an array has an area of 4,000-6,000 square feet. Electricity from the array is converted to AC by an inverter and the power is immediately used on site with excess fed into the grid. This technology needs full solar exposure and shadows can significantly restrict output. In the commercial context, this technology can be an architectural enhancement.

Measure Applicability

This measure is applicable wherever there is sufficient space and solar exposure. For this study we assume applicability to 25 percent of large buildings.

Incremental Cost

A system installation usually requires an electrical inspection to verify appropriate wire sizing, disconnects, and grounding. Costs are quite site-specific, with most of the costs associated with the solar electric panels. In the current supply constrained 2007 market, costs are $5.00-$7.00/watt peak for the solar cells alone. Installation and balance of system can be expected to add $3.00/watt. For the 11 kW array considered here the total cost will be taken as $90,000[61], or $8.25/watt.

Average Annual Expected Savings

The electrical output for this technology is directly related to the solar intensity. Monitoring studies in this region of the US have shown that 1 kW of installed capacity can yield in excess of 1,100 kWh/yr. For the 11 kW array considered here the annual savings will be taken as 12,000 kWh/yr.

Expected Useful Life

This equipment demonstrated long trouble free service in severe applications such as remote communications, navigation lighting, and road signage. The long-term output of the cells is assumed to decrease with time, but the rate of decrease for current technology is not known. The crystalline and semi-crystalline forms of the technology have already demonstrated degradation of less than 20 percent in 20 years. But earlier thin film forms of the technology have shown shorter lifetimes. The lifetime of new thin film technologies is expected to be of the order of 25 years but it is not known. For these purposes the lifetime is taken as 25 years.[62]

Small HVAC Optimization and Repair (C-2)

This measure applies to packaged rooftop units. These units are the predominant means of conditioning for small to medium scale commercial buildings. The savings proceed from improved compressor performance, better run time control, and fresh air cooling. These rooftop units are a homogenous pool of equipment that has been identified as underperforming. Typically, the refrigerant charge is out of specification, the economizers perform poorly if at all, and the airflow is too low for proper operation. Many utilities are offering programs employing a structured diagnosis and repair protocol, SCE, PG&E, National Grid. Often these programs use trade named processes such as Proctor Engineering “check me”, or PECI “aircare plus” etc. Candidates for this measure are roof top units found in a wide range of sizes with output capacities of from 4 tons to 50 tons with the most predominant capacity being 5 tons.

Measure Applicability

This measure is applicable in 70 percent of the large building commercial sector.

[61] The C&RD Database lists the incremental capital cost as $6,000 per kW, which would be comparable for an installed 2 kW system.
[62] The Conservation and Renewables Database lists a measure life of 20 years for standard technology solar PV.

Incremental Cost

The cost for this technology includes site visits and diagnostics with simple repairs performed immediately without need for a second site visit. The costs will naturally vary with the specifics of the repair. Planning estimates for this diverse mix of treatments, made by the Northwest Power and Conservation Council (NWPCC), use $0.20/first year kWh savings. In the average large commercial building considered here, the cost will be $1,137/site treated.

Average Annual Expected Savings

Savings vary from unit to unit, but in the cases where there have been significant corrections to the refrigerant charge or to economizer operation savings on the order of 2,500 kWh/unit have been observed. In the average commercial large building considered here, we will assume 5,617 kWh/yr as the whole building savings where 2-3 units have been improved.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited. The effective life of this measure is taken as 5 years.

Commissioning New and Re/Retro (C-3, C-4)

Commissioning is a systematic step by step process of identifying and correcting problems and ensuring system functionality. Commissioning seeks first to verify that the system design intent is properly executed, and it goes further by comparing actual building energy performance to appropriate bench marks to validate building performance as a whole. The best candidates for this measure are buildings larger than about 100,000 square feet. While commissioning in general can become quite complex, often the greatest savings proceed from a simple review of building operations to assure that the building is not being unnecessarily used during non-occupied times.

New commissioning (C-3) should be done as part of the construction contract, and most contractors will claim that this is normal business. But the performance of even new buildings is often erratic for a year or two while unnoticed problems come to light. This new commissioning is a detailed process of initial calibration and control sequence testing or verification. The initial process is usually not done well, but even so, the initial commissioning is inherently limited because usually it takes about a year of building operation to see how the building actually operates as a whole. By contrast, re/retro-commissioning (C-4) seeks to tune a building that is already operating and has a track record of a year or two at least. The retro-commissioning process starts with an analysis of the utility bills for all fuels, which to a trained eye will show the larger general operational problems which are then followed up with a limited scope site visit. Retro-commissioning is usually necessary even for buildings that have been initially commissioned. There will be the occasional building which after years of operation will have its controls so mixed up that it will need a comprehensive new commissioning. In practice the new commissioning is the larger more complicated job, while retro-commissioning is more superficial and focused on finding and fixing major problems only.

Measure Applicability

In this analysis, new commissioning is assumed to take place on 100% of new commercial stock as a matter of proper business. Re/retro-commissioning is applicable in 75% of the existing commercial sector, and after a few years, to all of the new commercial buildings.

Incremental Cost

The cost for this technology is quite site-specific, based on NWPCC estimates new commissioning costs about $0.37/kWh/yr, which for a typical large commercial building of 100,000 sqft would be about $37,000. For this study, we are assuming a brief version of retrofit commissioning, re/retro-commissioning (commissioning lite), that prescreens buildings on the basis of billing data and follows it with a site visit. This lighter commissioning is assumed to cost $4,000/site. In this analysis, all program-related commissioning is the re/retro-commissioning and the new commissioning is assumed to be part of the construction process.

Average Annual Expected Savings

Savings from this measure can vary widely. For new commissioning, it is assumed here that the building electric energy use can be reduced by on average 20%, leading to energy savings of 40,630 kWh/yr for an average large commercial building. For retro commissioning, electric savings of 20,315 kWh/yr for the average large building are assumed. A significant portion of the energy savings due to both of these measures is associated with the heating fuel, usually gas. In estimates of program cost effectiveness for electric utilities are usually not valued which often underrates the cost effectiveness of this measure.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited. The effective life of this measure is taken as 5 years.

Low E Windows New and Replace (C-5, C-6)

This measure saves energy by reducing the thermal losses and gains through windows. This measure assumes that the efficient window has a heat loss rate of 0.45 BTU/deg F hr, representing the performance of a quality, double glazed argon filled low E window. The original window is assumed to have a heat loss rate of 0.75 BTU/deg F hr, representing the average losses from a mix of single and double glazed windows.

Measure Applicability

This measure is applicable in 100 percent of new commercial buildings and 30 percent of existing commercial stock.

Incremental Cost

The incremental cost for this technology depends strongly on the context of use. If the efficient windows are used in a replacement context, then the full cost of $20/sqft is applicable which leads to a total cost of $30,000 for the average building considered here. But if the efficient windows are used as an upgrade in new construction then an incremental cost of only $3.00/sqft is used, leading to a total cost of $4,500 for the average building in this study.

Average Annual Expected Savings

It is assumed here based on I&M specific simulations that 1500 square feet of high efficiency windows will have savings of 14,979 kWh/yr for an electrically heated building.

Expected Useful Life

This is a very long lived measure with an assumed life of 25 years.

Premium New HVAC Equipment (C-7)

Premium new HVAC equipment employs more efficient motors/pumps and larger heat exchangers and pipes to lower operating energy requirements. Premium equipment is often designated with and energy star rating or by CEE as tier I or tier II, or it may not have an official rating, but it does deliver slightly improved performance and is usually sold as such. Premium HVAC equipment is a very broad category including efficient variable speed fans, and efficient chillers, efficient ice makers, and efficient packaged roof top units. It should be noted that rooftop units serve more than half the commercial space, and they have therefore been the subject of an ongoing efficiency improvement campaign by CEE and the industry.

Measure Applicability

This measure is applicable in 100 percent of new commercial construction.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.46/kWh/yr. For the average building considered here that cost would be $2,603/site.

Average Annual Expected Savings

Savings attributable to this measure are generally fairly small because they represent only an incremental improvement in performance on equipment that is already required to be reasonably efficient. It is assumed here that the savings in new construction will be 3 percent of total energy use, in the average building considered here that is 5,617 kWh/yr.

Expected Useful Life

The premium upgrades can be expected to last the life of the equipment, taken here as 15 years.

Large HVAC Optimization and Repair (C-8)

This measure refers to restoring large HVAC equipment to its nominal operating performance. This measure needs to be distinguished from commissioning which is used to refine the controls of large HVAC which generally leads to large savings. By contrast this measure applies to the operation of the equipment and includes chiller and condensing tower cleaning, filter maintenance and tune-up etc. It also includes the optimization of economizer operation by verifying that the enthalpy sensors and economizer controls are functioning properly.

Measure Applicability

This measure is applicable in 20 percent of the commercial sector with large HVAC systems.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.34/kWh/yr. For the average building considered here that cost would be $3,201/site.

Average Annual Expected Savings

Savings attributable to this measure are generally fairly small because they claim only the savings due to restoring equipment to its original operation. For this study these savings are assumed to be 3 percent of building energy use. On the average building, this will be 9,362 kWh/yr.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited. The effective life of this measure is taken as 5 years.

Integrated Building Design (C-9)

This measure applies to new construction where careful design and specific engineering can get beyond the rules of thumb, leading to the use of smaller equipment more carefully matched to load. Integrated design refers to an approach commonly used to design energy efficient new commercial buildings. Essentially, the design process lowers building loads, then carefully matches HVAC equipment to the lowered load. In practice the most significant characteristic of efficient new commercial buildings is significantly reduced lighting loads and often reduced plug loads. The other important characteristic is enhanced building shell performance through improved insulation and solar shading. Taken together these improvements result in significantly altered heating and cooling loads. Typically, the cooling loads will be significantly reduced, while the changes to the heating loads are more complex. The reduced internal gain from lighting etc will actually increase the gross heating loads, which the shell improvements may reduce somewhat through insulation or solar gain.

The altered heating and cooling loads will usually not conform to established equipment sizing rules of thumb, which generally result in oversized equipment. A primary objective in integrated design is to down size the equipment leading to more efficient operation, and often leading to installation cost savings. It is notable that the shell improvements will usually result in more stable and comfortable interior wall and glazing surface temperatures that permit alternative and reduced means of heating and cooling distribution which can lead in turn to reduced fan or pump energy, leading to significantly more efficient heating and cooling distribution strategies. This reduction in distribution can also result in reduced installation costs. The integrated design process usually employs building modeling, but as more efficient new commercial building experience develops, a few basic strategies are emerging which can be used without recourse to costly building modeling. (cf New Buildings Institute, Core Performance Guide).

Measure Applicability

This measure is applicable in 100 percent of new commercial construction, but in national chain or franchise designs, the integrated design may already have been done at the corporate level, or getting to a level of integrated design may require interaction at the corporate design level that may not be possible at the local level.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. The incremental costs of efficient new commercial buildings developed through integrated design are quite building specific, and may range widely from about $3.50/square foot to negative incremental cost. But in general, the incremental cost will be the net of some increased costs for various building elements (such as lighting, external shading elements, insulation, more efficient equipment, more sophisticated controls and etc), and some decreased costs resulting from reduced equipment sizes and simplified distribution strategies. There are examples of highly efficient new commercial buildings that have negative incremental costs, but a good rule of thumb is to assume that the incremental cost will be of the order of $1.75/square foot, or about $0.35/first year kWh saved.

The particular incremental cost for a real building could be quite complex to estimate. Therefore in-order to minimize overhead, utility programs that provide incentives for integrated design will base the incentives on modeled and deemed per square foot estimates of energy savings for principal occupancy types (retail, schools, offices etc) for various HVAC systems and measure packages.

Based on NWPCC estimates, the premium upgrade costs about $0.34/kWh/yr. For the average building considered here that cost would be $8,932/site.

Average Annual Expected Savings

The savings due to integrated design will include the savings due to efficient lighting, efficient HVAC equipment, and controls. Taken as a package these savings can easily be on the order of 20-40 percent of the standard code compliant design. The current US tax code allows preferred treatment for new buildings that are 50 percent better than code or lighting systems that are 30 percent better than code. For this analysis we consider 20 percent better than code to be an achievable and significant goal. For the average building considered here the savings are taken to be 26,365 kWh/yr.

Expected Useful Life

Integrated design can be expected to last the life of the building, taken here as 25 years.

Efficient Package Refrigeration (C-10)

This measure consists of an efficient packaged and optimized new refrigeration system.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants. The applicability is estimated here to be 4 percent of the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the efficient packaged refrigeration costs about $0.15/kWh/yr. For the average building considered here that cost would be $2,654/site.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use in applicable sites by 10 percent. The average commercial building considered here is assumed to save 17,900 kWh/yr.

Expected Useful Life

Electrically commutated motors are assumed to have a useful life of 15 years.

Electrically Commutated Motors (C-11)

An electronically commutated motor is a more efficient motor with variable speed control capability. In fan and pump applications it can save energy by operating at a more efficient speed. Refrigeration applications involving case cooling distribution fans are especially favored because the power reduction leads to a lower refrigeration load.

Measure Applicability

This measure is broadly applicable throughout the commercial sector. For this study we assume the measure is applicable in 60 percent of the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.33/kWh/yr. For the average building considered here that cost would be $1,250/site.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use by 2 percent. The average commercial building considered here is assumed to save 3,745 kWh/yr.

Expected Useful Life

Electrically commutated motors are assumed to have a useful life of 15 years.

Premium Motors (C-12)

This measure saves energy by reducing energy losses in motors. Motor energy use is preponderant in manufacturing applications where of the order of 40-60 percent of electric energy is used in motors, and these motor applications are frequently full time operation or near full time operation.

Motor efficiency varies with the size of the motor as is illustrated in the figure below.

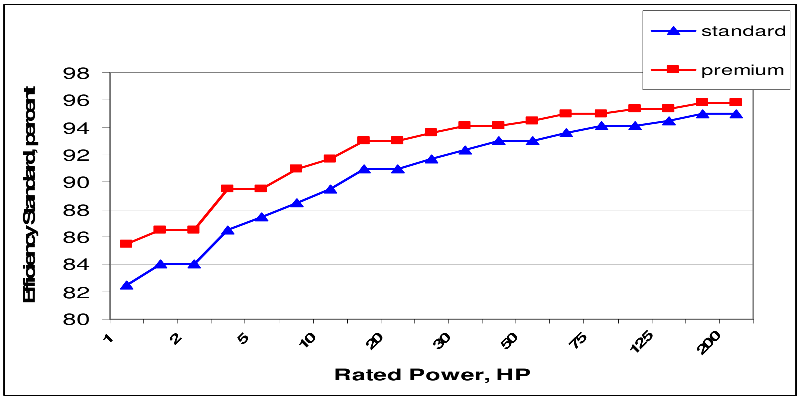

Figure 30. Motor Efficiency Specification NEMA Premium

The figure above shows the efficiency improvement to be gained by using the more efficient motor. While the efficiency gain is only about 2% for the smaller motors, it is important because the duty cycle of many motor applications is of the order of 5,000-8,760 hours/year.

In constant speed motor applications, an even greater electric energy savings may be available by properly matching the motor to its load. In particular, the efficiency of smaller motors in the 1-10 horsepower range can vary greatly with the duty load on the motor as illustrated in Figure 31. In this figure, it is evident that if a smaller motor is oversized relative to its load, the efficiency can be reduced by of the order of 10 percent.

In motor replacement (and new motor) specifications, it is especially important to consider the fit of the motor to its load in terms of motor horsepower, speed, and starting torque. The greater portion of savings often rests with the proper match of the motor to its load.

A simple one for one motor replacement can have unexpected results. An important element in the use of higher efficiency motors is that the equilibrium speed of the higher efficiency motor is often slightly higher than the speed of the lower efficiency motor that was replaced. In fan and pump systems this slight increase in speed will increases the fluid throughput and power. So although a more efficient motor has been used, it may actually lead to an unintended but slight increase in flow and power unless the drive system is adjusted to compensate.

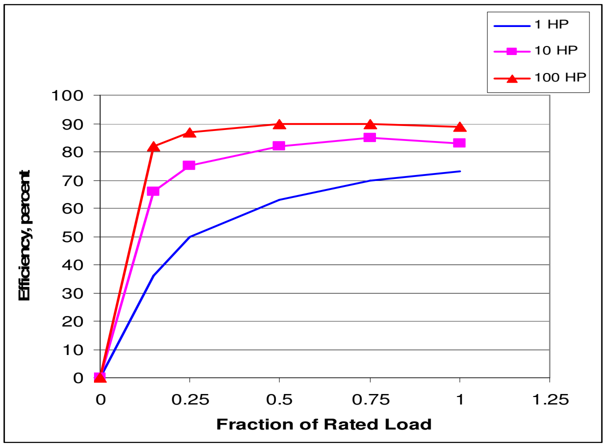

Figure 31. Typical Motor Operating Efficiencies versus Load

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations. In all, this measure is taken as applicable to 60 percent of the commercial and manufacturing sectors.

Incremental Cost

The incremental cost for this technology will be very diverse, and dependent on the size of the motor. For this study we will take an incremental cost of $412 for the average site.

Average Annual Expected Savings

The savings from an efficient motor must assume that the drive has been adjusted as necessary to give equivalent flow or drive effort, and the savings will then depend strongly on the duty cycle hours/yr. For this average motor we take a duty cycle of 6,000 hours/yr and annual savings of 1,800 kWh/yr. For an average site the savings associated with premium motors is taken as 1 percent of energy use, 3,745 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 15 years.

Variable Speed Drives, Controls, and Motor Applications Tune-Up (C-13)

This measure saves energy by providing an efficient way to match a motor to a varying load. Motor controls commonly referred to as variable speed or variable frequency drives, alter the frequency applied to the motor and thereby permit the motor to run more efficiently at lower outputs. This control capability is particularly important in process applications where a pump or fan is being controlled to maintain a particular and often varying fluid flow. Often the fluid flow is controlled by means of dampers or throttling valves that force the fan or pump motor to operate inefficiently. The savings associated with the proper speed control are most pronounced when the motor is operating at less than its rated capacity. At full capacity there may be little savings.

Situations involving fans or pumps, (which is the most common commercial/industrial application of motors), have a very high energy sensitivity to flow rate; typically the energy varies as the cube of the flow rate. Attention to how the flow is controlled with the use of variable speed controls, and elimination of excess flow can often lead to power reductions of the order of 50 percent with only minor reductions in flow. In this manner, variable speed motor control permits finer tuning and control of pumps, fans, compressors, and conveyers.

There is another genre of motors and controls referred to as brushless permanent magnet torque motors. These are very high torque motors that have no drive and can be very precisely controlled. These have very good positioning capabilities and are used in machining and manufacturing assembly operations.

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations. In all, this measure is taken as applicable to 30 percent of the commercial and manufacturing sectors.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPPC estimates an aggregated estimate of the costs of adjustable speed drives is about $0.86/kWh/yr. For the average building considered here that cost would be $16,126 site.

Average Annual Expected Savings

It is assumed here that an application of drive control can save about 10 percent of the total building energy. In the average building considered here this measure can save 18,723 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 15 years.

Energy Star Transformers (C-14)

This measure saves energy by reducing energy losses associated with stepping down from high service voltages to typical service application voltages. In larger buildings and plants is often more economic to distribute the power at high voltages to various floors and major areas where it is then stepped down to its ultimate application voltage through a transformer. These transformers are typically efficient (>95%) when they are properly loaded, but an oversized or under loaded transformer can operate at a much lower efficiency; therefore it is important that the transformers be sized properly. However, even when the transformer is properly sized, it is important to use the most efficient transformer because all power passes through it.

Transformer efficiency varies with the size of the transformer as is illustrated in the figure below.

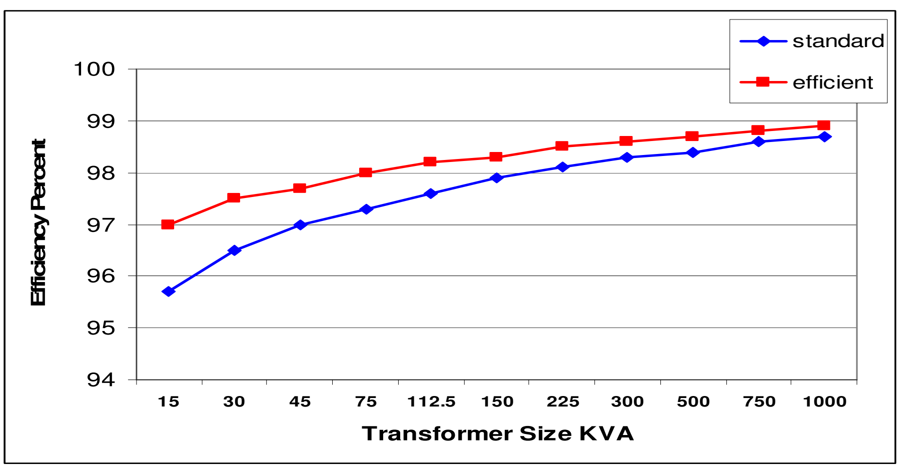

Figure 32. Transformer Efficiency Specification NEMA TP-1

Figure 32 shows the efficiency improvement to be gained by using the more efficient Energy Star labeled transformer. While the efficiency gain is only about 1 percent for the smaller transformers it is important because all power runs through it and the percentage savings will be taken off the top.

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations. In all, this measure is taken as applicable to 30 percent of the commercial and manufacturing sectors.

Incremental Cost

The incremental cost for this technology will vary with the size of the transformer. For this study we take a 150 KVA transformer as the average with an incremental cost of $76 for the typical facility considered here.

Average Annual Expected Savings

Transformer savings are based on the size of the transformer, and are based on the power throughput of the transformer as well as standby losses, 8760 hours/year. For this average transformer operating at 60 percent of load we estimate savings of 10,000kWh/yr. For the average facility considered here, savings are assumed to be ½ percent of energy, 936 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 18 years.

Efficient AC/DC Power (C-15)

A modern office environment has a multitude of electronic appliances, most of which are powered by a small transformer AC/DC converter. Standard transformer based converters are about 30-40 percent efficient. More efficient designs called switching power supplies operate with an efficiency of about 90 percent. The energy savings for this measure proceed from switching to the more efficient power supplies.

Measure Applicability

This measure is applicable in 100 percent of the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, the premium upgrade costs about $0.074/kWh/yr. For the average building considered here, that cost would be $209/site.

Average Annual Expected Savings

Electronics and computers use 12 percent of commercial energy on a US average basis. This equipment is often on 24 hours a day. It is assumed here that doubling the power supply efficiency from 45 percent to 90 percent would save at least 1.5 percent of the total building energy or 2,808 kWh/yr for the average commercial building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 5 years.

Efficient Network Management (C-16)

This measure involves powering down unused network functions during unoccupied hours.

Measure Applicability

This measure is technically applicable in 100 percent of the commercial sector, but it is assumed that only 10 percent of the commercial sector will have the networks large enough and staff conversant enough to execute the measure.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, the premium upgrade costs about $0.115/kWh/yr. For the average building considered here, that cost would be $431/site.

Average Annual Expected Savings

Approximately 12 percent of commercial energy is for electronics and computers. It is assumed here that, at an applicable site, 2 percent of energy can be saved by efficient network power management or 3,745 kWh/yr in the average building considered here.

Expected Useful Life

This is a transient measure dependent on the current system configuration. It is assumed to have a useful life of only 2 years.

New and Retrofit Efficient Lighting (C-17, C-18)

Lighting efficiency is the major commercial efficiency measure. Lighting accounts for 35 percent of commercial energy, and lighting also accounts for significant cooling energy that is saved when lighting is more efficient. There are literally hundreds of combinations of more efficient lighting elements that can replace less efficient elements. This efficient lighting measure goes beyond the light sources only and includes lighting controls, bi-level switching and occupancy sensors. Taken together it is common to find efficient lighting that can reduce lighting energy by 30 percent from the minimum code required levels (ASHRAE 90.1, 2001). In fact, the 2006 energy legislation offers preferred tax treatment to lighting configurations that can reduce lighting energy by 30 percent.

Measure Applicability

This measure is applicable in 100 percent of the new commercial buildings and in 85 percent of the existing commercial sector.

Incremental Cost

The incremental cost for this technology is essentially the cost of the efficient lighting components. These costs will be will be very diverse and site specific. Based on NWPCC estimates, and averaging the full range of conditions, efficient lighting costs about $.26/kWh/yr. For the average building considered here that cost would be $4,924/site. For a retrofit application the cost is increased by 25 percent to $6,155/site in-order to allow for installation constraints.

Average Annual Expected Savings

A comprehensive lighting retrofit or new building lighting can save about 30 percent of the 35 percent lighting end use, in all 10 percent of building energy. In the commercial building considered here, the average annual expected savings is 18,723 kWh/yr.

Expected Useful Life

The useful life of the wide variety of lighting equipment varies widely from one light source or ballast to another. However, these elements are the replaceable elements in an overall system that is assumed to have a useful life of 18 years.

LED Exit Signs (C-19)

Typical existing exit signs are incandescent exit signs. This measure is designed to replace these typical exit signs with an Energy Star Light Emitting Diode (LED) Exit Sign which is more efficient than the incandescent versions.

Measure Applicability

In principal, measure is applicable in the entire commercial sector, and there are no physical constraints to replacing existing exit signs, but to account for already installed LED exit signs the applicability is assumed to be 85 percent of the commercial sector.

Incremental Cost

The incremental cost of an Energy Star LED Exit Sign over an incandescent exit sign is $45. For the average building considered in this analysis, six exit signs are assumed, for a full site cost of $270.

Average Annual Expected Savings

The average annual expected saving for this replacement is 245 kWh/year.[63] In the average building considered in this analysis, there are assumed to be 6 exit signs, for a full site savings of 1,470 kWh/yr.

Expected Useful Life

LED exit signs are very long-lived light sources. Accordingly, the useful life is taken as 10 years.[64]

LED Traffic Lights[65] (C-20)

LED traffic lights save energy because LED light sources are a much more efficient and long lived light source than the incandescent bulbs they replace. They save energy but they also save in terms of bulb replacement costs. LED traffic lights have a variety of configurations. Each color (red, Green, or yellow), each size (8 inch, or 12 inch) and each type (thru lane, left turn bay, right turn bay, and don't walk large or small) has different incremental cost, savings and effective useful life values.

Measure Applicability

Measure applicability was not estimated due to lack of data on the traffic lights in I&M service territory. But for this analysis, it is assumed that there are 0.2 retrofittable intersections for every commercial building.

Incremental Cost

Depending on the color, size and type, the incremental cost ranges from $110 to $225. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light costs $200 and that the full intersection with 10 replacement lights costs $2,000. This cost compares favorably with the $1,850 cost derived from NWPCC data. These incremental costs do not assume an installation cost. It is assumed that the installation is done by the agency controlling the lights, and that it is more than paid for by the ongoing maintenance savings.

Average Annual Expected Savings

Depending on the color, size and type, the savings range from 111 kWh/year to 808 kWh/year. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light saves 500 kWh/yr and that the full intersection with 10 replacement lights saves 5,000 kWh/yr.

Expected Useful Life

Depending on the color, size and type, the expected useful life ranges from 3 – 16 years. For this analysis we will use 10 years.

Perimeter Daylighting (C-21)

This measure saves energy by reducing energy to lighting that is in or adjacent to day lit spaces. Some cooling energy savings are also possible because well controlled day lighting contributes less internal gain to a space. This measure controls lighting based on a well placed day light sensor. This measure also includes design and details to control glare or over lighting.

Measure Applicability

This measure is applicable in the new commercial sector, and in suitable retrofit situations. In all this measure is taken as applicable to 30 percent of the commercial sector.

[63] C&RD Database
[64] C&RD Database
[65] All values for LED Traffic Lights is available in the C&RD Database

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, perimeter daylighting costs about $0.85/kWh/yr. For the average building considered here that cost would be $4,771/site.

Average Annual Expected Savings

It is assumed here that a full application of perimeter daylighting can save about 3 percent of the total building energy. In the average building considered here this measure can save 5,617 kWh/yr.

Expected Useful Life

This measure is essentially a built in measures and is assumed to have a useful life of 18 years.

Low Flow Fixtures (C-22)

This technology consists of a new showerhead rated at 2.0 gpm at 80 psi and a swivel aerator for any kitchen faucets, and fixed aerators for the lavatory faucets. The current US standard for showerheads is 2.5 gpm. And measurements of the existing shower flows in building stock show a range of 2.75 to 3.75 gpm with frequent individual cases showing in excess of 5 gpm. Evaluations have shown that programs that replace with 2.0 gpm heads have greater savings than programs that replace with the standard 2.5 gpm shower heads. Program shower heads should be 2.0 gpm at 80 psi and with a lifetime scaling and clogging warranty. It is important also to be cautions about the use of "pressure compensating" showerheads. These are more prone to clogging, and can lead to unintentional increases in flow rate in low pressure situations such as well water systems or older systems with occluded piping. Customer acceptability is an important component in a showerhead program. Customers will remove new low flow showerheads if the quality of the showering experience declines with the new showerhead. Therefore it is important to research and test the showerhead chosen for the program carefully. In addition the old showerhead must be removed from the premises to decrease the likelihood of having it reinstalled.

Measure Applicability

This measure is applicable to circumstances where there is showering such as schools, hospitality, health clubs etc. The best application will be a site where the water is heated electrically. For this analysis the applicability is taken as 10 percent of the commercial sector.

Incremental Cost

The incremental cost for this measure is taken as $1,000 reflecting the installation of 10-20 showerheads by appropriately licensed professionals. Because the cost of the showerhead varies significantly and quality is so important for this program, it is essential to test, choose and pay for a high quality showerhead. This measure is so cost effective that even with a more expensive showerhead the program will still remain cost effective and a quality showerhead will ensure measure persistence.

Average Annual Expected Savings

The average annual savings for this measure are directly related to the daily number of showers taken. For this study the showering load is assumed similar to a residential one and the overall savings are taken as 6,000 kWh/yr, representing the savings from 10-20 showerheads. The flow of the showerhead used has a significant impact on savings. Programs should be designed around a 2.0 gpm showerhead as compared to a 2.5 gpm showerhead. Therefore the savings will be more than the 120–133 kWh per unit listed in DEER. In addition the climate is different and the inlet water temperature is lower so the savings in this I&M program will be greater. Several studies have measured final savings in terms of electric input to the tank, but usually these studies have included savings from comprehensive treatments including other measures including tank and pipe insulation, kitchen and bath lavatory aerators, tank thermostat set back, and leaky diverter replacement. Savings can very from program to program depending strongly on the choice of showerhead. Savings can also diminish with "take back" in the event that the new showering experience is longer than the original. Actual savings observed in the comprehensive cases include these take back effects, and are in the range of 650 kWh/yr to 950 kWh/yr. The savings from a showerhead and aerator change alone are assumed to be 500 kWh/yr.

Expected Useful Life

The life time of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. For these purposes that lifetime is taken as 10 years.[66] Normally showerheads will last longer but with renovations and changes in ownership a 10 year EUL is a good planning number.

Solar Water Heaters (C-23)

The water heating end use in commercial buildings is a smaller end use than in residences. In the I&M service area large commercial water heating will be done by gas and it will not be a very good candidate for this measure. But the smaller commercial water heating applications will be residential scale in usage and often these smaller applications will be electrically heated. These are the candidate applications for this measure. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. Countless demonstration cases have shown that solar energy can supply all or a portion of this heating. The portion of the water heating load assumed by a solar water heater depends on the size of the solar water heater in relation to the size of the load. Field experience has shown that the best combination of system size to load favors the more moderately sized systems that can fully meet the summer water heat load, but that only meet about 40-50 percent of the non summer load. In physical terms, this is a system consisting of about 40-65 square feet of solar collector and an additional 80 gallon heated water storage tank and appropriate pumps and controls.

Measure Applicability

This measure is applicable to large commercial buildings with reasonably low hot water use, and the system is sized as if it were residential. This measure is taken as applicable to 25 percent of the commercial sector.

Incremental Cost

The installation of a solar water heating system involves a mix of building skills including plumbing, electrical, roofing and general carpentry. In the general market, a turn key installation for one of these systems is in the range of $5,000-$7,000. For this study the incremental cost will be $6,000.

Average Annual Expected Savings

The savings from solar water heaters depend on site specifics, principally solar insulation, air temperature, incoming water temperature, and hot water usage rate. Considering these dependencies for the I&M service area, leads to average annual savings for a system sized and designed to be in the cost effective range to be 2,500 kWh/yr.

Expected Useful Life

Solar water heating systems are essentially plumbing fixtures that are certified products (SRCC) and are often inspected by local building officials. A well designed system will have lifetime in excess of 25 years, even though the system will take some intermediate maintenance such as inspecting the pump and fluid level. This study will take 25 years as the useful life.

Heat Pump Water Heaters (C-24)

The water heating end use in commercial buildings is a smaller end use than in residences. In the I&M service area large commercial water heating will be done by gas, and it will not be a very good candidate for this measure. But the smaller commercial water heating applications will be residential scale in usage, and often these smaller applications will be electrically heated. These are the candidate applications for this measure. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. The heat pump water heater is essentially a small heat pump drawing heat from the air by cooling and de-humidifying it and injecting this heat into a storage tank. Physically, this measure consists of a small self contained heat pump and a water storage tank and associated pumps and controls.

[66] DEER Database, 2005

Measure Applicability

This measure is applicable to large commercial buildings with reasonably low hot water use, and the system is sized as if it were residential. This measure is taken as applicable 25 percent of the commercial sector.

Incremental Cost

The incremental cost of this measure consists of the cost of the heat pump water heater, water storage tank and installation plumbing and general construction labor. The siting of such a unit is important; it should never be sited in an attic, and freezing situations should also be avoided. Therefore, some special site adaptation and plumbing may be necessary. For this study we will take $2,500 as the cost; others report lower costs, but we do not think these take adequate account of special site costs.

Average Annual Expected Savings

For this study it is assumed that the heat pump water heater will perform with a coefficient of performance of 2, leading to annual savings of 2,000 kWh/yr.

Expected Useful Life

The useful life of this measure is assumed to be that of a similar appliance, a window air conditioner, which has an EUL of 18 years.

Energy Star Hot Food Holding Cabinet (C-25)

This measure saves energy by keeping prepared food warm more efficiently; they are 60 percent more efficient than standard models. These models have better insulation, and may have magnetic door gaskets, auto-door closers, or Dutch doors.

Measure Applicability

This measure is applicable in portions of the restaurant hospitality and education sectors, and the applicability is estimated here to be 7 percent of the commercial sector.

Incremental Cost

For the average building considered here that cost would be $1,100/site.

Average Annual Expected Savings

It is assumed here that this measure will save 3 percent at a suitable site or 4,100 kWh/yr[67] in terms of the average building considered here. The DEER Database confirms this value with a value of 4,029.

Expected Useful Life

This measure is assumed to have a useful life of 15 years.

Energy Star Electric Steam Cooker (C-26)

This measure saves energy by cooking food more efficiently. It also saves water and cooling energy.

Measure Applicability

This measure is applicable in portions of the restaurant hospitality and education sectors. The applicability is estimated here to be 7 percent of the commercial sector.

Incremental Cost

For the average steam cooker considered here, the incremental cost would be $5,000/site.

[67] Energy Star Website: http://www.energystar.gov/index.cfm?c=hfhc.pr_hfhc

Average Annual Expected Savings

It is assumed here that this measure will save 1.5 percent at a suitable site or 2,200 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 15 years. DEER lists a slightly more conservative value of 12 years.

Pre-Rinse Spray Wash (C-27)

This measure applies to the commercial sector and provides a low pressure nozzle for pre-washing dishes. Using a low pressure nozzle saves water and heating energy in commercial kitchen settings.

Measure Applicability

This measure is applicable in portions of the restaurant hospitality and education sectors. The applicability is estimated here to be 7 percent of the commercial sector.

Incremental Cost

Based on NWPCC estimates, the pre-rinse spray wash costs about $0.03/kWh/yr. For the average building considered here that cost would be $237/site.

Average Annual Expected Savings

It is assumed here that this measure will save 5 percent at a suitable site or 9,362 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 15 years.

Restaurant Commissioning Audit (C-28)

This measure consists of an audit conducted by a restaurant energy professional to identify the potential for efficiency in a commercial kitchen. Savings proceed from small things such as leaky faucets and unnecessary equipment operation to larger things such as major process changes. Since kitchen equipment is energy intensive the audit includes identification of cost effective equipment changes.

Measure Applicability

This measure is applicable to commercial kitchens in the restaurant, hospitality, and education sectors. In this analysis this measure is taken as applicable in 30 percent of the commercial sector.

Incremental Cost

The incremental cost for this measure is limited to the cost of the audit only. The cost of any major equipment changes is associated with other measures. The cost for the audit is here assumed to be $1,382, $0.0738/kWh/yr.

Average Annual Expected Savings

It is assumed here this measure can reduce the energy use in an applicable facility by 10 percent, or 18,723 kWh/yr for the average building considered in this analysis.

Expected Useful Life

This measure will have a relatively short life; here it is assumed to be 5 years.

Grocery Refrigeration Tune-Up and Improvement (C-29)

This measure consists of cleaning heat exchangers and assuring proper airflow at the freezer cases and condenser coil. It also involves appropriate belt adjustment and refrigeration charge correction and the addition of a floating head pressure control if appropriate.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants. The applicability is estimated here to be 4 percent of the commercial sector.

Incremental Cost

Based on NWPCC estimates, the grocery refrigeration tune-up costs about $0.19/kWh/yr. For the average building considered here that cost would be $3,549/site.

Average Annual Expected Savings

It is assumed here that this measure will save 10 percent at a suitable site or 18,723 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 5 years.

Refrigeration Casework Improvements (C-30)

This measure refers to improvements to refrigeration casework that can lower the refrigeration load. These include high quality insulated glass doors on the refrigeration case or other transparent refrigeration case covers that limit mixing of the warmer store air with the refrigerated air.

Casework improvements also include attention to two refrigeration case auxiliaries that emit heat into the refrigerated space. The first is the anti sweat heater made part of the clear refrigeration door to melt frost that could accumulate on the door and obscure the view of the contents. These heaters are commonly on all the time when they are only needed during high humidity episodes with humidity greater than 55 percent. The control improvement is to control the anti sweat heaters with a humidistat thus allowing operation only to times when it is needed. While this control improvement will depend on the store humidity and the specific heater size, the savings for a typical refrigeration case are estimated here to be 400 kWh/yr.

The second heat emitting auxiliary is the small fans used to distribute the cooled air inside the refrigerated case. These fans typically use a small inefficient motor coupled to an inefficient fan blade. In a typical medium sized refrigeration case the existing fans may use about 70 Watts, with the efficient fans using only about 20 Watts, for a savings during 8760 hours/yr of 50Watts or about 450 kWh/yr per case.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants. The applicability is estimated here to be 4 percent of the commercial sector.

Incremental Cost

Based on NWPCC estimates, an average refrigeration case upgrade costs about $0.33/kWh/yr. For the average building considered here that cost would be $3,089/site.

Average Annual Expected Savings

It is assumed here that this measure will save 5 percent at a suitable site or 9,362 kWh/yr in terms of the average building considered here.

Expected Useful Life

This measure is assumed to have a useful life of 10 years.

VendingMiser® (C-31)

The VendingMiser® is a controller placed on vending machines which powers down a vending machine during low use times while maintaining product quality. It cycles the machine to maintain temperature and uses occupancy sensors to control the lighting on the vending machine.

Measure Applicability

This measure is assumed to be applicable in 25 percent of the commercial sector.

Incremental Cost

The incremental cost for a VendingMiser® unit is $179 and installation costs are expected to be $35.50 in labor for a total incremental cost of $215.[68]

Average Annual Expected Savings

Measure savings range from a low value of 800–1,200 kWh/yr, depending on the vending machine. Large machines with an illuminated front save 1,200 kWh/yr, and small machines or machines without an illuminated front save 800 kWh/yr. For planning purposes, we will assume 1,000 kWh/yr.

Expected Useful Life

The expected useful life for this measure is 10 years.[69]

Sources

DEER: 2004-05 Database for Energy Efficient Resources (DEER) Version 2.01 October 26, 2005 developed by the California Public Utility Commission and the California Energy Commission.

C&RD: Northwest Power and Conservation Council's Conservation Resource Comments Database, which is continually updated as new information becomes available.

[68] DEER
[69] DEER

APPENDIX E. SEGMENTATION AND CIS SAMPLING PLAN

In order to accurately understand the nature of loads and DSM opportunities, we start by disaggregating the I&M customer base into smaller groups of customers. These customer segments are chosen so that customers with similar energy attributes can be grouped for modeling purposes.

Customer Segments

I&M provided an extract from their customer information system (CIS) that included the information we requested for all retail customers in the I&M service areas. Using the CIS extract, segments were developed using the following rules-based approach:

1. Aggregate customer loads (kW and kWh) for 2007
2. Group customers based on account class codes
    a. Residential (account class codes 'R')
    b. Non-Residential (account class codes 'C', 'I', ‘O’, and 'P')
3. Residential customers were then grouped into housing type and vintage.
    a. Housing type based on housing type code.
        i. Single Family includes houses and manufactured homes (code ‘Single Family’)
        ii. Multi Family includes apartments and condominiums (code ‘Multi Family’).
    b. Vintage based on service start date. (Note: The importance of delineating between new and existing stock is to describe and contrast current construction practices. The cutoff is somewhat arbitrary)
        i. New construction (2004 and after)
        ii. Existing stock (prior to 2004)
    c. Due to the large number of customers (nearly 20,000) for whom housing type codes were blank, we used two approaches to extrapolate housing type.
        i. A non blank value of service unit number (serv_unit_nbr_adr) was assumed to be a Multi Family residence.
        ii. Customers with a blank value of both service unit number and housing type code were placed in the Single Family group.
4. Commercial customers were then grouped by load and SIC.
    a. Customers with exceptionally small loads were assigned the small loads segment (less than 3,000 kWh over a recent 12-month period unadjusted for weather).
    b. Customers not classified in the small load were assigned segments based on their SIC code.
5. Industrial customers are shown in the segmentation approach but will be dropped from the study.

The segmentation strategy is shown in the table below. (Code refers to Account Class Code)

Residential (Code R)			**Non-Residential (Codes C, I, O and P)**
Single Family New Construction	Single Family Existing		Manufacturing and Non-Manufacturing Segments Based on SIC
Multi Family New Construction	Multi Family Existing		Small Loads (< 3,000 kWh/year)

Commercial segment assignments, based on SIC code, are shown in the table below.

SIC Code	Business Type Assignment
01 – 17	Agriculture, Mining and Construction
20 – 39	Manufacturing
42, 50 and 51	Warehouse
54	Grocery
58	Eating/Drinking
70	Hotels
80 (except 806)	Health Services (excludes hospitals)
806	Hospitals
82	Schools
52 – 59	Retail
40 – 98	Office
All other SIC	Other

Customer counts and usage by segment are shown in the attached PDF file.

Observations:

1. There were a large number (nearly 16,000) of commercial customers with small loads (< 3,000 kWh). This is fairly typical in that electric utility services include facilities that are not typical commercial establishments. Examples include billboards and railroad signals and switching equipment. The 3,000 kWh cutoff was determined after a review of the distribution of kWh usage and considering what a reasonable lower limit might be for a small commercial establishment.

Sample Selection

A random sample of 5,000 customer sites served before 2005 (to allow sufficient billing history) for each segment was drawn. This level of sampling essentially provided a census of all customers in all segments but the ones with the largest number of customers (e.g. single family existing).

APPENDIX F. GLOSSARY OF ACRONYMS AND TERMS

The following is a glossary of acronyms and terms used in the report.

AC-air conditioner

AMI-advanced metering infrastructure

ASHRAE- American Society of Heating, Refrigerating and Air-Conditioning Engineers

C&I-commercial and industrial

CBECS-2003 Commercial Building Energy Consumption Survey published by the US DOE

CEE-Consortium for Energy Efficiency

CFL-compact florescent lights

CHP-combined heat and power

CIS-customer information system

DHW-domestic hot water

DR-demand reduction

DSM-demand side management

EEM-energy efficiency measure

EER-Energy Efficiency Ratio - a measure to assess heat pumps and air conditioners. This is the ratio of output cooling in Btu/Hr to the input power in Watts at a given operating point. It measures how efficiently a cooling system will operate when the outdoor temperature is at a specific level. The higher the EER, the more efficient the air conditioner. EER is used to assess the efficiency of a unit at when operating on a peak day. Energy Star qualified Central Air Conditioners must have an EER of at least 11 for single package equipment and at least 11.5 for split systems.

EPA-Environmental Protection Agency

ESCO-Energy Services Company

EUI-energy utilization index

GWh- Gigawatt Hour

HERS-Home Energy Rating System

HSPF-Heating Seasonal Performance Factor - a measure of the efficiency of heat pumps. The higher the HSPF of a unit, the more energy efficient it is. The dimensions of the ratio are BTU heat output over the heating season to Watt-hours of electricity used. Energy Star heat pumps must have a HSPF of at least 8.2 for split systems and at least 8.0 for single package equipment including gas/electric package units.

HVAC-heating, ventilation, and air conditioning

I&M-Indiana Michigan Power

INCAA-Indiana Community Action Agency

IPVMP-International Measurement and Verification Protocol - maintained by the Efficiency Valuation Organization (EVO) which is located on the Internet at www.evo-world.org. It is a set of engineering protocols used worldwide to measure the results of energy efficiency projects. IVMVP is becoming the accepted standard for assessing utility DSM programs, although there are other systems of DSM measurement and evaluation protocols.

IURC-Indiana Utility Regulatory Commission

kWh-kilowatt hour

kW-kilowatt

LED- light-emitting-diode

M&V-monitoring and verification

MEEA-Midwest Energy Efficiency Alliance

MEF-modified energy factor

MWh-megawatt hour

MW-megawatt

NAICS-North American Industry Classification System

O&M-operating and maintenance

OUCC-Indiana Office of Utility Consumer Counselor

PRISM-Princeton Scorekeeping Method

R&D-research and development

RFP-request for proposal

RLC-real levelized cost

SAE-Statistically-Adjusted Engineering

SEER-Seasonal Energy Efficiency Ratio - a performance rating of air conditioning and heat pump equipment. It is calculated over a range of expected external temperatures, and is most commonly used to measure the efficiency of a central air conditioner. The higher the SEER, the more efficient the air conditioner. SEER is used to assess the efficiency of a unit operation over a whole season. As of January 2006, all air conditioners sold in the United States must have a SEER of at least 13. Energy Star qualified Central Air Conditioners must have a SEER of at least 14.

SIC-Standard Industrial Classification

TRC- Total Resource Cost

WAP- Weatherization Assistance Program

Updated Action Plan for Electric Demand Side Management (DSM) Programs:

Final Report

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March 27, 2013

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Updated Action Plan for Electric Demand Side Management (DSM) Programs:

Final Report

Portfolio Level Overview

This document presents a three-year demand side management (DSM) program action plan for residential and non-residential electric customers in the Indiana portion of the Indiana Michigan Power Company service area, referred to in this report as I&M-Indiana (I&M). This report was prepared by H. Gil Peach & Associates, Jai J. Mitchell Analytics and Forefront Economics Inc with consultation and review by the I&M DSM staff and the Oversight Board. The design and cost effectiveness of electric DSM programs are addressed in this report. In this first section the focus is on the program portfolio.

The overall portfolio parameters are summarized in Tables 1 and 2. The portfolio Total Resource Cost Test (TRC) is 2.3 with a weighted life of 12.4 years (Table 1). The profile of portfolio costs and benefits from a TRC perspective is shown in Table 2, with a breakout (using a TRC perspective) in Table 3.[1]

Table 1: Portfolio TRC and Life.

Portfolio TRC	2.3
Weighted life (Years)	12.4

Table 2: Portfolio TRC Perspective – Benefit and Cost Profile.

Portfolio Level	Dollars (Thousands)
Net Benefits	$ 379,852
Net Costs	$ 160,017
Umbrella DSM Program Costs	$ 3,396
Net Present Value	$ 216,439
Annual Net Benefits	$ 24,633

[1] The Total Resource Cost test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs. Of the standard tests, the TRC provides the broadest measure of program cost effectiveness from the standpoint of energy acquisition. The primary benefit in the TRC Test is the avoided cost of energy. Loads used in the avoided cost calculation are net of free-riders. Tax credits and reductions in annual O&M costs, if applicable, are also treated as a program benefit (or a reduction in costs). Costs used in the TRC calculations include all energy efficiency measure installation costs, program related costs and any increased O&M costs no matter who pays them. Incentive payments are viewed as transfers between participants and ratepayers and are excluded from the TRC.

Table 3: Breakout of TRC Perspective – Benefit and Cost Profile

Commercial & Industrial vs. Residential			
	C&I	Residential	Portfolio
Net Benefits	$ 234,955	$ 144,897	$ 379,852
Net Costs	$ 63,631	$ 96,386	$ 160,017
Umbrella DSM Program Costs	$ 1,228	$ 2,168	$ 3,396
Net Present Value	$ 170,096	$ 46,343	$ 216,439
Core vs. Core Plus			
	Core	Core Plus	Portfolio
Net Benefits	$ 143,505	$ 236,347	$ 379,852
Net Costs	$ 62,540	$ 97,476	$ 160,016
Umbrella DSM Program Costs	$ 1,264	$ 2,132	$ 3,396
Net Present Value	$ 79,701	$ 136,738	$ 216,439

The overall portfolio table values can also be shown with specific program bundles according to sector or status within the statewide effort. The specific program bundle breakouts are shown below.

Within the Overall Portfolio:

- The Overall Commercial & Industrial TRC is 3.5
- The Overall Residential TRC is 1.5
- The CORE TRC is 2.2
- The CORE Plus TRC is 2.4

Special Budget Items at the Portfolio Level

The portfolio budget contains certain portfolio level expenses (budget lines) that are not assigned to specific program budgets (or included in the program level Total Resource Cost calculations) but operate at the overall portfolio level (Table 4).[2]

[2] The special portfolio level budget items are included in the calculation of the overall portfolio level TRC.

Table 4: Annual Portfolio Level DSM Expenses.

Line No.	Budget Line Item	Amount ($)
1	Information technology and systems	$ 150,000
2	Staff development & memberships	$ 120,000
3	New Program Development	$ 210,000
4	General energy efficiency management and collaboration	$ 140,000
5	Codes work	$ 100,000
6	MPS and Action Plan	$ 100,000
7	DSM Marketing and Customer Awareness	$ 300,000
8	Evaluation and Related	$ 140,000
	Total	$ 1,260,000

These line items either apply across all programs (regardless of the specific inclusion or exclusion of individual programs), or provide start-up funding for an area that is not ready to be formulated as a program in this program cycle (codes work). The first item supports the tracking system and other computer systems. The second supports staff development, participation in industry conferences and membership organizations and training. The third is a pool to draw on each year to support new program development (NPD). This permits drawing upon resources of AEP that are outside I&M's DSM staff. The fourth is funding for one staff member outside the actual program level budgets to support a "point position" for participation in statewide meetings and common efforts. The fifth item is to permit work on codes, which will require development over the new program cycle. We could not put this activity in as a specific DSM program because we could not figure a way to assign savings at this stage: it needs to be tested as an ongoing pilot for three to five years and part of the pilot will be developing a mutually agreed link between codes work and energy savings results with regulators.[3] The sixth item is to fund the next full scale potential study and program action plan and/or to provide supplementary support in this area moving forward. The seventh, "DSM Marketing and Customer Awareness" is a general marketing and communications budget separate from the line items in the individual program budgets. The eighth line item covers an in-house position for evaluation and related functions separate from the individual program budgets.

The extra first year costs in the individual program budgets have been deleted and instead there is an annual cost adder for each program budget.

[3] Codes work for Indiana will have been specially developed for Indiana. Guidance from other states can found in the presentations at the MEEA Midwest Regional Codes Conference (http://www.mwalliance.org/policy/midwest-regional-energy-codes-conference). Codes work is carried in various states but varies considerably depending on specific codes legislation, existing staffing and training for codes enforcement, whether code enforcement is a state or county responsibility and the degree to which the energy-efficiency parts of codes are enforced.

Staffing for the Portfolio

The recommended staffing level if all programs are implemented is 10 positions. Two of these are covered (Line Items 4 and 8) in the Overall Portfolio budget. The other 8 are in the individual program budgets.

Summary of Program Level TRCs for the Portfolio

The individual programs with their Total Resource Cost (TRC) results are as follows (the portfolio level budget items have been loaded on the portfolio TRC but not on the individual program TRCs):

- **Demand Programs:** C&I Peak Reduction (2.7); Residential Peak Reduction (1.5);
- **R&D:** Renewables & Demonstrations (0.3);
- **Commercial & Industrial Programs:** C&I Custom (10.9); C&I Rebates (2.8); C&I Retrocommissioning Lite (5.0); C&I HVAC and Refrigeration Optimization (1.2); C&I Audit (1.3); Energy Efficient Schools – Audit (0.4);
- **Residential Audit Programs:** Residential On-Site Audit (1.9); Residential On-Line Audit (1.0);
- **Weatherization Programs:** Residential Weatherization – Regular Income (1.5); Residential Moderate Income Qualified Weatherization (1.5); Residential Low Income Qualified Weatherization (0.6) – because we added money for Health and Safety items that belong in this program type; Residential Neighborhoods (1.6);
- **Other Residential:** Residential EE Products (1.5); Residential Home Reports (0.8) – due to the one year measure life and the PJM numbers; Energy Efficient Schools - Education (1.8); Residential New Construction (1.5); Residential Appliance Recycle (1.3); Residential Lighting (2.2);
- **Codes:** Not TRC tested – to be developed as a pilot over 3-5 years, and then converted to a program. Specific cost categories and estimation of costs will need to be developed as part of the project.

A bar chart of the planning results for the TRCs is shown in Figure 1 to permit easy visual inspection. Since the Codes effort has not been TRC tested, it does not appear on the chart. The two demand reduction programs have been added.

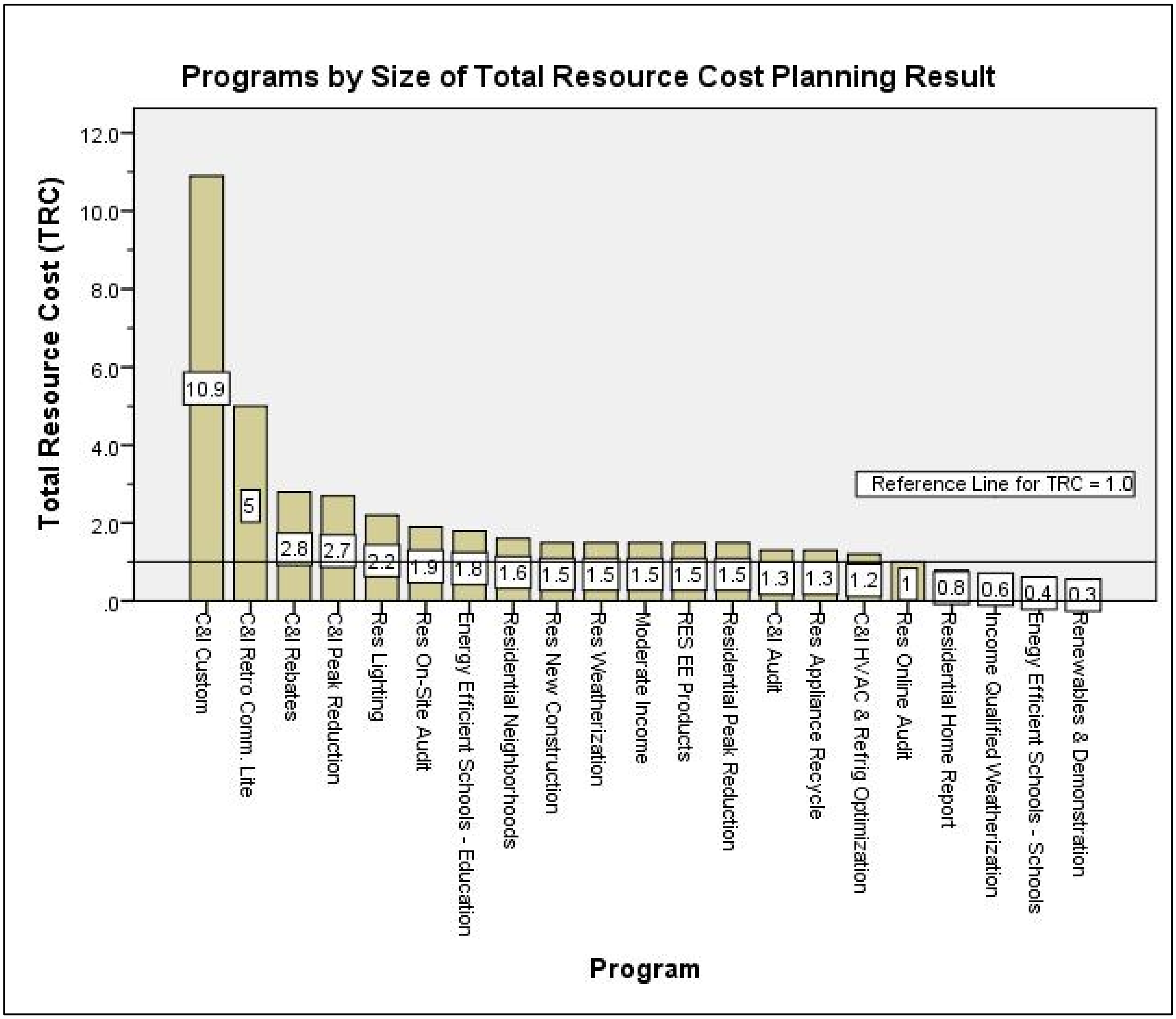


Figure 1: Summary of Planning TRC Results by Program.

The programs are discussed in the following section of the report. The final section of the report provides a discussion of individual measures.

The Programs

The programs are outlined individually in this section of the report. Each program is briefly discussed in terms of:

- Rationale
- Participation & Measures
- Marketing Plan
- Program Tracking
- Budget Assumptions

The program descriptions are planning projections that can be considered initial program designs. The real program designs will be more complex and will evolve from I&M internal planning, the Oversight Board and work with program vendors on final design. Also, the operative design for each program implemented will be emergent from actual practice. Planning requires a certain linearity of thinking for use in making projections to future years. In contrast, in the direct experience of implementation each program is its own unique totality and will encounter realities that require interaction and adjustment. To be practical, we advocate the model of the "free administrator," [4] so that each program manager is seen as implementing a program but is free (with I&M and OSB review) to modify the program to make it more relevant, efficient and effective to achieve goals. Just as the Technical Resource Manual (TRM) is meant to be a "living document," the programs here are understood to be initial designs for "living programs" that will require improvements as they venture out into full implementation. The nature of necessary improvements will only be discoverable in the action of implementation.

This plan advocates 21 programs plus new program development in the codes area. The programs cover the Residential and Commercial & Industrial areas, and include both Core and Core Plus programs.[5] Planned savings for the three-year cycle are shown in Figure 2 and Table 5. Planned savings for 2016 (Year 3 of the program cycle) are shown in Figure 2 and Table 6. The 3-Year perspective is most useful for estimation of environmental effects; the Year-3 perspective is most useful in making comparisons to a base year. The kWh savings order of programs is the same in both perspectives. Discussion of each of the planned programs follows.

[4] The "free administrator" is Donald Campbell's "experimental administrator": "*Experimental administrators* have justified the reform on the basis of the importance of the problem, not the certainty of their answer, and are committed to going on to other potential solutions if the first tried fails." Campbell, Donald T., "Reforms as Experiments," Pp. 7 1-100 in E.L. Streuening and M. Guttentag (eds.), *Handbook of Evaluation Research (Vol. 1)*. Beverly Hills, California: Sage, 1975. In Campbell's perspective a program is a "reform."

[5] In Indiana, Core programs are run statewide by a single program vendor; Core Plus programs are run by individual utilities. For both Core and Core Plus programs, the Oversight Board (OSB) plays a role in the final shaping of the programs and in the selection of program vendors along with the utilities.

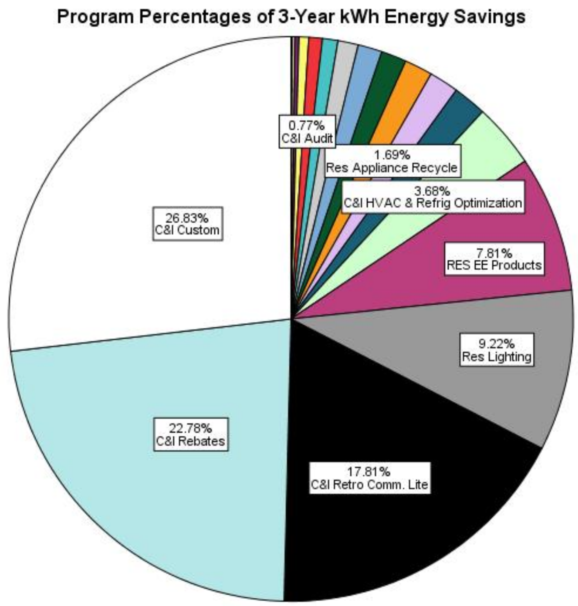


Figure 2: Planned Energy Savings over Three-Year Program Cycle.

Table 5: Planned Energy Savings over Three-Year Program Cycle.

Cumulative Energy Savings (All 3 Years in the 3-Year Program Cycle)		
Program	**kWh**	**Percent of Total**
Renewables & Demonstration	107,370	0.01%
Enegy Efficient Schools - Schools	614,080	0.05%
Res New Construction	1,980,118	0.17%
Res Online Audit	2,688,696	0.23%
Residential Neighborhoods	6,498,701	0.55%
C&I Audit	9,056,691	0.77%
Energy Efficient Schools - Education	10,385,244	0.88%
Income Qualified Weatherization	13,722,360	1.17%
Res On-Site Audit	16,257,330	1.38%
Res Weatherization	16,969,815	1.44%
Moderate Income	18,925,036	1.61%
Res Appliance Recycle	19,811,715	1.69%
Residential Home Report	22,552,050	1.92%
C&I HVAC & Refrig Optimization	43,273,440	3.68%
RES EE Products	91,727,316	7.81%
Res Lighting	108,324,256	9.22%
C&I Retro Comm. Lite	209,288,916	17.81%
C&I Rebates	267,731,772	22.78%
C&I Custom	315,288,244	26.83%
Portfolio	1,175,203,150	100.00%

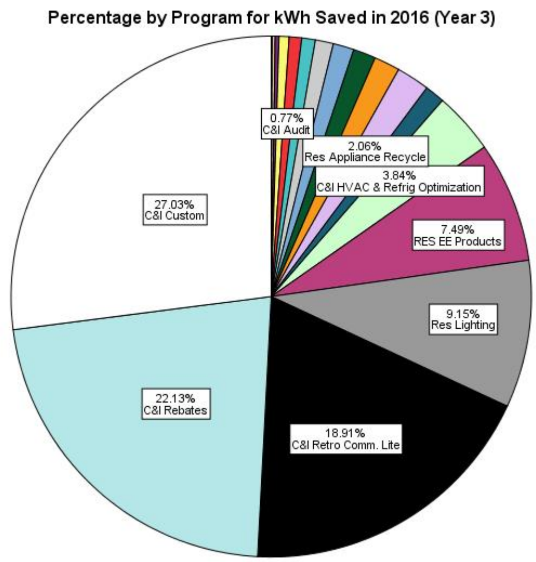


Figure 3: Planned Energy Savings in 2016 (Year 3).

Table 6: Planned Energy Savings in 2016 (Year 3).

Annual Energy Savings: 2016 (Year 3)		
Program	kWh	**Percent of Total**
Renewables & Demonstration	53,685	0.01%
Enegy Efficient Schools - Schools	322,392	0.05%
Res New Construction	1,110,386	0.18%
Res Online Audit	1,438,080	0.23%
Residential Neighborhoods	3,801,160	0.62%
C&I Audit	4,728,008	0.77%
Energy Efficient Schools - Education	5,192,622	0.85%
Income Qualified Weatherization	6,861,180	1.12%
Res On-Site Audit	7,954,755	1.30%
Res Weatherization	8,573,520	1.40%
Moderate Income	9,827,492	1.61%
Res Appliance Recycle	12,607,455	2.06%
Residential Home Report	7,517,350	1.23%
C&I HVAC & Refrig Optimization	23,525,640	3.84%
RES EE Products	45,863,658	7.49%
Res Lighting	56,029,712	9.15%
C&I Retro Comm. Lite	115,775,730	18.91%
C&I Rebates	135,489,200	22.13%
C&I Custom	165,482,780	27.03%
Portfolio in Year 3	612,154,805	100.00%

Program 1: Commercial and Industrial Peak Reduction (CORE PLUS)

This program involves providing an AC cycling peak reduction measure to a wider market of small and medium-sized commercial customers as a load reduction program focused on air conditioners. It is not assumed that the program is functioning within a "smart grid" and while we recommend consideration of two-way meters for immediacy of certain verification, we assume a one-way signal with the use of meters with memory that may be queried on-site.

Rationale

Load (kW) constraints are one of the most costly events a utility encounters. During peak times when demand escalates and there is a problem with meeting demand with additional generation supply (either physically or at reasonable cost), the cost per kW to the company can escalate exponentially. For this reason, in these situations load control is essential to control costs and insure service.

Participation and Measures

Measures are shown below, followed by participation projections.

Table 7: Measures – C & I Peak Reduction

Measures
Load Control – AC Cycling

Table 8: Participation and Savings -- C&I Peak Reduction

Commercial and Industrial Peak Reduction				
Potential participants				10,290
Per participant savings (kWh):				0
Per participant savings (kW):				9.5
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	515	5.0%	0	4,910
2015	617	6.0%	0	5,882
2016	720	7.0%	0	6,864
Average	617	6.0%	0	5,885

Marketing Plans

The Marketing and Promotional Plan should include mention of the program in any communications with appropriate customers regarding energy efficiency program options and on the Company website. Additional promotion may include bill inserts and recognition window stickers for participating businesses. Customers with account representatives should be contacted through the account representatives. However, since utilities typically have fewer staff (and staff have many more responsibilities) than in the past, it may be that the most effective marketing will be through the selected program delivery agent.

The small and medium sized commercial class is not expected to be easy to enlist. Generally, these customers will be concerned about the effects of the cycling on clients (sales) and staff. It is expected that this program may cause a temperature fluctuation of about 2 degrees. If this can be communicated or demonstrated it may ease fears about effects on customers or production. The small commercial class is usually not assigned account representatives, so this will be a limiting factor in communications. The issue of owner-occupied versus tenant-occupied space will also be a challenge in promoting participation in this program. The marketing and promotion effort will give priority to owner-occupied facilities.

Program Tracking Considerations

Direct load control is data intensive and load management data is precise. When load events are called either for capacity shortages or economic emergencies, the systems self-validate. Care needs to be taken to insure the collection of data elements sufficient to show the baseline condition at the time an event is called and the response to the call as a kW effect. The duration of each event for evaluation purposes should also last long enough to show the affected units back on line to demonstrate there are no unexpected rebound effects.

Budget Assumptions

The anticipated cost to I&M for offering the medium/small commercial AC cycling component to customers involves budgets for a monthly participant incentive and payment when events are responded to. Cost to the participants is to accept the temporary load control when incidents are called.

Table 9: Estimated Three-Year Program Budget - C&I Peak Reduction

C&I Peak Reduction	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Program Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	2%
DSM Staffing		$104,794	$108,462	$112,256	$325,511	4%
Monitoring & Evaluation		$40,000	$40,000	$40,000	$120,000	2%
Variable Program Costs						
Annual Incentives	$80	$41,200	$90,560	$148,160	$279,920	4%
Delivery & Other	$3,626	$1,867,390	$2,237,242	$2,610,720	$6,715,352	88%
Total Budget		$2,103,384	$2,526,264	$2,961,136	$7,590,783	100%

Program 2: Residential Peak Reduction (CORE PLUS)

A load control program is a dispatch program. In a dispatch program, a switch can be engaged to send a signal which directly reduces load. Direct load control is an important approach to peak reduction because it offers low cost to the company and is dispatchable.

Rationale

Load (KW) constraints are one of the most costly events a utility encounters. During peak times when demand escalates and there is a problem with meeting demand with additional generation supply (either physically or at reasonable cost), the cost per kW to the company can escalate exponentially. For this reason, in these situations load control is essential to control costs and insure service.

Participation and Measures

Measures are shown below.

Table 10: Measures – Residential Peak Reduction

Measures
DLC – Residential AC

Projected participation by year is shown in the table below.

Table 11: Estimated Participation and Savings - Residential Peak Reduction

Residential Peak Reduction				
Potential participants				234,850
Per participant savings (kWh):				0
Per participant savings (kW):				0.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	11,743	5.0%	-	10,686
2015	14,091	6.0%	-	12,823
2016	16,440	7.0%	-	14,960
Average	14,091	6.0%	-	12,823

Marketing Plans

Marketing should take advantage of current concerns for mitigating climate problems by emphasizing a green marketing theme and can include the following elements:

- Proposed marketing efforts are to include mention of the program in any communications with customers regarding energy efficiency program options such as bill inserts, recognition window stickers for participating homes, media coverage of how to manage electric bills, customer service representatives, and promotion using the I&M website.
- Residential communications for the program can reach out to customers with high bill complaints and to customers with payment problems as well as to general promotion to customers concerned with keeping costs low and interested in mitigating global warming.

Program Tracking Considerations

Direct load control is data intensive and load management data is precise. When load events are called either for capacity shortages or as tests, the systems self-validate. Care needs to be taken to insure the collection of data elements sufficient to show the baseline condition at the time an event is called and the response to the call as a kW effect. The duration of each event for evaluation purposes should also last long enough to show the affected units back on line to demonstrate there are no unexpected effects.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Cost to the participants is to accept the temporary load control when incidents are called.

Table 12: Estimated Three-Year Program Budget – Residential Peak Reduction

Res Peak Reduction	Cost/ Participant	2014	2015	2016	3-Yr Total	Percent of Total
Fixed Program Costs						
Implementation & Other Annual Cost		$30,000	$30,000	$30,000	$90,000	0%
DSM Staffing		$104,794	$108,462	$112,256	$325,511	2%
Program Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	1%
Variable Program Costs						
Incentives	$40	$469,720	$1,033,360	$1,690,960	$3,194,040	14%
Delivery & Other	$460	$5,401,780	$6,481,860	$7,562,400	$19,446,040	83%
Total Budget		$6,106,294	$7,753,682	$9,495,616	$23,355,591	100%

Program 3. Renewables and Demonstrations (CORE PLUS)

This program contains five program elements: Solar photovoltaic, solar hot water, ground source heat pumps, LED streetlights, and the "Go Deep" project. This program is open to new technologies as they become feasible. Each of these program elements is currently borderline cost-effective. Together, the set is not cost-effective. However, this program in included as a recommended program for three reasons. First, it is a source for a small number of technology demonstration projects that can be used for promoting interest in energy efficiency. This can include a small number of solar demonstration projects at schools, a ground source heat pump demonstration and sponsoring a few homes for the "Go Deep" project. In addition, LED streetlights are now fully available and will likely become a recommended program measure in future years.

Since most people are interested in "Green" programs, these examples will fit with and encourage this interest. Second, each of the demonstrations is at the edge of current technology in its area. This will keep key company staff current in solar, ground source, and "Go Deep" technologies. Third, each of these has sufficient scale possibilities that make them sufficiently powerful to address climate change and, at the same time, running these demonstrations will place the company in with companies in a leadership role in developing these technologies.

Rationale

Each of these program elements push technology beyond current cost-effective limits, but, at the same time, present coherent pathways towards the future of energy efficiency applications. The "Go Deep" project is based on a German model using a "passive house" strategy. The goal is to reduce energy use by eighty percent in existing homes. The principles of this approach include tight super-insulated homes with a thick building envelope and high performance windows and doors. According to the organizer of the "Go Deep" project, Linda Wigington, "Our housing is facing a crisis of obsolescence, and we have a lion share of existing houses that need to be dealt with to reduce energy in the near term." In this approach structure and appliances are parts of the solution as is "how a family lives in a house." "Go Deep" is a national project in which individual utilities sponsor a small number of homes in the 1,000 home pilot. Early results suggest that attaining the savings goal is possible, and the focus is on system replacements and increasing efficiencies.

Participation and Measures

Measures are shown below.

Table 13: Measures and Incentives – Renewables and Demonstrations

Measure/Program Element	Measure Number	Incentive Amount
Solar PV	Demo	100%
Solar Hot Water	Demo	100%
Ground Source Heat Pump	Demo	100%
Go Deep	Demo	100%
LED Streetlights	Demo	100%

Because this is a promotional and R&D program there will be only a very small number of projects each year.

Table 14: Estimated Participation and Savings - Renewables and Demonstrations

Renewables & Demonstration				
Potential participants				10,000
Per participant savings (kWh):				3,579
Per participant savings (kW):				1.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	5	0.1%	17,895	6
2015	5	0.1%	17,895	6
2016	5	0.1%	17,895	6
Average	5	0.1%	17,895	6

Marketing Plans

These projects will be used to create interest in energy efficiency through public demonstration projects and to provide referrals to the other programs.

Program Tracking Considerations

Since these are demonstration programs data collection will focus on technical documentation of each project.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 15: Estimated Three-Year Program Budget - Renewables and Demonstrations

Renewables & Demonstrations	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Program Costs						
Implementation & Other Annual Cost		$25,000	$25,000	$25,000	$75,000	12%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	17%
Program Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	36%
Variable Program Costs						
Incentives (paid annually to participants)	$7,590	$37,950	$37,950	$37,950	$113,850	18%
Delivery & Other	$7,000	$35,000	$35,000	$35,000	$105,000	17%
Total Budget		$207,881	$209,104	$210,369	$627,354	100%

Program 4. Commercial and Industrial Rebates (CORE)

This program targets non-residential customers eligible for prescriptive measures. These will include commercial, industrial, and institutional customers. For-profit, non-profit and public agencies (such as schools) will be included.

Rationale

Rebates are straightforward reimbursements of a portion of customer cost of specific rebated energy efficiency items. Many customers have concerns about the high first cost associated with some of the larger energy efficiency investments (e.g. HVAC systems or energy management systems). The incentives proposed will help remove that barrier.

Participation and Measures

Representative measures are shown in the table below. Measures may be added or deleted from the prescriptive list as information is gained during program planning and administration.

Table 16: Measures and Incentives – C&I Rebates

Measures	Measure Number	Incentive
Window Film	C-7	50%
Efficient Package Refrigeration	C-9	50%
Electronically Commutated Motors	C-10	50%
Premium Motors	C-11	50%
Single Application VFD	C-13	50%
Energy Star Transformers	C-14	50%
New Efficient Lighting Equipment	C-17	50%
Retrofit Efficient Lighting Equipment	C-18	50%
LED Exit Signs	C-19	50%
LED Traffic Lights	C-20	50%
Low Flow Fixtures	C-23	50%
Vending Miser and Vending Machine Timers	C-14b	50%

An offering of energy efficient products is a traditional role that customers expect from utilities. And, we know that customers tend to trust utilities above other entities in this specialized area. We expect this program to easily communicate to customers and to have substantial participation from the first year. It is important to note that unlike most other programs, participants may return repeatedly to this program to purchase additional products. Projected participation by year is shown in the table below.

Table 17: Estimated Participation and Savings - C&I Rebates

C&I Rebates				
Potential Participants				42,400
Per participant Savings (kWh):				25,564
Per Participant Savings (kW):				4.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,696	4.0%	43,356,544	6,879
2015	1,781	4.2%	45,529,484	7,224
2016	1,823	4.3%	46,603,172	7,394
Average	1,767	4.2%	45,163,067	7,166

Marketing Plans

This program will need to be continually advertised during its operations. We recommend some general advertising in the form of brochures and mailings targeted to potential program participants. I&M should work directly with business associations and contact some customers through account representatives.

Program Tracking Considerations

The program manager should insure that the vendor managing this program has an excellent tracking system and provision should be made to gather in-service date and technical data about equipment being replaced as well as the energy savings measures that will replace old equipment.

Detailed Budget Plans

An estimated three-year budget for the Commercial and Institutional Rebate Program is provided below. Costs to participating customers include the remainder of equipment and installation costs.

Table 18: Estimated Three-Year Program Budget – C&I Rebates

C&I Rebates	Cost per Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	1%
DSM Staffing		$104,794	$108,462	$112,256	$325,511	1%
Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	1%
Variable Costs						
Annual Incentives	$4,520	$7,665,920	$8,050,120	$8,239,960	$23,956,000	94%
Delivery & Other	$130	$220,480	$231,530	$236,990	$689,000	3%
Total Budget		$8,161,194	$8,560,112	$8,759,206	$25,480,511	100%

Program 5. Energy Efficient Schools – Audit (CORE)

The program is available to public and private schools in the service territory. The school energy use analysis and audit component of the Energy Efficient Schools Program will provide building walkthrough energy audits for school buildings. All K-12 schools that are greater than 10 years old will be eligible for an energy audit. Information on the age of buildings will be self-reported by the school districts on the audit application. The objective of the school audits is to educate school officials on the benefits of energy efficiency and the savings associated with the installation of recommended energy saving measures and operational improvements to their schools.

Rationale

The state education system is a critical activity with limited resources. The effort to increase efficiency in schools will lead to the use of resources towards a more rational allocation. Additionally, the implementation of energy efficient measures will lead to increased quality of lighting and comfort within the learning environment. There is significant potential energy savings within the education system.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 19: Measures and Incentives – Residential Energy Efficient Schools - Audit

Measures – Kit Items	Measure Number	Incentive
Efficient Residential Lighting	R-11	100%
Lighting Controls	C-18	100%
LED Exit Signs	C-19	100%
Vending Machine Timers	C-31	100%
7-Plug Smart Strips	RC-1	100%

Table 20: Estimated Participation and Savings – Energy Efficient Schools – Audit

Energy Efficient Schools - Audit				
Potential Participants				320
Per participant Savings (kWh):				7,676
Per Participant Savings (kW):				2.0
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	12	3.6%	92,112	24
2015	14	4.5%	107,464	28
2016	16	5.0%	122,816	32
Average	14	4.4%	107,464	28

Marketing Plans

The school audit program will be one of two programs that will be rolled out to the school districts, using a number of marketing channels including the Special Education Planning Districts (SEDs) located throughout the state. The use of the SEDs facilities will assist the fulfillment of the program goals while addressing equitable distribution. In addition to the SEDs, program marketing, outreach and recruitment will occur through state-level organizations such as the Indiana Association of School Business Officials, and via direct outreach to the school districts themselves.

Marketing and outreach activity will be conducted initially over the phone with the Director of each Special Education District (SED) and/or the individual school districts.

Program Tracking

The program vendor will be required to perform detailed program tracking.

Budget Assumptions

An estimated three-year budget for this program is provided below. There are no costs to participating customers.

Table 21: Estimated Three-Year Program Budget – Energy Efficient Schools – Audit

Energy Efficient Schools - Schools	Cost per Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	7%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	19%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	52%
Variable Costs						
Incentives	$1,717	$20,606	$24,041	$27,475	$72,122	17%
Delivery & Other	$600	$7,200	$8,400	$9,600	$25,200	6%
Total Budget		$138,681	$144,221	$149,793	$432,696	100%

Program 6. Commercial and Industrial Retro-Commissioning Lite (CORE PLUS)

This program targets commercial and institutional customers with a usage profile that indicates a possible high value from retro-commissioning. Although direct requests may also be received, typically the program begins off-site with a scan of billing records using EZ Sim or a similar tool. This screening process will select a pool of buildings for which it looks like retro-commissioning is highly likely to produce substantial energy savings. Building commissioning is a process that is associated with new buildings; a quality assurance process that is followed to facilitate new buildings performing as designed. Retro-commissioning applies a similar process to existing buildings. The goal is insure that a building operates efficiently and effectively. The focus of this pilot program is in insuring efficient operation, rather than on upgrading equipment. The program conducts a low-cost "tuning" of electricity related building systems. The tuning typically involves control systems such as energy management systems that may be improperly programmed, or controls that are out of calibration. When problems are identified and demonstrated, they may have major economic effects. When this type of problem exists, retro-commissioning resolves such problems at low cost.

There is single measure, retro-commissioning. This project will also feed participants towards the Commercial & Industrial Rebates Program and the Commercial & Industrial Custom Program.

Rationale

Most buildings have never been commissioned, so the commissioning of an existing building may be able to identify and correct high priority operating deficiencies and verify proper operations. The focus will typically be on energy-using equipment, lighting, and controls. Further, this program is designated as "retro-commissioning lite," since it will involve engagements of about $4,000 per building[6], rather than the $10,000 to $52,000 associated with

[6] This is per building; an individual project may have more than one building.

full retro-commissioning.[7] The objective will be to find the best buildings for the program. These will be buildings with significant energy problems that can be easily detected and easily fixed. Energy savings will be documented by engineering calculations and evaluated using EZ Sim. The persistence of energy savings will also be tested.

Participation and Measures

Measures are listed below.

Table 22: Measures and Incentives – C&I Retro-Commissioning Lite

Measure	Measure Number	Incentive Amount
Retro Commissioning Engagement	C-3	$750

Table 23: Estimated Participation and Savings – C&I Retro-Commissioning Lite

C&I Retro Commissioning Lite				
Potential Participants				42,400
Per participant Savings (kWh):				26,253
Per Participant Savings (kW):				4.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,060	2.5%	27,828,180	4,583
2015	1,442	3.4%	37,856,826	6,234
2016	1,908	4.5%	50,090,724	8,249
Average	1,470	3.5%	38,591,910	6,355

[7] See Haasl &Terry Sharp, A Practical Guide for Commissioning Existing Buildings. Washington, DC: Office of Building Technology, State and Community Programs, US Department of Energy. Prepared by Portland Energy Conservation, Inc. and Oak Ridge National Laboratory, April 1999.

Marketing Plans

We recommend some general advertising within the business community, primarily in the form of brochures and mailings targeted to potential program participants; also coordination with business associations.

Program Tracking Considerations

The program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc. The major concern will be for complete and accurate documentation of "before" and "after" energy use and demand impacts. In addition, a way to monitor the duration of energy savings and demand reduction should also be included.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers include the remainder of equipment costs. Note that the delivery cost shows as zero. This is due to bundling delivery cost into the $1,500 per site (see incentive of $750 under variable costs) and the $50,000 per year for implementation and other annual costs.

Table 24: Estimated Three-Year Program Budget – C&I Retro-Commissioning Lite

C&I Retro Comm. Lite	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	4%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	5%
Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	9%
Variable Costs						
Incentives	$750	$795,000	$1,081,500	$1,431,000	$3,307,500	82%
Delivery & Other	$0	$0	$0	$0	$0	0%
Total Budget		$1,034,863	$1,323,808	$1,675,837	$4,034,507	100%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 7. Commercial and Industrial HVAC and Refrigeration Optimization (CORE PLUS)

This program was designed on the premise that much commercial, industrial, and institutional Heating Ventilation and Cooling is not operating as planned. A typical assignment envisioned in this program is to do on-site testing of HVAC units, and review their operation as an integrated building system. For example, out of twelve rooftop units, it is likely that two will be operating out of specification due to improper installation, subsequent damage to units, or problems with controls. In the case of a large school, built in sections over time, it would not be unusual to find adjacent units, some cooling and some heating, and other units damaged while most units are performing as designed.

Rationale

Most buildings have never had a focused look at the working of the HVAC systems. This program will deploy HVAC specialists to test units and make recommendations for their efficient operation as a building system. This will primarily involve repair of units and control adjustments, but may also involve recommendations for modification to air circulation within buildings.

Participation and Measures

Measures are listed below.

Table 25: Measures and Incentives – C&I HVAC and Refrigeration Optimization

Measure	Measure Number	Incentive Amounts
Small HVAC Optimization	C-2	50%
Grocery Refrigeration Tune-Ups and Improvements	C-29	50%
Refrigeration Casework Improvements	C-30	50%

Participation is indicated in the table below.

Table 26: Estimated Participation and Savings – C&I HVAC and Refrigeration Optimization

C&I HVAC & Refrigeration Optimization				
Potential Participants				25,100
Per participant Savings (kWh):				7,155
Per Participant Savings (kW):				1.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	853	3.4%	6,103,215	1,056
2015	1,054	4.2%	7,541,370	1,305
2016	1,381	5.5%	9,881,055	1,710
Average	1,096	4.4%	7,841,880	1,357

Marketing Plans

It is likely that company representatives can help develop lists of buildings that will be likely candidates for this program. In addition, there should be coordination with business associations. The budget below provides for some general advertising at business events, as well as brochures and premiums.

Program Tracking Considerations

This is an applied technical program that will be dependent on the quality and completeness of technical drawings and brief technical explanation provided by the program staff. Evaluation will rely on this information and may also involve spot metering and (where applicable) billing analysis.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers include the remainder of costs (for repairs to HVAC equipment and remodeling to permit better airflow within buildings).

Table 27: Estimated Three-Year Program Budget – C&I HVAC and Refrigeration Optimization

C&I HVAC & Refrig Optimization	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	4.4%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	6.4%
Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	8.8%
Variable Costs						
Incentives	$830	$707,990	$874,820	$1,146,230	$2,729,040	80.4%
Delivery & Other	$0	$0	$0	$0	$0	0%
Total Budget		$927,853	$1,097,128	$1,371,067	$3,396,047	100%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 8. Commercial and Industrial Audit (CORE PLUS)

This program is targeted to small commercial/retail establishments, food service facilities and grocery store/supermarkets. It consists of refrigeration casework improvements, improvements to refrigeration setpoints to reduce load, restaurant commissioning audits (designed to optimize controls and limit energy losses in food service facilities) and a commercial LED bulb change out. The program will also serve as a feeder to Program 5, C&I Rebates.

Rationale

There are consistent energy savings to be obtained from food service facilities (primarily restaurants) and the refrigeration end-use in grocery stores and supermarkets. There are four DSM measures in this program, listed in the table below.

Participation and Measures

Measures are listed below.

Table 28: Measures and Incentives – C&I Audit

Measure	Measure Number	Incentive Amount
Small Commercial LED Change out	C-21	100%
Restaurant and Grocery Audit	C-28	100%
Grocery Refrigeration Tune-Up and Improvements	C-29	50%
Refrigeration Casework Improvements	C-30	50%

Participation is indicated in the table below.

Table 29: Estimated Participation and Savings – C&I Audit

C&I Audit				
Potential Participants				2,470
Per participant Savings (kWh):				15,973
Per Participant Savings (kW):				2.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	86	3.5%	1,373,678	194
2015	99	4.0%	1,581,372	224
2016	111	4.5%	1,773,003	251
Average	99	4.0%	1,182,002	167

Marketing Plans

It is likely that company representatives can develop lists of buildings that will be likely candidates for this program. In addition, there should be coordination with business associations. There are two audit paths for measure implementation within this program. The LED change out measure is to be managed as an independent feature and a "feeder" to the efficiency audit measure. In this case a local lighting supplier is hired as the ESCO for this measure with pre-approved rates for material and labor based solely on a per-bulb basis. As teams of installers contact potential businesses an agreement to include a C&I audit for grocery/supermarket and food service facilities will be required to receive the 100% incented LED bulb offering. During a normal C&I measure audit, in absence of the LED bulb contact, the offering of the LED change out will be made in addition to those measures and programs made available through the audit process.

Program Tracking Considerations

This is an applied technical program that will be dependent on the quality and completeness of technical drawings and brief technical explanation provided by the program staff developed on-site for each project.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 30: Estimated Three-Year Program Budget – C&I Audit

C&I Audit	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$50,000	$50,000	$50,000	$150,000	15%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	11%
Monitoring & Evaluation		$45,000	$45,000	$45,000	$135,000	13%
Variable Costs						
Incentive	$1,970	$169,420	$195,030	$218,670	$583,120	57%
Delivery & Other	$130	$11,180	$12,870	$14,430	$38,480	4%
Total Budget		$310,531	$339,054	$365,519	$1,015,104	100%

This program also serves as a feeder program for the prescriptive program (Program 5, C&I Rebates).

Program 9. Commercial and Industrial Custom (CORE PLUS)

This program targets only commercial, industrial and institutional accounts. The program is a totally custom program, designed to develop exceptionally productive energy savings opportunities in cooperation with the customer. Each project will be specially designed. The incentive is projected to be fifty percent of incremental cost. It is expected that projects will need to be carried out in narrow time windows as dictated by conditions specific to the customer's operations and that evaluation will consist primarily of short term instrumentation and spot metering. For the first nine months of each program year, no project may be allocated more than ten percent of the measures budget allocated for this program. The hurdle rate for projects under this program will be set to insure only the most cost-effective projects are selected so as to insure cost recovery.

Rationale

Some commercial and institutional customers will offer special opportunities for energy savings, either brought to I&M by the customer (or the customer's ESCO), or as identified by company account representatives and engineers. By providing a fifty percent "buy down," customer projects will be likely to move forward. Experience will show whether a fifty percent buy down is enough to attract projects. If this percentage proves too low (based on response to the program) the percentage buy down will be raised. Experience with similar projects in the Northeast has led utilities to offer 90 percent to 75 percent buy downs in this program sector. The hurdle rate (payment for savings) for the program will be set to insure I&M only acquires cost-effective projects.

Participation and Measures

Measures are shown below.

Table 31: Measures and Incentives – C&I Custom

Measures	Measure Number	Incentive
Customer Specified (Electric)	NA	Cost share of study to develop project proposal and 50% of energy efficiency improvements
Energy Champion (Large Industrial)	NA	
Integrated Building Design	C-8	

Table 32: Estimated Participation and Savings - C&I Custom

C&I Custom				
Potential Participants				4,000
Per participant Savings (kWh):				870,962
Per Participant Savings (kW):				143.3
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	54	1.4%	47,031,948	7,738
2015	64	1.6%	55,741,586	9,171
2016	72	1.8%	62,709,264	10,318
Average	63	1.6%	55,160,927	9,076

Because of the custom nature of the project, there will not be a large number of participants in any one year. Each participant, in this type of program, is special which makes tailoring to specific customers unique. In encouraging participation, it is important to recognize that standard baselines such as current practice for an industry or least cost alternative do not work for custom settings. Recognizing the unique baseline for each site, which will depend on the business operating procedures and on interactive equipment as much or more than on market factors should help in recruitment of participants

Marketing Plans

An example of this type of program is NSTAR Electric's Compressed Air Leak Detection and Remediation Program (www.compressedairchallenge.org and www.nstaronline.com/business/energy_efficiency). Also see Pacific Power's Energy FinAnswer and Energy FinAnswer Express programs, the WPPI, SDG&E and Mid-American Large Bid Programs and the Xcel Energy Large Industrial Process Improvement Program. It is expected that these will be high return projects in terms of savings achieved. The program approach is to "get out of the box" of conventional utility DSM programs to embrace programs that large customers may pursue for reasons of overall industrial efficiency. While both gas and electric energy will need to be analyzed, the Company would fund portions of these projects that produce electrical demand reductions and energy savings.

Program Tracking Considerations

Data requirements will vary with the specifications for each project. In some cases, utility billing meter information is capable of the level of detail required to assess program impacts. In other cases, spot metering or other types of assessment may be required. In any case, the program manager should collect, at a minimum, information about all customer electrical equipment, hours of operation, etc. It is expected that evaluations will primarily take the form of short term instrumentation and spot metering with engineering review. Since these are custom projects, it will be particularly important in insure provision is made to assess the kWh and/or kW condition that constitutes the baseline, and then measure the change due to the DSM improvements.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers include the remainder of energy study cost to develop project proposals, provision for staff involvement in developing and monitoring the project, and the remainder of equipment costs.

Table 33: Estimated Three-Year Program Budget – C&I Custom

C&I Custom	Cost per Participant	2014	2015	2016	3-Yr Total	Percent of Total
Fixed Costs						
Implementation & Other Annual Cost		$30,000	$30,000	$30,000	$90,000	2%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	4%
Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	7%
Variable Costs						
Incentives	$21,360	$1,153,440	$1,367,040	$1,537,920	$4,058,400	79%
Delivery & Other	$2,000	$108,000	$128,000	$144,000	$380,000	7%
Total Budget		$1,481,303	$1,717,348	$1,906,757	$5,105,407	100%

Program 10. Residential Home Energy Audit (CORE)

This program targets single-family and multi-family homes for a series of low-cost direct installed measures. Onsite walkthroughs are performed and recommendations are given for targeted weatherization retrofits that are needed and guidance is given to help the customer achieve greater savings in the home. The program delivery agent is responsible for the outreach and performance of the program and deemed savings are determined on a per site basis.

Rationale

The On-Site Audit with direct install program element will provide households with a walk-through examination of their home by a trained auditor. The auditor will convey energy saving tips during the walk-through, and attempt to be comprehensive in their assessment of opportunities. The recommendations of the auditor are expected to be standard measures associated with whole house weatherization, such as ceiling insulation, wall insulation, air sealing, etc. At the same time, during the walk-through audit, the auditor will install the measures at no cost to the customer.

Participation and Measures

Measures are listed below.

Table 34: Measures and Incentives – Residential Home Energy Audit

Measure	Measure Number	Incentive Amounts
Efficient Residential Lighting	R-11	100% of incremental cost
Low Flow Fixtures	R-12	100% of incremental cost
WH Tank/Pipe Wrap and Temp Setpoint	R-13	100% of incremental cost

Projected participation is shown in the table below.

Table 35: Estimated Participation and Savings – Residential Home Energy Audit

Residential Home Energy Audit				
Potential Participants				389,500
Per participant Savings (kWh):				465
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	6,201	1.6%	2,883,465	741
2015	5,453	1.4%	2,535,645	652
2016	5,453	1.4%	2,535,645	652
Average	5,702	1.5%	2,651,585	681

Marketing Plan

Marketing and customer communications will be orchestrated through the CORE program's contractor and the Utilities. Working together the groups will orchestrate a messaging campaign that will develop a target list of potential customers and ensure that customers understand the program benefits. The development of scheduled site visits will be orchestrated using a variety of outreach platforms including, direct mail, internet, email, call center and via neighborhood canvassing. All enrollment methods will provide detailed information to the customer regarding the scope of program operations.

Program Tracking Considerations

The CORE program contractor will be required to maintain a program tracking database.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. This program is provided at no cost to the customer. Due to the cost reimbursement mechanism established for gas treated homes, costs associated with measures that produce gas savings but no electric savings are not included. Gas savings are not included in the model.

Table 36: Estimated Three-Year Program Budget – Residential Home Energy Audit

Res On-Site Audit	Cost per Participant	2014	2015	2016	3-Yr Total	Percent of Total
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	2%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	6%
Monitoring & Evaluation		$30,000	$30,000	$30,000	$90,000	5%
Variable Costs						
Incentive	$37	$230,057	$202,306	$202,306	$634,670	37%
Delivery & Other	$50	$310,050	$272,650	$272,650	$855,350	50%
Total Budget		$615,038	$551,110	$552,375	$1,718,523	100%

Program 11. Residential Lighting (CORE)

The Residential Lighting program is focused on providing wholesale incentives to buy down or mark down the incremental cost of CFLs, LEDs, and other efficient lighting fixture and control systems.

The promotion will provide discounts to utility customers toward the purchase of CFLs, LEDs, and other ENERGY STAR qualified lighting efficiency products.

Rationale

The Residential Lighting program elements both improve the product mix in favor of energy efficient technologies for the service territory by promoting the purchase and stocking of efficient replacement units. Energy Star has overcome all of the defects of the earlier local or regional promotional programs through a single national program structured to periodically advance program standards and regulate minimum efficiencies. At the same time, it is structured to work with regional marketing initiatives and local promotion.

Participation and Measures

Measures are shown in the table below.

Table 37: Measures and Incentives - Residential Lighting

Measures/Program Element	Measure Number	Incentive Amount
Efficient Residential Lighting	R-11	66%

Projected participation by year is shown in the table below.

Table 38: Estimated Participation and Savings - Residential Lighting

Residential Lighting				
Potential Participants (yearly)				389,500
Per participant Savings (kWh):				274
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	60,373	15.5%	16,542,202	3,816
2015	70,110	18.0%	19,210,140	4,432
2016	74,005	19.0%	20,277,370	4,678
Average	68,163	17.5%	18,676,571	4,309

Marketing Plans

The program delivery agent will perform regular store visits to actively engage customers in Indiana with messages about the cost savings and environmental benefits of energy efficient lighting products. Promotional lighting program labeling and signage will be placed in retail locations that promote the participant products and provide customers with cost and efficiency value information. Activities within retail events may include a booth, educational materials and hands-on activities.

Program Tracking Considerations

Data collection and documentation for program purposes and monthly/annual reporting will be included as features of the vendor program.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 39: Estimated Three-Year Program Budget – Residential Lighting

Residential Lighting	Cost per Participant	2014	2015	2016	3-Yr Total	Percent of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	0.4%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	0.8%
Monitoring & Evaluation		$50,000	$50,000	$50,000	$150,000	1.1%
Variable Costs						
Incentives	$63	$3,803,499	$4,416,930	$4,662,315	$12,882,744	90.6%
Delivery & Other	$5	$301,865	$350,550	$370,025	$1,022,440	7.2%
Total Budget		$4,210,295	$4,873,634	$5,139,759	$14,223,688	100%

Program 12. Energy Efficient Schools – Education (CORE)

The program is available to public and private schools in the service territory for students in grades 5 and 6. The goal is to educate students about energy use and to produce cost effective electric and natural gas savings by influencing students and their families to focus on conservation and efficient use of electricity. Each eligible student will receive a kit of low-cost efficiency measures and educational materials.

Rationale

Education programs have in the past largely been seen as a part of the public service role of utilities and have generally emphasized information about the science of electricity and safety around power lines or when using electricity. The current program emphasizes the problem of assessing opportunities to make a home more energy efficient, joined with an opportunity to install kit items.

Education programs are important even without immediate energy savings because the substantial payoff for these programs is in the knowledge gained by the students and the potential influence it will have in their ability to make smart energy choices over the life course. The assessed savings for this program come from the kit measures installed.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 40: Measures and Incentives – Residential Energy Efficient Schools - Education

Measures – Kit Items	Measure Number	Incentive
Efficient Residential Lighting	R-11	100%
Low Flow Fixtures	R-12	100%

Table 41: Estimated Participation and Savings – Energy Efficient Schools - Education

Energy Efficient Schools - Education				
Potential Participants				5,729
Per participant Savings (kWh):				318
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	5,443	95.0%	1,730,874	446
2015	5,443	95.0%	1,730,874	446
2016	5,443	95.0%	1,730,874	446
Average	5,443	95.0%	1,730,874	446

Marketing Plans

This program is unusual because its success depends on considerable ongoing effort to work with school organizations at several levels in order to insure institutional support and to promote enthusiasm for the program among teachers and students.

Program Tracking

The program requires detailed reporting on school, classroom and student participation rates, allocation of kits, and documentation of kit items installed. All data requirements should be part of the program database maintained by the program vendor.

Budget Assumptions

An estimated three-year budget for this program is provided below. There are no costs to participating customers. Due to the cost reimbursement mechanism established for gas treated homes, costs associated with measures that produce gas savings but no electric savings are not included. Gas savings are not included in the model.

Table 42: Estimated Three-Year Program Budget – Energy Efficient Schools – Education

Energy Efficient Schools - Education	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	5.2%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	7.0%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	19.6%
Variable Costs						
Incentives	$23	$124,645	$124,645	$124,645	$373,934	32.6%
Delivery & Other	$25	$136,075	$136,075	$136,075	$408,225	35.6%
Total Budget		$381,595	$382,500	$383,437	$1,147,532	100%

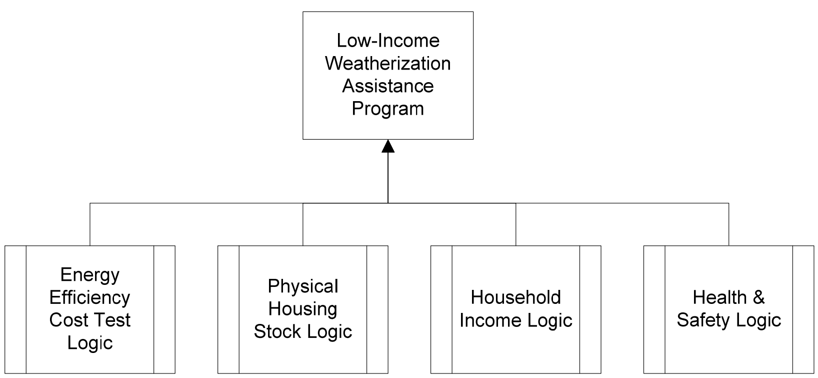
Program 13. Income Qualified Weatherization (CORE)

This program will serve income qualified residential customers. The program element is the Residential Low Income Program which will serve customers up to an including 200 percent of the Federal Poverty Level. The program is oriented toward single-family detached homes. .

Rationale

Low-income programs are different from traditional DSM programs. They are a special case in that they attempt to cover four objectives:

1. Like other DSM programs, a core objective is to provide energy savings (DSM savings).
2. Unlike other DSM programs, a second core objective is to provide repairs necessary to install energy savings improvements in a part of the housing stock that is often old and substandard in comparison to middle and upper income housing.
3. Provide DSM service to customers who otherwise could not obtain DSM improvements due to cost.
4. Due to problems with low-income housing stock, address health and safety concerns.



For these reasons, the prevailing practice in the area of low-income programs is not to focus solely on the "California tests" traditionally used in DSM program review.[8] Instead,

[8] For low-income programs, program cost-effectiveness is a lesser issue, although still an important objective. Because of their particular focus on the special needs of disadvantaged households, low-income energy efficiency programs are generally not held to the same cost-effectiveness criteria as utility energy-efficiency "resource" programs (i.e., while test results are calculated for consideration as one factor, they are not judged with a strict "total resource cost" test, or TRC). More typically, the focus is on the magnitude of utility bill savings to participating customers, rather than the utility system avoided energy supply costs. Also, low-income programs often include

commissions have been adopting different tests for low-income programs. For example, the DC Commission uses an "Expanded All Ratepayers Test" (incorporating several "non-energy benefits" for low-income programs if the Benefit Cost ratio on the initial TRC test is 0.8 or above). The California commission uses a "Modified Participant Test" and a Utility Cost Test (including "non-energy benefits") for screening measures for low-income programs. A measure is accepted into the program if it passes either test. Thus, the Total Resource Cost (TRC) test result for the Southern California Edison Low-Income Energy Management Assistance Program was 0.63 for 2004 and 0.61 for 2005. Similarly, the TRC for Pacific Gas & Electric's Low-Income Energy Partners Program was 0.41 for 2004.[9]

Unlike most of the DSM programs in this report, the Income Qualified Weatherization Program will also serve homes heated with natural gas up to the limit of reimbursement by gas companies. Due to the cost reimbursement mechanism established for gas treated homes, costs associated with measures that produce gas savings but no electric savings are not included. Gas savings (therms) are also not included in the spreadsheet models.

Participation and Measures

The types of weatherization measures to be offered are shown in the table below. This program is free to qualifying participants each year until funds are exhausted.

Table 43: Measures – Residential Income Qualified Weatherization

Measure	Measure Number
Ceiling Insulation/Attic Insulation	R-2
Refrigerator Charge and Duct Tune-Up	R-4
House Sealing Using Blower Door	R-5
Efficient Residential Lighting	R-11
Low Flow Fixtures	R-12
Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-13

broader "non-energy benefits" (NEBs) such as lowered credit and collection costs and avoided bad debt for the utility, and improved health and safety for customers. See: Kushler, Martin, Dan York & Patti Witte, "Meeting Essential Needs: The Results of a National Search for Exemplary Utility-Funded Low-Income Energy Efficiency Programs." Washington, DC: American Council for an Energy-Efficient Economy, Report Number U053, September 2005.

[9] For differences in the treatment of TRC with respect to low-income programs in several jurisdictions, please see: https://dl.dropbox.com/u/12011114/The%20TRC%20and%20Low-Income.pdf

Table 44: Canvassing Measures – Residential Income Qualified Weatherization

Measure	Measure Number
7-Plug Smart Strips	RC-1
Compact Fluorescent Light	RC-2

Table 45: Estimated Participation and Savings - Residential Income Qualified Weatherization

Income Qualified Weatherization				
Potential Participants				135,500
Per participant Savings (kWh):				1,730
Per Participant Savings (kW):				0.6
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,322	1.0%	2,287,060	810
2015	1,322	1.0%	2,287,060	810
2016	1,322	1.0%	2,287,060	810
Average	1,322	1.0%	2,287,060	810

Marketing Plans

Marketing will be performed as a combined effort between the utility and the program delivery agent. Identified communities will receive program information and canvassing dates during which time each home will be approached for weatherization services on a door-to-door basis.

Program Tracking Considerations

Data collection and documentation for program purposes and annual reporting will require a tracking system. The selected delivery contractor will be requested to carry out most of the data entry for this system.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. Costs to participating customers will be customer's time and permitting access to the home for improvements.

Table 46: Estimated Three-Year Program Budget – Residential Income Qualified Weatherization

Income Qualified Weatherization	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	0.6%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	1.1%
Program Monitoring & Evaluation		$120,000	$120,000	$120,000	$360,000	3.7%
Variable Costs						
Incentives	$574	$759,452	$759,452	$759,452	$2,278,356	23.4%
Delivery & Other	$1,750	$2,313,500	$2,313,500	$2,313,500	$6,940,500	71.2%
Total Budget		$3,247,883	$3,249,106	$3,250,371	$9,747,360	100%

Program 14. Residential Weatherization (CORE PLUS)

This program provides a home weatherization inspection audit, blower-door leak test and recommendations to the homeowner for incented weatherization measures. This program targets electrically heated homes that have incomes above the qualification criteria for the moderate and income qualified weatherization program. The program is designed to ensure the retrofit installation of major weatherization measures in households.

Rationale

The program is designed to promote whole-house or near whole-house weatherization for families above moderate incomes.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 47: Measures and Incentives – Residential Weatherization

Measure	Measure Number	Incentive Amounts
Wall Insulation	R-1	40%
Ceiling Insulation	R-2	40%
Programmable Thermostats	R-3	40%
Refrigerator Charge and Duct Repair	R-4	40%
House Sealing Using Blower Door	R-5	40%
Low Flow Fixtures	R-12	40%
HW Tank/Pipe Wrap and Temperature Setpoint	R-13	40%

Projected participation is shown in the table below.

Table 48: Estimated Participation and Savings - Residential Weatherization

Residential Weatherization				
Potential Participants				56,724
Per participant Savings (kWh):				2,085
Per Participant Savings (kW):				0.9
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,333	2.4%	2,779,305	985
2015	1,361	2.4%	2,837,685	1,005
2016	1,418	2.5%	2,956,530	1,047
Average	1,371	2.4%	2,857,840	1,012

Marketing Plans

I&M will need to actively market this program in customer communications, such as bill stuffers and radio or television spot advertisements. Employees can also make customers aware of this program if they contact the company about energy efficiency or a need to lower bills.

Program Tracking Considerations

Data collection and documentation for program purposes and annual reporting will require a tracking system. The selected delivery contractor will be requested to carry out most of the data entry for this system. All data requirements should be part of the program database.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 49: Estimated Three-Year Program Budget – Residential Weatherization

Res Weatherization	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	1%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	2%
Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	6%
Variable Costs						
Incentives (paid annually to participants)	$419	$557,994	$569,715	$593,575	$1,721,283	33%
Delivery & Other	$750	$999,750	$1,020,750	$1,063,500	$3,084,000	58%
Total Budget		$1,712,675	$1,746,618	$1,814,493	$5,273,787	100%

Program 15. Moderate Income Weatherization (CORE PLUS)

This program provides a home weatherization inspection audit and blower-door leak tests and recommendations to the homeowner for incented weatherization measures. This program targets electrically heated homes that have incomes above the qualification criteria for the Core Income Qualified Weatherization program but below 300% FPL. The program is designed to ensure the retrofit installation of major weatherization measures in households.

Rationale

The program is designed to promote whole-house or near whole-house weatherization for families of moderate income. The program designed incentive is lower than the Core Income Qualified Weatherization program but more than the Core Plus Residential Weatherization Program. Some health and safety repair costs are included in the implementation budget.

Participation and Measures

Measures are shown in the table below, and may be added or subtracted during the program based on experience.

Table 50: Measures and Incentives – Moderate Income Weatherization

Measure	Measure Number	Incentive Amounts
Wall Insulation	R-1	50%
Ceiling Insulation	R-2	50%
Programmable Thermostats	R-3	50%
Refrigerator Charge and Duct Repair	R-4	50%
House Sealing Using Blower Door	R-5	50%
Residential Efficient Lighting	R-11	100%
Low Flow Fixtures	R-12	50%
HW Tank/Pipe Wrap and Temperature Setpoint	R-13	50%

Projected participation is shown in the table below.

Table 51: Estimated Participation and Savings – Moderate Income Weatherization

Moderate Income Weatherization				
Potential Participants				17,650
Per participant Savings (kWh):				4,124
Per Participant Savings (kW):				1.5
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	706	4.0%	2,911,544	1,031
2015	794	4.5%	3,274,456	1,160
2016	883	5.0%	3,641,492	1,290
Average	794	4.5%	3.275,831	1,160

Marketing Plans

I&M will need to actively market this program in customer communications, such as bill stuffers and radio or television spot advertisements. Employees can also make customers aware of this program if they contact the company about energy efficiency or a need to lower bills.

Program Tracking Considerations

Data collection and documentation for program purposes and annual reporting will require a tracking system. The selected delivery contractor will be requested to carry out most of the data entry for this system. All data requirements should be part of the program database.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 52: Estimated Three-Year Program Budget – Moderate Income Weatherization

Moderate Income	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	1%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	1%
Monitoring & Evaluation		$100,000	$100,000	$100,000	$300,000	5%
Variable Costs						
Incentives	$756	$533,612	$600,125	$667,393	$1,801,131	28%
Delivery & Other	$1,750	$1,235,500	$1,389,500	$1,545,250	$4,170,250	65%
Total Budget		$1,914,987	$2,136,406	$2,360,361	$6,411,754	100%

Program 16. Residential Energy Efficient Products (CORE PLUS)

This program will provide rebates to I&M customers toward the purchase energy efficient appliances including ductless heat pumps, heat pump water heater, and selected consumer electronics. Cool roof materials will also be included.

The dollar amount for the appliance incentive for this promotion is lower than might be expected based on industry experience in prior years. This is due in part to recent changes in the Energy Star program and the overall success of the Energy Star strategy as demonstrated by the gradual increase in energy efficiency of base case (non-Energy Star) equivalent products. Refrigerators may be included based on analysis as new Energy Star refrigerator standards go into effect. Currently some DSM administrators, such as the Energy Trust of Oregon, offer refrigerator rebates only on Consortium for Energy Efficiency (CEE) Tier 3 refrigerators. Rebates for energy efficient appliances should be set using Consortium for Energy Efficiency tiers.

Rationale

Energy efficient appliances and other residential products improve the product mix in favor of energy efficient technologies for the service territory by promoting the purchase and stocking of efficient replacement units. Appliance promotions are best developed on a national level with participation by utilities and governments. Energy Star has overcome all of the defects of the earlier local or regional promotional programs through a single national program structured to periodically advance program standards and regulate minimum efficiencies. At the same time, it is structured to work with regional marketing initiatives and local promotion.[10]

Participation and Measures

Representative measures are shown in the table below.

[10] For an example of the history of the residential clothes washer initiative, see Shel Feldman Management Consulting, Research into Action incorporated, and Xenergy incorporated, *The Residential Clothes Washer Initiative*, *A Case Study of the Contributions of a Collaborative Effort to Transform the Market,* prepared for the Consortium for Energy Efficiency, June 2001.

Table 53: Measures and Incentives – Residential Energy Efficient Products

Measures	Measure Number	Incentive
Cool Roofs	R-7	50%
Electric Heat to SEER 16 Heat Pump	R-8	50%
Energy Star Clothes Washer	R-10	50%
Heat Pump Water Heater	R-14	50%
Ductless Heat Pump	R-15	50%

Table 54: Estimated Participation and Savings – Residential Energy Efficient Products

RES EE Products				
Potential Participants (yearly)				389,500
Per participant Savings (kWh):				801
Per Participant Savings (kW):				0.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	19,086	4.9%	15,287,886	3,542
2015	19,086	4.9%	15,287,886	3,542
2016	19,086	4.9%	15,287,886	3,542
Average	19,086	4.9%	15,287,886	3,542

Because of normal consumption trends, a large numbers of customers are expected to participate in this program from the beginning. Note that for this program customers may repeat in different years. The offer of energy efficient products is a long established role for utilities. Also, customers tend to trust utilities for information on energy efficiency. Communication with customers regarding offerings in this program is expected to proceed with ease.

Marketing Plans

Proposed marketing efforts focus on coordinated advertising with selected retail outlets, general media ads and bill stuffers. This type of program is best implemented using program implementation vendors. The program elements exist in nationally available programs for utilities to implement, and selection of a regional vendor will provide added value in the form of detailed program and technology knowledge and relationships. A basic assumption in the development of this program is that it is not so much the size of the rebate so much as the existence of a rebate and the skill in developing engaging promotions and long-term relationships with the appliance industry and dealers that will help move the more energy-efficient products.[11]

The basic marketing goals for the appliance program elements come from the Consortium for Energy Efficiency and Top Ten™ and are provided below:[12]

- Consumers understand and value the benefits from energy-efficient features.
- Retail sales force is knowledgeable about Energy Star and considers it a meaningful distinction for making a sale.
- Rebate stickers are on appliances on retail sales floors.
- Manufacturers market and promote energy-efficient products and/or features.
- Energy efficiency, defined by Energy Star performance levels, becomes a standard feature or is available across all manufacturers' product lines.
- Energy Star represents the most energy efficient quality products available, but generally now serve as the base and the rebated appliance is typically a Tier 3 Consortium for Energy Efficiency retail appliance or a Top Ten™ level Energy Star appliance. *Though we refer to the efficient alternative as Energy Star, we really mean Consortium for Energy Efficiency Tier 3 or Top Ten™ appliances.*

In this program, I&M will be an active participant in the US Energy Star campaign. Through this participation, it is expected that the company will move more Energy Star products into retail stores, help make energy efficient lighting more affordable to its customers, and provide a continuing and responsible guidance and energy efficiency education message to customers.

Incentives may be implemented by coupons, in-store markdowns, or upstream manufacturer buy-downs. A coupon approach is more suitable for a service territory because it gives the program administrator direct control over where coupons are available and for which sales outlets.

Program Tracking

Data collection and documentation for program purposes and monthly/annual reporting will be included as features of the vendor program "package." Data estimation of the baseline market and market potential for the specific Energy Star appliances promoted should be refined as a part of the vendor services and developed for each product type.

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[11] A review of rebates offered across the US suggests that most utilities are offering rebates from this kind of marketing and promotional perspective rather than from a direct resource acquisition perspective. See the Database of State Incentives for Renewables & Efficiency, (DSIRE), maintained by the North Carolina Solar Center for the Interstate Renewable Energy Council (IREC) funded by the U.S. Department of Energy (DSIRE) at http://www.dsireusa.org/.

[12] CEE's National Residential Home Appliance Market Transformation Strategic Plan, December 2000 (http://www.docstoc.com/docs/78624721/Home-Appliance-Market).

Budget Assumptions

An estimated three-year budget for this program is provided below. The cost to participating customers is the customer's share of the cost (cost of product after the rebate).

Table 55: Estimated Three-Year Program Budget – Residential Energy Efficient Products

RES EE Products	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	0.2%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	0.5%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	1.5%
Variable Costs						
Incentives	$254	$4,845,267	$4,845,267	$4,845,267	$14,535,802	95.9%
Delivery & Other	$5	$95,430	$95,430	$95,430	$286,290	1.9%
Total Budget		$5,051,572	$5,052,478	$5,053,415	$15,157,465	100%

Program 17. Residential Online Audits (CORE PLUS)

This program provides an online tool available for all residences within the I&M service territory. Individuals are invited to participate by modeling their residence's equipment and typical household operations. Guidance is then given to the participant on potential energy efficiency activities or measures that might be useful in helping them to achieve greater efficiency within their home. Based on the survey results, a kit of low-cost measures is mailed to the participants for self-installation.

Rationale

The program is open to all residential customers at no charge to provide easy access to energy efficiency recommendations tailored to the home. Since it is conducted by Internet, it can fit in a customer's schedule, and provides an opportunity for all customers to participate. The program elements are an entry-level degree of customer engagement, providing a way for customers to begin to get direct information on what they can do to make their home more energy efficient.

All homes will receive low-cost lighting measures for self-installation. Homes that identify as electrically heated will also receive water conservation measures.

Participation and Measures

Measures are shown below.

Table 56: Measures and Incentives – Residential Online Audit

Measures	Measure Number	Incentive Amounts
CFLs	R-11	100%
Low Flow Fixtures	R-12	100%

Projected participation by year is shown in the table below.

Table 57: Estimated Participation and Savings – Residential Online Audit

Residential Online Audit				
Potential Participants				389,500
Per participant Savings (kWh):				321
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,169	0.3%	375,249	97
2015	1,558	0.4%	500,118	129
2016	1,753	0.5%	562,713	145
Average	1,493	0.4%	479,360	123

Marketing Plans

The program will be marketed to residential households through normal customer communications and as a feature on the company website.

Program Tracking Considerations

Website activities should be utilized to populate a tracking database with comprehensive list of all recommendations made to participants. Savings assessments will be determined based on follow-up surveys and tracking of measures contained within the savings kits. This program will be used as a feeder to other programs.

Detailed Budget Plans

An estimated three-year budget for this program is provided below.

Table 58: Estimated Three-Year Program Budget – Residential Online Audit

Res Online Audit	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Program Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	5%
DSM Staffing		$69,863	$72,308	$74,837	$217,007	38%
Monitoring & Evaluation		$35,000	$35,000	$35,000	$105,000	19%
Variable Costs						
Incentives	$23	$26,887	$35,834	$40,319	$103,040	18%
Delivery & Other	$25	$29,225	$38,950	$43,825	$112,000	20%
Total Budget		$170,975	$192,092	$203,981	$567,047	100%

Program 18. Residential Appliance Recycling (CORE PLUS)

The recycling program improves the in-service technology mix for the service territory by removing energy hog appliances and deleting them from existence in an environmentally friendly way. Appliance recycling is available primarily through two national program vendors, both of which bring the necessary environmentally sound technologies and procedures to the program.

This program targets households with second refrigerators or freezers. The program will provide free refrigerator and/or freezer pick up. Once I&M receives verification that the refrigerator has been recycled, the customer will receive a $40 incentive.

Rationale

This program targets residential customers with second refrigerators or freezers, preferably those older than 1993. The program is designed to take these inefficient older refrigerators off the market entirely, and to do so in an environmentally-sustainable manner. I&M will pay a $40 incentive to each customer to help persuade them to get rid of the second refrigerator or freezer, and will also cover the cost associated with removing the refrigerator or freezer and recycling its components.

Participation and Measures

Measures are shown below.

Table 59: Measures and Incentives – Residential Appliance Recycling

Measure	Measure Number	Incentive Amount
Eliminate Old Appliances	R-9	$40

Projected participation is reported in the following table.

Table 60: Estimated Participation and Savings – Residential Appliance Recycling

Res Appliance Recycle				
Potential Participants				119,000
Per participant Savings (kWh):				1,009
Per Participant Savings (kW):				0.2
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,785	1.5%	1,801,065	378
2015	3,570	3.0%	3,602,130	755
2016	7,140	6.0%	7,204,260	1,511
Average	4,165	3.5%	4,202,485	881

Marketing Plans

This program will be marketed directly to consumers through bill inserts, direct mailing materials, and through refrigerator distributors. The program will need to mail information to customers on a regular schedule (twice a year basis, or more frequently as needed to produce the desired participation rates), and through point-of-purchase information at trade ally facilities.

Program Tracking Considerations

The program vendor will be required to supply a detailed database sufficient to demonstrate the age and condition of units picked up and also to demonstrate that the units are properly destroyed and recycled. In addition, the database should be sufficient to supply data necessary for program evaluation. Generally tracking for this program type begins with a photo of the refrigerator nameplate or attachment of an ID code sticker on pick-up, and tight tracking capability is required through disassembly to insure beyond question that there is never even a slight diversion of working units to the secondary market.

Detailed Budget Plans

An estimated three-year budget for this program is provided below. There are no costs to participating customers.

Table 61: Estimated Three-Year Program Budget – Residential Appliance Recycling

Res Appliance Recycle	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	2%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	4%
Monitoring & Evaluation		$90,000	$90,000	$90,000	$270,000	10%
Variable Costs						
Incentives	$40	$71,400	$142,800	$285,600	$499,800	19%
Delivery & Other	$140	$249,900	$499,800	$999,600	$1,749,300	65%
Total Budget		$466,231	$788,754	$1,432,619	$2,687,604	100%

Program 19. Residential New Construction (CORE PLUS)

This is a "beyond Energy Star" strategy for new residential construction. A second program element, Energy Star manufactured homes would have been included except that the relatively small stock and yearly increment of manufactured homes in I&M's Indiana service territory are too small to support a program.

Recent changes in Energy Star and the general success of Energy Star in improving the performance of baseline (Non Energy Star) new homes have negatively affected the cost-effectiveness of the standard Energy Star program. In the Energy Star program, there are many builder pathways (called Building Options Packages) to enable manufacturers to meet Energy Star criteria. Many Energy Star builders, in order to be sure of meeting the Energy Star criterion, now build beyond it. From a utility perspective, supporting "beyond Energy Star" homes is the only viable option to insure cost-effectiveness of this program element.

Two other certifications have been introduced into the home performance market. These are LEED and Passivehaus. The basic concept of the program is the "high performance" home. All such homes will be Energy Star Plus and some will also be LEED and Passivehaus certified. I&M should provide all three tracks. The ultimate goal is the "net zero ready" home, which, with the addition of Solar PV from the renewable energy program will become net zero or even slightly revenue positive for the household, selling net energy back to the utility. This end goal will not be met by most homes in the program, but they can all be oriented towards this track.

Passive solar design and orientation reduce a home's heating and cooling costs and makes the home more comfortable. Better lighting and better internal temperature control are to be included. The incremental cost of $3,000 per home plus a $500 inspection fee in the illustrative measure package represents a generalized measure package.

Rationale

The basic philosophy for the program should incorporate net-zero concepts. These include an expected measure life for the new house of 150 years and a net-zero plan. The plan for each house will provide elements of energy savings in the original construction plus a set of steps which may be taken later to move towards net-zero. The key feature of the plan is to order elements so no work impedes the future steps. PV, since it is not a DSM measure is not included in this program but the goal is a house that is solar ready. A basic concept is the development of the customers as a repeat customer for additional increments or energy efficiency packages throughout the life of the structure.

Participation and Measures

Measures are shown below.

Table 62: Measures and Incentives – Residential New Construction

Measures	Measure Number	Incentive Amounts
Energy Star New Home (Building Options Package)	R-6	$1,500
Lighting and Appliance Bonus when 10 energy efficient fixtures and 3 labeled Energy Star appliances are included (or equivalent upgrade)		
Inspection Service Fee		$500

Projected participation by year is shown in the table below.

Table 63: Estimated Participation and Savings - Residential New Construction

Res New Construction				
Potential Participants				375
Per participant Savings (kWh):				4,222
Per Participant Savings (kW):				1.4
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	56	15.0%	236,432	77
2015	94	25.0%	396,868	130
2016	113	30.0%	477,086	156
Average	88	23.3%	370,129	121

Marketing Plans

The financial incentive is provided directly to homebuilders to help offset the additional cost to build an Energy Star home. This gives the incentive a multiplier of between two and three. This program element is a vendor-delivered program requiring an experienced Energy Star program vendor. The program vendor provides all of the detailed knowledge and relationships to put the program in place with a restricted set of measures to reach savings levels significantly beyond Energy Star using a set of builder options packages. While the customer has higher first cost, the customer pays less for energy over the life of the home and on a life cycle basis comes out well ahead financially. The program vendor will also provide the established channels to national builders, establish relationships with local builders, and will come supplied with all manner of promotional materials.

The key, according to the Texas Energy Star program, is in promoting the value of the brand to builders who would like to differentiate their product. Marketing methods include:

1. Newspaper and real estate guide ads
2. Signage
3. Marketing materials
4. Builder and subcontractor training and ongoing technical assistance
5. Training in the advantages of Energy Star homes for all the builders, sales staff, realtors, and the lending community.
6. Seminars and literature targeted at consumers. This is a valuable addition to a marketing effort because consumers can create a market pull.

Key points to include in a beyond Energy Star program element are:[13]

1. Establish a single stable multi-year approach. This will give stability to builders and allow the program to grow more readily.
2. Establish a single, simple, and high program standard of efficiency. This is important because it lets builders know where they stand and what is expected.
3. Establish good relationships with area builders and developers.
4. Ensure that staff professionalism, delivery systems, equipment, marketing materials and quality assurance are all of high quality.
5. Maintain strict adherence to specifications based on sound building science and economics to maintain program credibility and consistency.
6. Establish a process for certifying and documenting homes built to requirements.[14]
7. Develop a solid infrastructure of experienced, well-known and respected organizations.

[13] Drawn from Vermont Energy Star Program, managed by Efficiency Vermont.
[14] Texas Energy Star Program.

8. Develop targeted incentives that are well coordinated with marketing and other service-related materials.
9. Coordinate with health and safety standards and codes for residential construction.
10. Provide ongoing technical training for builders and subcontractors.
11. Promote builders buy-in into the program by getting them financially invested in the program through advertising, building requirements, and training so they will support all aspects of the program.[15]
12. New construction is an excellent area to review for strategic combination of gas and electric energy efficiency measures.

Program Tracking Considerations

As Energy Star homes, Energy Star Plus homes are certified by HERS raters, and I&M will need to work with the HERS raters and the program vendor to establish a workable data tracking system. There are several models for this system, for example the "Dashboard" system developed by Paragon Consulting Services.

Detailed Budget Plan

An estimated three-year budget for this program is provided below. Costs to participating customers include the customer's outlay for any remaining incremental cost of the Energy Star Plus home.

[15] Texas Energy Star Program.

Table 64: Estimated Three-Year Program Budget – Residential New Construction

Res New Construction	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$10,000	$10,000	$10,000	$30,000	3.7%
DSM Staffing		$34,931	$36,154	$37,419	$108,504	13.3%
Monitoring & Evaluation		$50,000	$50,000	$50,000	$150,000	18.4%
Variable Costs						
Incentives	$1,500	$84,000	$141,000	$169,500	$394,500	48.4%
Delivery & Other	$500	$28,000	$47,000	$56,500	$131,500	16.2%
Total Budget		$206,931	$284,154	$323,419	$814,504	100%

Program 20. Residential Neighborhoods (CORE PLUS)

This program is targeted primarily to households at or below 150 percent of poverty. The program involves identification of a specific neighborhood with approximately 60 percent low-income customers which is approached through local leaders and an organized effort to secure community participation.

The program provides a set of low-cost/no-cost energy saving homes in the neighborhood. This service will be provided to all homes, including low-income and non low-income homes. Gas customers are provided with energy efficient lights (CFLs, LEDs and/or halogens). Electrically heated homes will receive lighting measures, low-flow fixtures and some portion will receive infiltration reduction treatment. Though administered through a program delivery vendor, the program requires staff involvement in community meetings and events.

The program concentrates services in a neighborhood blitz and with local recognition to minimize cost. It then moves on to another neighborhood. By concentrating on lower income neighborhoods and rural communities, the program serves mainly low-income customers. However, in keeping with the community approach all homes in the neighborhood are offered service.

Participation and Measures

Measures are shown in the table below.

Table 65: Measures and Incentives – Residential Neighborhoods

Measures	Measure Number	Incentive
House Sealing using Blower Door	R-5	100%
Efficient Residential Lighting	R-11	100%
Low Flow Fixtures	R-12	100%
Tank Wrap, Pipe Wrap & Water Temp Setpoint	R-13	100%

Participation is expected to begin with the selection of one or two neighborhoods, and then be expanded to additional neighborhoods. Projected participation by year is shown in the table below.

Table 66: Estimated Participation and Savings – Residential Neighborhoods

Residential Neighborhoods				
Potential Participants				210,300
Per participant Savings (kWh):				583
Per Participant Savings (kW):				0.1
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	1,262	0.6%	735,746	189
2015	2,103	1.0%	1,226,043	315
2016	3,155	1.5%	1,839,365	472
Average	2,173	1.0%	1,267,053	325

Marketing Plans

Marketing is approached through community social relations in a neighborhood application with the support of community leaders. Generally, a community meeting or community dinner will be included. Application will be in a house by house blitz.

Program Tracking

Data collection and documentation for program purposes and annual reporting will require a tracking system so that measures installed can be tracked by relevant household classification variables.

Budget Assumptions

The budget for this program will be refined with experience. In several ways, this is a social marketing program rather than a traditional marketing program in that it is community based. This means there will be overhead for working with local officials and community leaders and for community events such as a dinner.

Table 67: Estimated Three-Year Program Budget – Residential Neighborhoods

Residential Neighborhoods	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	4%
DSM Staffing		$36,225	$37,493	$38,805	$112,522	7%
Monitoring & Evaluation		$75,000	$75,000	$75,000	$225,000	13%
Variable Costs						
Incentives	$147	$185,893	$309,772	$464,732	$960,396	57%
Delivery & Other	$50	$63,100	$105,150	$157,750	$326,000	19%
Total Budget		$380,218	$547,415	$756,286	$1,683,918	100%

Program 21. Residential Home Reports (CORE PLUS)

The Home Energy Comparison Report is a periodic comparative usage report that compares customers' energy use relative to similar residences in the same geographical area and which also gives customers specific energy savings recommendations to encourage energy saving behavior. The reports are typically mailed quarterly but the pattern may be altered by the program manager. The recommendations may be accompanied by coupons and links to other Company programs and to a website that promotes energy efficiency opportunities. The program has been tested as a pilot in South Carolina, where it was limited to individually metered, owner-occupied single family homes. The pilot showed approximately 2 percent overall energy savings for the pilot participants as compared to a control group of non-participants. According to the evaluation study, customers who reduced energy use tended to live in homes that had higher energy consumption and customers who increased energy use tended to live in homes with lower energy consumption compared with average homes. Based on pilot results, expansion to a full scale program will use information on homes that lowered use and homes that increased use for targeting and for testing messaging content to improve program performance.

Rationale

Customer Reports programs have emerged since 2007 and are being introduced by several utilities and other DSM administrators. They are often referred to as "behavioral" programs since the program theory is that careful messaging will influence energy savings behavior and because the first generation of these pilot programs studied only the messages and the net energy savings with respect to the control group. Only much more recently have the physical mechanisms causing energy savings been a subject of program research. Behavior, for example, may be as simple as changing energy use habits and patterns. Or it may be the purchase of an energy efficient appliance. It could be participation in one of the Company's other DSM programs. This program differs from all other DSM programs because it is not designed to provide meaningful savings to individual households. An average savings of 2 percent is well within the range of normal year to year variation in household energy use ("noise"), and the pattern of reduction for high use homes coupled with increase for low use homes is the typical pattern of regression to the mean. However, if the 2 percent savings can be shown to hold up over time as a contrast between a treatment group and a control group (with both groups determined by random assignment under control of a third-party evaluator rather than the Company or a program vendor or implementer) the result is meaningful and sizable at the system level on a one-year savings basis.

Participation and Measures

There is one measure, the Customer Report. However, the reports may be delivered with different frequencies, and messaging may be tested to achieve best results.

Table 68: Measures – Residential Home Reports

Measures – Kit Items	Measure Number
Residential Home Report	R-16

Table 69: Estimated Participation and Savings – Residential Home Reports

Potential Participants				194,750
Per participant Savings (kWh):				193
Per Participant Savings (kW):				0.05
Program Year	**Incremental Participants**	**Percent Participation**	**kWh Saved**	**kW Saved**
2014	38,950	20.0%	7,517,350	1,930
2015	38,950	20.0%	7,517,350	1,930
2016	38,950	20.0%	7,517,350	1,930
Average	38,950	20.0%	7,517,350	1,930

The knowledge base for messaging is similar to that for corporate communications and traditional marketing and promotion programs.

This program type is unique in that it presents no dollar cost that is apparent to customers and participation is assigned by the utility (with provision for opt-out) as a part of the program design. As this program matures, different groups of customers may be targeted for participation.

Marketing Plans

Since the program content is marketing and promotion/corporate communications there is not a special marketing plan other than the actual Customer Reports. Instead, the program manager will determine which customers should be included and which excluded from the program (targeting). Then the total group eligible for the program will be split using random assignment conducted by the third party independent evaluator. This will provide a treatment group and a control group. The treatment group will receive the messaging; the control group will not. Possibly the program manager will decide to form more than one treatment and/or control group. In that case, the key feature is always random assignment from a pool of eligible customers to the various groups. Also, frequency of reports may be quarterly or varied.

Program Tracking

Data collection and documentation for program purposes and annual reporting will require a tracking system. This will require careful tracking of group members, attrition, and of messages and frequency. In addition, an effort will be conducted to determine the physical causes of energy savings and customer costs.

Budget Assumptions

Costs to participating customers will be customer's time and any incremental costs due to selection of energy-efficient appliances or home improvements. Company costs will be limited to the communications, the tracking system, and determining the actual customer costs. An estimated three-year budget for this program is provided below.

Table 70: Estimated Three-Year Program Budget – Residential Home Energy Reports

Residential Home Report	Cost/ Participant	2014	2015	2016	3-Yr Total	% of Total
Fixed Costs						
Implementation & Other Annual Cost		$20,000	$20,000	$20,000	$60,000	4%
DSM Staffing		$25,875	$26,781	$27,718	$80,373	5%
Monitoring & Evaluation		$40,000	$40,000	$40,000	$120,000	7%
Variable Costs						
Incentives	$0	$0	$0	$0	$0	0%
Delivery & Other	$12	$467,400	$467,400	$467,400	$1,402,200	84%
Total Budget		$553,275	$554,181	$555,118	$1,662,573	100%

The Measures

The first question about measures is whether there should be a Measures section in a Program Action Plan now that there is a fully completed Indiana Technical Resource Manual (TRM). An alternative would be to simply reference all measures to the TRM. But each team developing Program Action Plans brings its own experience and this experience will color to some degree how certain measures are understood in the ex ante planning process. Where there are differences of perspective, the planning process for Program Action Plans is one of the key places where discussions of possible changes to the TRM will arise.

The purpose of this section is to provide documentation of the assumptions used to screen the Energy Efficiency Measures (EEMs) identified for consideration in this report. Our assumptions are based on references cited throughout this section as well as the direct experience of our team with technologies in the field and actual DSM program evaluations. While not all of the field and DSM program experience can be cited in published works, published references are used to establish a reasonable range of assumptions. The point estimate used within that range is based on our professional opinion. For the most part, since the Indiana TRM now exists, measure characteristics have been conformed to the Indiana TRM.

The mapping of EEMs to Residential DSM programs is shown in the table below by the value listed in each cell. The value represents the percentage of participants installing the measure. Cells with no value mean the measure is not included in the program.

Measure Maps

The mapping of EEMs to DSM programs is shown in the following tables. Measures are listed down the side of each table; programs are listed across the top. The Residential table is shown first, followed by the Commercial & Industrial table.

The values represented in each table are the percentage of participants installing each measure. Cells with no value mean the measure is not included in the program.

Table 71: Residential Measure Map.

RESIDENTIAL PROGRAMS: MEASURE MAPPING								
Residential Program No.			**10**	**11**	**12**	**13**	**14**	**15**
End-Uses	**EEM Description**	**EEM Ref #**	**Residential Home Energy Audit**	**Residential Lighting**	**Energy Efficient Schools - Education**	**Income Qualified Weatherization**	**Residential Weatherization**	**Moderate Income Weatherization**
Residential Space Conditioning	**Wall Insulation (R3-R11)**	**R-1**					0.30	0.20
	Ceiling Insulation (R6-R30)	**R-2**				0.21	0.45	0.85
	Programmable Thermostats	**R-3**					0.20	
	Refrig Charge/Duct Tune-Up	**R-4**				0.35	0.10	0.35
	House Sealing Using Blower Door	**R-5**				1.00	0.90	1.00
	Energy Star Construction	**R-6**						
	Cool Roofs	**R-7**						
	Elec Heat to SEER 16 H Pump	**R-8**						
Load Management	**Eliminate Old Appliances**	**R-9**						
Residential Appliances	**Energy Star Clothes Washers**	**R-10**						
Residential Lighting	**Efficient Residential Lighting**	**R-11**	1.00	1.00	1.00	1.00		1.00
Water Heating	**Low Flow Fixtures**	**R-12**	0.25		0.25	0.25	0.15	0.85
	Tank Wrap, Pipe Wrap and Water Temp Setpoint	**R-13**	0.15			0.45	0.10	0.45
	Heat Pump Water Heaters	**R-14**						
Miscellaneous Technologies	**Ductless Heat Pump**	**R-15**						
	Customer Report	**R-16**						
	Smart Plug	**RC-1**				1.00		
Note: Values in the table represent the percentage of participants receiving the measure.								

RESIDENTIAL PROGRAMS: MEASURE MAPPING

Residential Program No.			16	17	18	19	20	21
End-Uses	EEM Description	EEM Ref #	Residential EE Products	Residential Online Audits	Residential Appliance Recycling	Residential New Construction	Residential Neighborhoods	Residential Home Reports
Residential Space Conditioning	Wall Insulation (R3-R11)	R-1						
	Ceiling Insulation (R6-R30)	R-2						
	Programmable Thermostats	R-3						
	Refrig Charge/Duct Tune-Up	R-4						
	House Sealing Using Blower Door	R-5					0.15	
	Energy Star Construction	R-6				1.00		
	Cool Roofs	R-7	0.04					
	Elec Heat to SEER 16 H Pump	R-8	0.04					
Load Management	Eliminate Old Appliances	R-9			1.00			
Residential Appliances	Energy Star Clothes Washers	R-10	0.20					
Residential Lighting	Efficient Residential Lighting	R-11		1.00			1.00	
Water Heating	Low Flow Fixtures	R-12		0.25			0.90	
	Tank Wrap, Pipe Wrap and Water Temp Setpoint	R-13					0.12	
	Heat Pump Water Heaters	R-14	0.05					
Miscellaneous Technologies	Ductless Heat Pump	R-15	0.08					
	Customer Report	R-16						1.00
	Smart Plug	RC-1						

Note: Values in the table represent the percentage of participants receiving the measure.

Table 72: Commercial & Industrial Measure Map.

COMMERCIAL & INDUSTRIAL PROGRAMS: MEASURE MAPPING								
Commercial & Industrial Program No.			**4**	**5**	**6**	**7**	**8**	**9**
End-Uses	**EEM Description**	**EEM Ref #**	**C&I Rebates**	**Energy Efficient Schools - Audit**	**Retro-Commissioning Lite**	**HVAC and Refrigeration Optimization**	**C&I Audit**	**C&I Custom**
Customer-Sited Generation	**Combined Heat and Power, CHP**	**C-1**						*
C&I Space Conditioning	**Small HVAC Optimization and Repair**	**C-2**				0.90		*
	Retro-Commissioning Engagement	**C-3**			1.00			*
	Low-e Windows 1500 ft2	**C-4**						*
	Premium New HVAC Equipment	**C-5**						*
	Large HVAC Optimization and Repair	**C-6**						*
	Window Film	**C-7**	0.05					*
	Integrated Building Design	**C-8**						*
Design	**Efficient Package Refrigeration**	**C-9**	0.10					*
Motors and Drives	**Electronically Commutated Motors**	**C-10**	0.10					*
	Premium Motors	**C-11**	0.10					*
	Motor Controls and Motor Applications Tune-Up	**C-12**						*
	Single Application VFD	**C-13**	0.15					*
Power Distribution	**Energy Star Transformers**	**C-14**	0.02					*
	Efficient AC/DC Power	**C-15**						*
Lighting	**LED Outdoor Lighting**	**C-16**						*
	New Efficient Lighting Equipment	**C-17**	0.10					*
	Retrofit Efficient Lighting Equipment	**C-18**	0.90	1.00				*
	LED Exit Signs	**C-19**	0.05	1.00				*
	LED Traffic Lights (10)	**C-20**	0.05					*

COMMERCIAL & INDUSTRIAL PROGRAMS: MEASURE MAPPING

Commercial & Industrial Program No.			4	5	6	7	8	9
End-Uses	EEM Description	EEM Ref #	C&I Rebates	Energy Efficient Schools - Audit	Retro-Commissioning Lite	HVAC and Refrigeration Optimization	C&I Audit	C&I Custom
	Small Commercial LED Change out	C-21					0.85	*
	Perimeter Daylighting	C-22						*
Water Heating	Low Flow Fixtures	C-23	0.01					*
	Solar Water Heaters	C-24						*
	HP Water Heaters	C-25						*
Cooking and Laundry	HE Food Prep and Holding	C-26						*
	Energy Star Commercial Clothes Washer	C-27						*
	Restaurant & Grocery Audit	C-28					1.00	*
Other	Grocery Refrigeration Tune-Up and Improvements	C-29				0.05	0.25	*
	Refrigeration Casework Improvements	C-30				0.10	0.20	*
	VendingMiser® and Vending Machine Timers	C-31	0.05	0.05				*
	Network Computer Power Management	C-32						*
	Solar Electric	C-33						*
	Smart Strips	RC-1		1.00				*

Note1: Values in the table represent the percentage of participants receiving the measure.
Note2: The asterisk in the column for Program 9 (C&I Custom) indicates the measures that may appear in this program.

Residential Measures

Wall Insulation (R-1)

This measure involves increasing wall insulation from R-3 and adding insulation to the R-11 level. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. Therefore the cost effective application of this measure is for electrically heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 24 percent of residential customers that heat with electricity. Of these customers, about 5 percent have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17 percent, we will assume that half are poorly insulated and could benefit from this measure. Overall the applicability is taken as 8 percent of the residential sector.

Incremental Cost

This measure contemplates adding wall insulation to a 2x4 stud wall where there is none. We assume a cost of $1.25 per square foot of wall area. DEER uses a value of $1.32 per square foot of wall area. The DEER values are based on going from an R-0 to an R-13; the equipment costs are given as $0.15 for equipment and $1.17 for labor resulting in the overall cost of $1.32. Our estimate is more conservative. The total installed cost for the home modeled is $1,400.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations show savings of 1885 kWh to 2600 kWh/yr for electric-heated residences and less than 400 kWh/yr for gas-heated residences. For this analysis the annual savings will be taken as 2,100 kWh/yr for electric-heated residences and 400 kWh/yr for gas-heated residences.

Expected Useful Life

This analysis uses an effective useful life of 25 years, the DEER uses 20 years.

Ceiling Insulation R6-R30 (R-2)

This measure involves increasing ceiling insulation from R-6 to the R-30 level. This measure saves both heating and cooling energy. In the case of gas heated residences, the electric savings are for cooling only and are much less than the heating savings. So the cost effective application of this measure is to electric heated residences only.

Measure Applicability

This measure is considered applicable to a portion of the 24 percent of residential customers that heat with electricity. Of these customers about 5 percent have heat pumps and live in more recent stock that is probably insulated. Of the remaining 17 percent we will assume that half are poorly insulated enough to benefit from this measure. Overall the applicability is taken as 8 percent of the residential sector.

Incremental Cost

We assume a cost of $0.75/square foot of wall area and 1000 square feet of wall space for a total cost of $750. DEER uses a value of $0.757/square foot of wall area. This job includes the cost of providing for adequate attic venting.

Average Annual Expected Savings

Savings from this measure are strongly dependent on the efficiency of the electric heat source. The stock to which this measure is applied consists primarily of electric furnaces. Therefore the simulations assume the displacement of resistance heat. Building simulations from I&M specific weather data show savings of 1,500 kWh to 2,700 kWh/yr for electric heated residences and less than 400 kWh/yr for gas-heated residences. For this analysis, the annual savings is assumed to be 1,500 kWh/yr for electric-heated residences and 300 kWh/yr for gas-heated residences.

Expected Useful Life

This analysis uses an effective useful life of 25 years.

Programmable Thermostats (R-3)

Programmable thermostats save energy by lowering the average daily temperature of the inside of a building. Most of the energy savings is heating energy because that heating thermal load is much larger than the cooling load, but some energy savings in cooling energy will also be realized. Programmable thermostats are commonly sold for self installation. But the installation has the following four important issues that need to be considered.

1. Some thermostats are line voltage thermostats, and there is some shock hazard to the unaware.
2. The first step in programming a thermostat is the system specification. Here the installer tells the thermostat what kind of a system it is controlling. The system type is selected from a list of about 30-50 different system types. This is a non-obvious choice.
3. For system controls there are standard colored wires, but often hookups use non-standard wire. For the mechanically inclined this process is okay but for others it is daunting.
4. Then, after it is installed successfully there is the issue of controlling it to get satisfactory results. Sometimes this needs a guiding hand.

The US DOE is phasing out programmable thermostats from the Energy Star program. Evaluation studies have found insufficient savings to warrant the Energy Star designation. Proper installation and operation appear to be at the root of the lack of energy savings. We have chosen to leave these devices in our mix of EEMs and feel that with proper installation and setup the technology is sound. Our incremental cost includes the cost of installation over and above the off-the-shelf cost of programmable thermostats. Even with proper installation, there is an ongoing need for a design that is more user-friendly and easier to operate.

Measure Applicability

The I&M Appliance study shows 23 percent of the respondents reported the use of a programmable thermostat. Also the Appliance Study reports 23 percent have electric heating in the form of resistance heat or heat pumps. It is not clear if the reported programmable thermostats were all on electric heating situations. For this analysis 20 percent of treated homes are taken as good candidates for a new programmable thermostat.

Incremental Cost

Programmable thermostats cost retail in the range of $50-$100. A utility program may be able to purchase in bulk. It may be necessary to have a range of options which include at least line voltage and low voltage. For these purposes we take $70 as the melded cost of the thermostats.[16] It is assumed here that thermostats will be installed as part of a site visit in a broader program with $25 allocated for installation labor. In total the installed cost will be taken as $120 per thermostat.[17] Some sites with line voltage thermostats may require more than one thermostat.

[16] DEER lists the incremental cost as $56.3, and the installed cost as $73.33 per unit.
[17] DEER lists the incremental cost as $73.33 of which $56.37 is equipment cost and $16.96 in labor. This analysis uses $50 for the labor cost which accounts for some of the difference in the costs.

Average Annual Expected Savings

Thermostat savings are best realized when the set back interval is of the order of 8 hours or longer, and the amount of savings depends on the number of degrees the thermostat is set back. The rule of thumb is one percent heating savings for every degree the thermostat is set back for at least 8 hours. For this estimate a five degree thermostat set back is assumed, leading to heating savings in the average electrically heated home of 500 kWh/yr.

Expected Useful Life

In principle, these thermostats can last for in excess of 20 years, but the backup batteries have a finite life and the programming can be changed or confused. In this case, the effective lifetime will be taken as 10 years.[18]

[18] DEER list the EUL as 12 years.

Refrigeration Charge and Duct Tune-Up (R-4)

This measure is designed to save electric energy by increasing the operating efficiency of the refrigerant system by insuring that it is properly charged. It is common in residential cooling or heat pump systems to have an incorrect amount of refrigerant charge because these systems are usually charged on site during installation. This measure also leads to significant savings from finding and sealing duct leaks which increases the system distribution efficiency.[19]

Measure Applicability

This measure is applicable to most of the residential stock. Notably even new installations can benefit from this measure.

Incremental Cost

The incremental cost of this measure pays for a visit by a specially trained HVAC technician. For this analysis this cost is taken as $350.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find savings of 1,200 kWh/yr for a heat pump (electrically heated residence) and 300 kWh/yr on a gas heated residence with AC only.

Expected Useful Life

This is essentially a tune-up measure and is considered here to have a useful life of 5 years.

[19] While these measures are theoretically handled by different trades, in practice they are implemented by a specially trained HVAC technician. This combination is efficient from a cooling system perspective and also typically cost-effective.

House Sealing Using Blower Door (R-5)

This measure applies to residential electrically heated properties. It involves using blower door technology to pressurize the home. Once the house is pressurized, the air leaks are identified and sealed with appropriate materials to decrease heat loss from the building envelope.

Measure Applicability

This measure is applicable to most of the residential stock.

Incremental Cost

The incremental cost of sending a technician to a home and performing a Blower Door test and sealing the identified leaks is assumed here to be $500. By comparison, the C&RD database lists $0.16 per 0.1 air change per square foot which translates to $500 per house with 0.2 air changes per square foot.

Average Annual Expected Savings

An electrically heated home will achieve 1,000 kWh in annual savings according to our modeling, and a gas home will save 200 kWh annually.

Expected Useful Life

The life of the savings for this measure depends on the quality of the materials used especially for the gaskets for the windows and doors. An expected useful life of 15 years is assumed by the Indiana TRM.

Energy Star Construction (R-6)

An Energy Star qualified new home is required to be 15 percent more efficient than a similar home that meets the 2004 International Energy Conservation Code, IECC. The mechanism for estimating Energy Star compliance is through the use of a Home Energy Rating System (HERS) score calculated from a brief estimate of annual energy use. The savings proceed principally from heating, cooling, lighting and water heating savings.

Measure Applicability

This measure is applicable to all new residential construction. But for the purposes of this study the measure is restricted to new residential all electric construction, estimated here to be 40 percent of new construction.

Incremental Cost

The incremental cost for this measure consists of the increased cost of building components such as insulation, windows, lighting and appliances. This cost is site specific, and there is some choice in selecting the package of measures. An initial cost effectiveness screening of this measure showed that the maximum cost effective cost is $3,000. This requires composing a package of only the most cost effective measures. Therefore this package includes the strongly cost effective measures of flow efficient showerheads and inspection and checkout of heat pumps that are not commonly part of the Energy Star package (but should be). Based on the choice of the most cost effective measures, the cost used for this study is $3,000.

Average Annual Expected Savings

The savings from this measure are variable depending on the particular site treatment chosen, but estimates for this region are in the range of 3,000-4,500 kWh/yr. For this study, the savings is assumed to be 4,223 kWh/yr.

Expected Useful Life

This measure has a useful life comparable to that of new construction and for this study the life will be taken as 25 years.

Package Detail New Residential Energy Star Plus

Program planning for an assumed package of energy star plus treatments has used a model of a prototypical all electric participant. Using this model the full package of measures is examined to estimate the energy savings for the individual measures in the package.

The energy star new residential achieves energy savings principally through improvements to the building shell and reductions in interior appliance energy use.

As perspective consider an all electric single storey residence of about 1,900 square feet. This residence is heated and cooled by a SEER 13 heat pump which is the current standard.

The Energy Star package consists of three common sense building steps. First the thermal conductivity of the envelope is reduced by small coordinated improvements to the building shell, better glazing, selective increase to insulation levels, and by attention to air sealing and framing details. Then the performance of the heating cooling systems is improved by duct insulation and testing. Finally, the internal energy use is reduced by using efficient lighting, appliances, and showerheads. None of these improvements is extreme, but taken together these small improvements can result in an approximate 20 percent reduction in annual energy use. This is the core of the Energy Star Plus savings.

Another 5 percent reduction in energy use is possible if the residence is oriented to use solar gain to offset winter heating. And a further 5+ percent reduction in energy use can be achieved through the use of a SEER 15 rated heat pump. Another 10 percent savings is possible through the use of solar hot water heating, and another 10 percent reduction is possible by applying a modest solar PV array. These further reductions are all beyond the core Energy Star package, and only the first, the solar site orientation is cost effective currently. The further enhancements from a more efficient heat pump and other solar applications are quite reliable and effective, but beyond the current cost effectiveness horizon.

In practice each building is unique, and slightly different packages of improvements to shell and appliances are selected based on specific circumstances, but the savings will break down approximately as in Table 73. In this example the annual energy use for an all electric residence has been reduced from about 19,400 kWh/yr to about 15,600 kWh/yr, about a 20 percent reduction by core energy star measures alone and another 5 percent through solar site orientation.

Table 73. Energy Star Plus Residential Savings Example

Efficiency Category	Annual Savings, kWh/yr	How Achieved
Shell Improvements	1,600	20% reduction in thermal loss, shell and infiltration
Hot Water Improvements	700	2.0 gpm showerhead
Duct Improvements	585	Insulation and leak testing
Efficient Appliances	945	Efficient light, washer, dishwasher, an average 20% reduction in internal loads
Solar Site Orientation	1,050	Enhanced south glazing

The Energy Star Plus package consists of the efficiency measures noted in Table 74.

Table 74. Energy Star Plus Savings Measures

Shell insulation
Duct insulation and leak testing
Three energy star appliances including efficient lighting and an energy star clothes washer
A 2.0 gpm rated shower head(s) and faucet aerators
Whole house air sealing details

In the case of a residence with gas heat and hot water heating, the efficient appliance and cooling savings are the same with the shell and hot water improvements resulting in gas savings.

Cool Roofs (R-7)

This measure is intended to save cooling energy by reducing the temperature in the attic through attic ventilation and through the use of optically reflective roofs. Recent improvements in roofing have led to roofing in attractive architectural colors that can reflect solar gain almost as well as white or reflective roofs. This reflection of solar gain along with adequate attic ventilation can lower attic temperatures significantly thereby reducing heat gain to the home and also improving the distribution efficiency of any ductwork or distribution fans that are located in the attic space. Attic cooling lowers the thermal gain to the residence below, and it also improves the distribution efficiency of any attic duct work. At least half the cooling savings attributable to this measure proceed from the improved distribution efficiency, and therefore this measure is intended for application where there are attic ducts or distribution fans. This is essentially a site built measure including the installation of roof vents and the installation of several hundred square feet of reflective material to the inside of the roof rafters.

Measure Applicability

This measure is considered applicable to all new roofing applications. It is especially effective for central air conditioning applications with distribution ductwork in the attic. According to the appliance survey 92 percent of residences have central AC, and of these 15 percent are assumed to have attic ductwork. Overall the applicability is taken as 92 percent of the residential sector.

Incremental Cost

The incremental cost for this measure is taken to be the incremental cost of the Energy Star Qualified roofing which is reported to be currently $0.23/square foot, but which is expected eventually to be zero. All other roofing costs and required ventilation are assumed to be unchanged by this measure. For this study we will take the incremental cost to be an average of $0.10/ square foot over the five year planning period. For the average residence, $340.

Average Annual Expected Savings

The savings from this measure proceed from lowered cooling energy by reducing ceiling heat gain. According to DOE, ceiling heat gain accounts for 15-25 percent of the residential cooling load. The radiant barrier has been observed to reduce ceiling heat gain by 16-42 percent. The cool attic strategy also improves cooling distribution efficiency if the cooling ducts or fan unit is in the attic. For this study we will take the average annual savings to be 560 kWh/yr. Savings larger than these will be found in the extreme cases with poorly insulated air conditioning distribution located in the attic spaces.

Expected Useful Life

This measure consists of reasonably durable material installed in an attic. The useful life is assumed to be 12 years.

Resistance Electric Heat to SEER 16 Heat Pump (R-8)

This measure is designed save heating energy and cooling energy by replacing an existing central air conditioner/electric furnace by a modern heat pump. Most of the savings proceed from replacing resistance heating by a heat pump at more than twice the thermal efficiency. This measure has significant savings, but also significant costs because it involves replacing the whole heating and cooling system, not including ducts.

Measure Applicability

This measure is applicable to about 17 percent of the residential sector that heats with an electric (resistance) furnace.

Incremental Cost

This measure requires replacing the whole heating/cooling system not including ducts. The cost of such a replacement is quite site specific, but can be expected to be a first cost of $10,000 or more. There are two contexts for such a replacement: 1) early retirement in-order to achieve large heating savings, and 2) where the central AC needs to be replaced anyway, the most prudent thing would be to replace with a heat pump because of its significant heating savings. The upgrade to a heat pump can be expected to cost about $5,500-$6,500 more than the AC replacement alone. For this analysis we assume $10,000 as the incremental cost.

Average Annual Expected Savings

The average annual expected savings from this measure depends on the size of the residence. Based on I&M specific simulations we find savings in the range of 8,000 kWh/yr for a single family residence and 6,470 kWh/yr in the multifamily application.

Expected Useful Life

The physical life of this measure is about 20 years, but for the purposes of this analysis we will take 15 years as the useful life of this measure to reflect the application of this measure in an early retirement context.

Eliminate Old Appliances (R-9)

This measure involves creating electric energy savings by collecting and dismantling underused older refrigerators and freezers. Ideally only operating or operable appliances would be eligible for removal.

Measure Applicability

This measure is applicable to the approximately 28 percent of the residential sector that have more than one refrigerator or freezer. Of these only 50 percent are assumed to have an interest in the program. For this study the applicability will be taken as 14 percent of the residential sector.

Incremental Cost

The incremental cost of this measure will be taken as the cost of acquiring and recycling the unit. For this study that cost will be assumed to be $165.

Average Annual Expected Savings

Savings from this measure are dependent on the age of the refrigerator and the location where it is used. Savings estimates for this measure also need to include the zero effects of including operable but not operating refrigerators. Reported savings estimates vary widely from an astonishing 1,900 kWh/yr for C&RD to 413 kWh/yr observed in the Connecticut Appliance Turn-In program. For this program, the savings will be assumed to take the middle road, 1,150 kWh/yr.

Expected Useful Life

The useful life of this measure is the length of time the removed refrigerator would have continued to be used absent the program. There is no reliable research on this and for this program the useful life will be taken as 5 years.

Energy Star Clothes Washers (R-10)

This measure involves obtaining an Energy Star clothes washer which is a more efficient clothes washer than a standard clothes washer. This measure has significant water and detergent savings in addition to the electric savings. According to the Environmental Protection Agency, horizontal-axis washing machines can use about 40 percent less water and 50 percent less energy than conventional washers, cause less wear and tear on clothes, and can accommodate large items that won't fit in a top-loader. A typical top-loading washer uses about 40 gallons of water per full load. In contrast, a full-size horizontal axis clothes washer uses between 20 and 25 gallons.

Measure Applicability

This program applies only to customers who have electric water heaters, electric dryers, and who have no high efficiency clothes washer. This applies to 40 percent of I&M customers.

Incremental Cost

The incremental cost for clothes washers vary significantly depending on the features. The value used in this analysis is $400; DEER uses a value of $565.82 and the C&RD lists a value of $245.26. Due to the wide variety of costs for Energy Star clothes washers $400 is a good mid-range value for the purposes of this analysis.

Average Annual Expected Savings

The kWh savings from a clothes washer depend to a significant extent on the source of the water heating and dryer's energy source. If the water heater is a gas water heater the kWh savings are insignificant but if the source is an electric water heater the savings can be substantial. Savings also depend on whether the clothes washer has a built in heat source which some do have. This analysis used 400 kWh. DEER lists 199 kWh and C&RD lists a range from 54 kWh to 509 kWh depending on the model chosen. Savings will be assumed to be 400 kWh because the program will be limited to customers with electric water heat and electric dryers.

Expected Useful Life

The expected useful life used in the analysis is 18 years; however, both DEER and C&RD use 14 years.

Efficient Residential Lighting (R-11)

This measure consists of substituting compact fluorescent lighting for incandescent lighting. At each socket treated, such a substitution will reduce lighting power by about 80 percent. A full application of this measure consists of converting all the most used lighting fixtures from incandescent to compact fluorescent. Housing audits taken over the last 10 years show that an average house has about 25-45 lighting sockets with an aggregate connected incandescent lighting load of about 2,700 watts. But of this load, only about 10-15 sockets are used for about an average of 5 hours/day, the rest are infrequently used. So it is the ten-fifteen most frequently used sockets that are the primary targets for a whole house lighting conversion. A satisfactory conversion of these most important sockets may require recourse to a variety of bulb styles, powers, and even adapters (such as lamp harps) to facilitate accommodating the CFL to these ten best locations.

Measure Applicability

This measure is applicable in 100 percent of residential sector, but to allow for some existing use of compact fluorescents this study will use 95 percent as the applicability factor for this measure.

Incremental Cost

The cost for this technology continues to decrease, and there are various sales or promotions where the cost may be as low as $1.50/bulb. But for the purpose of this program planning we will use the Indiana TRM value of $3.00/average bulb to cover the costs of compact fluorescent bulbs, and $14.00/bulb for 10.5 watt LED bulbs. Full application of this measure, assuming treatment as directed within program guidelines vary with the number and types of bulbs installed per household.

Average Annual Expected Savings

Expected savings are dictated by the Indiana TRM. For CFL bulb applications the typical per bulb annual savings for a direct install measure is taken to be 41 kWh per year. A typical LED bulb installation produces a savings of 32 kWh per year.

Expected Useful Life

Compact fluorescent bulbs have a life time of 10,000 hours, about 7-10 times as long as the incandescent bulbs they replace. Assuming the average compact fluorescent bulb is used 2,000 hours/yr (5-plus hours/day) gives a conservative estimate of useful life of 5 years. LED bulbs have a deemed lifetime of 15 years per the Indiana TRM.

Special Note

The United States (along with many other countries, including China and Australia) is phasing out inefficient bulbs. The US law (Clean Energy Act of 2007) holds that certain light bulbs must be 25% to 35% more efficient by 2012 to 2014. Certain bulbs are excluded (those lower than 40 Watts and those over 150 Watts, also specialty lights, appliance lamps, “rough service” bulbs, three-way bulbs, colored lamps, and plant lights). This means that traditional 60 Watt and 100 Watt incandescent bulbs will gradually become unavailable unless the underground economy expands to meet preferences of customers who do not desire to make the change. Also, from 2012 through 2014, government pro-CFL promotions, along with promotions by big box stores, advocacy by environmental groups, and climate change organizations, as well as some religious organizations will encourage reliance on CFLs and LEDs. From a "reason analysis" perspective, it is likely that people will increasingly say they would have purchased CFLs in the absence of a utility program, or that the percentage of influence of the utility program on their decisions to purchase CFLS will be radically declining. At the same time, just because a law has been put into place does not mean that it is enforceable (for example, some states have progressive building standards, but they are not reflected in current practice). Currently (in 2013) 60 Watt and 100 Watt bulbs are available in any quantity via the Internet.

The time will come for utilities to withdraw from the CFL area, at least for 60 Watt and 100 Watt bulbs. However, we recommend that CFL programs be continued until it is clear that there is general public acceptance of CFLs, through 2017. We suggest that I&M discuss with the Commission a temporary modification of the TRC test for CFLs to emphasize *gross* energy savings rather than *net* energy savings (the focus here is on removing the "free rider" label from customers who are jointly influenced). This negotiation is necessary due to the joint influence on purchasing decisions which is complex.

What has become clear in socket studies is that there is a huge number of sockets without CFLs or LEDs; also that households tend to purchase only some CFLs and moving household beyond a certain number of sockets does not create free riders (for those additional CFLs) even if the household already has some CFLs. If the Commission is unable to agree to move towards gross savings for 60 Watt and 100 Watt CFLS, I&M should evaluate the financial risk and terminate the CFL effort earlier.

Low Flow Fixtures (R-12)

This technology consists of a new showerhead rated at 2.0 gallons per minute (gpm) at 80 pounds per square inch (psi) and a swivel aerator for the kitchen faucet and fixed aerators for the lavatory faucets. The current US standard for showerheads is 2.5 gpm. Measurements of the existing shower flows in building stock show a range of 2.75 gpm to 3.75 gpm with frequent individual cases in excess of 5 gpm. Evaluations have shown that programs that replace with 2.0 gpm heads have greater savings than programs that replace with the standard 2.5 gpm shower heads. Program shower heads should be 2.0 gpm at 80 psi and with a lifetime scaling and clogging warranty. It is important also to be cautious about the use of “pressure compensating” showerheads. These are more prone to clogging and can lead to unintentional increases in flow rate in low pressure situations such as well water systems or older systems with occluded piping. Customer acceptability is an important component in a showerhead program. Customers will remove new low flow showerheads if the quality of the showering experience declines with the new showerhead. Therefore it is important to research and test the showerhead chosen for the program carefully. In addition, the old showerhead must be removed from the premises to decrease the likelihood of having it reinstalled.

Measure Applicability

This measure is applicable to the 40 percent of the residential sector that heat water with electricity.

Incremental Cost

Low flow fixture costs vary widely, and depend on whether the fixtures are purchased retail or in bulk. The costs for a bulk purchase for a showerhead and three aerators also have a wide range, about $8.00-$15.00/set. The most important feature of these fixtures is the long-term acceptability and durability because these factors have a direct impact on the lifetime savings. With a long enough lifetime, this is such a cost effective measure that all prices in the range are quite cost effective. Because the cost of the showerhead varies significantly and quality is so important for this program, it is essential to test, choose and pay the price for a high quality showerhead. This measure is so cost effective that even with a more expensive showerhead the program will still remain cost effective and a quality showerhead will ensure measure persistence. The per-unit-installed cost will be taken as $25/residence.[20]

Average Annual Expected Savings

Field monitoring studies can demonstrate the flow savings, but ultimately the overall savings will be a combination of flow savings and the duration of use. The flow of the showerhead used has a significant impact on savings. This program is designed around a 2.0 gpm showerhead as compared to a 2.5 gpm showerhead. Therefore the savings will be more than the 120–133 kWh per unit listed in DEER. In addition the climate is different and the inlet water temperature is lower so the savings in this I&M program will be greater. Several studies have measured final savings in terms of electric input to the tank, but usually these studies have included savings from comprehensive treatments including other measures such as tank and pipe insulation, kitchen and bath lavatory aerators, tank thermostat set back, and leaky diverter replacement. Savings can vary from program to program depending strongly on the choice of showerhead. Savings can also diminish with “take back” in the event that the new showering experience

[20] The DEER Database lists measure costs as $22.946 per unit and $37.946 installed cost

is longer than the original. Actual savings observed in the comprehensive cases include these take back effects, and are in the range of 650 kWh/yr to 950 kWh/yr. The savings from a showerhead and aerator change alone are taken as 500 kWh/yr.

Tank Wrap, Pipe Wrap, and Water Temperature Setpoint (R-13)

This technology consists of adding insulation around the water heater, checking and resetting the tank thermostat, and replacing leaky shower flow diverters. These measures are principally tank-centric, and can be self installed or by a site visit if the package is part of a broader program. Resetting the tank thermostat is also a safety issue because it can reduce scalding and burns due to too high a set temperature.

Measure Applicability

The applicability for measures of this type is discussed under low flow fixtures. In I&M service territory electric water heat accounts for about 40 percent of water heating, 2/3 of that 40 percent would be eligible for this measure because in some cases the tank cannot be accessed to install a blanket or one has already been installed. As a result the applicability is taken as 25 percent.

Incremental Cost

The cost of this treatment breaks down as $30 for materials and $20 for installation labor. For these purposes the measure cost is taken $50 because these measures will typically be part of a larger program.

Average Annual Expected Savings

The dwelling savings for these measures is discussed under low flow fixtures. Based on prior experience and evaluation work on other programs it is estimated that the savings would be about 1 kWh per day.[21] For this program we have used the conservative value of 200 kWh/yr savings.

Expected Useful Life

The lifetime of these measures is potentially quite long. For practical purposes the lifetime will be considered limited by the expected lifetime of the hot water tank, 10 years.[22]

Expected Useful Life

The life time of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. For these purposes that lifetime is taken as 10 years.[23] Normally showerheads will last longer but with renovations and changes in ownership a 10 year EUL is a good planning number.

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[21] Khawaja S. PhD, and Reichmuth, H. PE., 1997. Impact Evaluation of PacifiCorp's Ebcons Multifamily Program. Pacificorp.

[22] DEER says 15 years for pipe insulation, 9 years for faucet aerators, and 15 years for an efficient water heater so 10 years is conservative. The C&RD lists 10 years for a water heater with a minimum warranty of 10 years.

[23] DEER Database, 2005

Heat Pump Water Heaters (R-14)

Water heating is one of the largest energy uses in the home. In the case of electrically heated water, the annual water heating energy is about 4800 kWh/yr. The heat pump water heater is essentially a small heat pump drawing heat from the air by cooling and de-humidifying it and injecting this heat into a storage tank. Physically, this measure consists of a small self contained heat pump and a water storage tank and associated pumps and controls.

Measure Applicability

This measure is applicable to the 40 percent of the residential sector with electric water heat. Of these, 50 percent are assumed to have a suitable location for the unit. Overall measure applicability is assumed to be 20 percent of the residential sector.

Incremental Cost

The incremental cost of this measure consists of the cost of the heat pump water heater, water storage tank and installation plumbing and general construction labor. The site orientation of such a unit is important; it should never be sited in an attic and freezing situations should also be avoided. Therefore, some special site adaptation and plumbing may be necessary. For this study we will take $2,500 as the cost; others report lower costs but we do not think these take adequate account of special site costs.

Average Annual Expected Savings

For this study it is assumed that the heat pump water heater will perform with a coefficient of performance of 2, leading to annual savings of 2,000 kWh/yr.

Expected Useful Life

The useful life of this measure is assumed to be that of a similar appliance, a window air conditioner: 18 years.

Ductless Heat Pump (R-15)

This measure applies to residential electrically heated homes. Ductless heat pumps have two parts, an indoor and an outdoor unit. The outdoor unit can connect to multiple indoor units via a cable and refrigerant lines. The outdoor unit is placed outside at ground level and is connected to the indoor units via a small hole. The indoor units are wall mounted in centrally located rooms within the home and distribute the heated or cooled air throughout the space. Because of its design no ducts are required which eliminates fan energy and heat and cooling losses through the duct work.

Measure Applicability

This measure is applicable to most of the residential stock that uses electric resistance heat.

Incremental Cost

Incremental cost is expected to decline as the market becomes more familiar with this space heating technology.

Average Annual Expected Savings

Savings from installing a ductless heat pump depend on home size, usage, thermal integrity of the home, and temperature set point.

Expected Useful Life

Heat pump technology has been available for some time and its operating characteristics are well understood. The ductless heat pump is a new application of a tried and true technology; as a result the measure life of a heat pump is applied to the ductless heat pump in all applications.

Customer Reports (R-16)

Customer Reports is a behavioral measure. It saves energy by focusing customer attention on comparison to one's neighbor as a benchmark. In a generic approach to customer reports, participant households receive periodic reports illustrating their energy use performance in comparison to neighbors in similar homes.

Measure Applicability

All residential customers are technically eligible, however marking and promotion will be to random selected customers in the upper half of the yearly energy usage distribution.

Incremental Cost

The incremental cost is quite low since the form of the measure is simply a report received quarterly or with some other chosen frequency.

Average Annual Expected Savings

Some customer reports programs include resultant energy savings from change in energy use behaviors (reducing waste while preserving amenity), appliance purchases and recruitment into traditional energy efficiency programs as a result of the customer reports. For this measure/program we include only behavioral savings. The initial savings assumption used in program planning (as a one-year percentage of annual kWh usage) has been reported by prior programs. However, for treatments that continue over multiple years the decay of attention should be considered. We have assumed long range annual savings in the order of two-thirds of what might be expected in the first year of treatment.

Expected Useful Life

Until there is at least a decade of experience with scaled up customer reports programs and studies of decay following the last report received, the measure life is taken as one year. However, for a program of duration of more than one year the calculation assumes a decay effect after one year and that amount of savings is assumed to be stable for each year customer reports are received.

Smart Plug (RC-1)

This measure consists of a power strip with load sensing capability. When the primary load is turned off, the secondary loads connected to the power strip are automatically powered down. This measure is typically used in home office spaces where support equipment (printers, projectors, etc.) may be left on after the connected computer is turned off.

Measure Applicability

This measure is applicable to residential home office space and some entertainment center applications.

Incremental Cost

The incremental cost for this measure is determined to be the cost of purchase of the smart plug.

Average Annual Expected Savings

Savings associated with this measure are based on home-energy use surveys, with typical household electronics usages and reasonable assumptions of secondary equipment usage patterns. It should be noted that the household loading due to electronics is increasing steadily and projected savings from this measure will likely increase over time.

Expected Useful Life

This measure will have a medium-term useful life.

Commercial Measures

Combined Heat and Power (C-1)

This measure is a form of site generation with the waste heat applied to large steady thermal loads, usually at an industrial scale. The economics favorable to this measure usually involve a high thermal load factor. Electricity generated by CHP applied to an existing gas thermal load has a unique efficiency opportunity in terms of fuel use and in terms of carbon offset because the fuel use associated with the generated electricity is only the marginal increase in gas use. The CHP resource is strongly favored from the perspective of carbon calculations. System sizes range from about 100 kW to MW scale in electrical output.

Measure Applicability

This measure is applicable in a large scale industrial context.

Incremental Cost

This cost for measure is very site specific, of the order of $500-$1500/kW electric. This measure also has significant annual maintenance costs.

Average Annual Expected Savings

The savings from this measure consist of the net electrical output of the CHP plant. For example, a single moderately-sized plant of 250 kW would have an output of the order of 2 million kWh/yr.

Expected Useful Life

This measure has an expected useful life typical of appliances, of 15 to 20 years.

Small HVAC Optimization and Repair (C-2)

This measure applies to packaged rooftop units. These units are the predominant means of conditioning for small-to-medium scale commercial buildings. The savings proceed from improved compressor performance, better run time control, and fresh air cooling. These rooftop units are a homogenous pool of equipment that has been identified as underperforming. Typically, the refrigerant charge is out of specification, the economizers perform poorly if at all, and the airflow is too low for proper operation. Many utilities (e.g., SCE, PG&E, National Grid) are offering programs employing a structured diagnosis and repair protocol. Often these programs use trade named processes such as Proctor Engineering "check me", or PECI "aircare plus" etc. Candidates for this measure are rooftop units found in a wide range of sizes with output capacities of from 4 to 50 tons with the most predominant capacity being 5 tons.

Measure Applicability

This measure is applicable in 70 percent of the commercial sector.

Incremental Cost

The cost for this technology includes site visits and diagnostics with simple repairs performed immediately without need for a second site visit. The costs will naturally vary with the specifics of the repair. Planning estimates for this diverse mix of treatments, made by the Northwest Power and Conservation Council (NWPCC), use $0.20/first year kWh savings.

Average Annual Expected Savings

Savings vary from unit to unit, but in the cases where there have been significant corrections to the refrigerant charge or to economizer operation savings on the order of 2,500 kWh/unit have been observed. At a particular site there will typically be several treated units.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited.

Retro Commissioning Engagement (C-3)

Commissioning is a systematic step-by-step process of identifying and correcting problems and ensuring system functionality. Commissioning seeks first to verify that the system design intent is properly executed, and it goes further by comparing actual building energy performance to appropriate bench marks to validate building performance as a whole. The best candidates for this measure are buildings larger than about 100,000 square feet. While commissioning in general can become quite complex, often the greatest savings proceed from a simple review of building operations to assure that the building is not being unnecessarily used during non-occupied times. New Commissioning (C-3) should be done as part of the construction contract, and most contractors will claim that this is normal business. But the performance of even new buildings is often erratic for a year or two while unnoticed problems come to light. This new commissioning is a detailed process of initial calibration and control sequence testing or verification. The initial process is usually not done well, but even so, the initial commissioning is inherently limited because usually it takes about a year of building operation to see how the building actually operates as a whole. By contrast, Retro-Commissioning (C-4) seeks to tune a building that is already operating and has a track record of a year or two at least. The Retro-Commissioning process starts with an analysis of the utility bills for all fuels, which to a trained eye will show the larger general operational problems which are then followed up with a limited scope site visit. Retro-Commissioning is usually necessary even for buildings that have been initially commissioned. There will be the occasional building which after years of operation will have its controls so mixed up that it will need a comprehensive new commissioning (C-3). In practice the New Commissioning is the larger more complicated job, while Retro-Commissioning is more superficial and focused on finding and fixing major problems only by applying low-cost/no-cost controls changes.

Measure Applicability

In this analysis New Commissioning is assumed to take place on 100 percent of new commercial stock as a matter of proper business. Retro-Commissioning is applicable in 75 percent of the existing commercial sector, and after a few years, to all of the new commercial buildings.

Incremental Cost

The cost for this technology is quite site specific, based on NWPCC estimates new commissioning costs about $0.37/kWh/yr, which for a typical large commercial building of 100,000 square feet would be about $37,000. For this study we are assuming a brief version of retrofit commissioning. Retro-Commissioning, or “commissioning lite”, that prescreens buildings on the basis of billing data and follows it with a site visit. In this analysis, all program-related commissioning is the Retro Commissioning and the New Commissioning is assumed to be part of the construction process.

Average Annual Expected Savings

Savings from this measure can vary widely. For Retro Commissioning, it is assumed here that the building electric energy use can be reduced by on average 20 percent. A significant portion of the energy savings due to both of these measures is associated with the heating fuel, usually gas. In estimates of program cost effectiveness for electric utilities, gas savings are usually not valued which can underrate the overall cost effectiveness of this measure.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited.

Low-E Windows (C-4)

This measure saves energy by reducing the thermal losses and gains through windows. This measure assumes that the efficient window has a heat loss rate of 0.35 BTU/deg F hr, representing the performance of a quality, double glazed argon filled low-e window. The original window is assumed to have a heat loss rate of 0.75 BTU/deg F hr, representing the average losses from a mix of single and double glazed windows.

Measure Applicability

This measure is applicable in 100 percent of new commercial buildings and 30 percent of existing commercial stock.

Incremental Cost

The incremental cost for this technology depends strongly on the context of use. If the efficient windows are used in a replacement context, then the full cost of $20/sqft is applicable. If the efficient windows are used as an upgrade in new construction then an incremental cost of only $3/sqft is used.

Average Annual Expected Savings

It is assumed here that the average site installation will contain 1,500 square feet of high efficiency window replacements.

Expected Useful Life

This is a very long-lived measure that will generally last the life of the building. For the purpose of this study, a periodic change-out due to breakage and the potential for future technological innovations leading to window replacement were assumed.

Premium New HVAC Equipment (C-5)

Premium new HVAC equipment employs more efficient motors/pumps and larger heat exchangers and pipes to lower operating energy requirements. Premium equipment is often designated with an Energy Star rating or by the Consortium of Energy Efficiency (CEE) as Tier I or Tier II, or it may not have an official rating, but it does deliver slightly improved performance and is usually sold as such. Premium HVAC equipment is a very broad category including efficient variable speed fans, and efficient chillers, efficient ice makers, and efficient packaged roof top units. It should be noted that rooftop units serve more than half of the commercial space, and they have therefore been the subject of an ongoing efficiency improvement campaign by CEE and the industry.

Measure Applicability

This measure is applicable in 100 percent of new commercial construction.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.46/kWh/yr.

Average Annual Expected Savings

Savings attributable to this measure are generally fairly small because they represent only an incremental improvement in performance on equipment that is already required to be reasonably efficient. It is assumed here that the savings in new construction will be 3 percent of total energy use.

Expected Useful Life

The premium upgrades can be expected to last the life of the equipment.

Large HVAC Optimization and Repair (C-6)

This measure refers to restoring large HVAC equipment to its nominal operating performance. This measure needs to be distinguished from commissioning which is used to refine the controls of large HVAC which generally leads to large savings. By contrast this measure applies to the operation of the equipment and includes chiller and condensing tower cleaning, filter maintenance and tune-up etc. It also includes the optimization of economizer operation by verifying that the enthalpy sensors and economizer controls are functioning properly.

Measure Applicability

This measure is applicable in commercial sector buildings with large HVAC systems.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.34/kWh/yr.

Average Annual Expected Savings

Savings attributable to this measure are generally fairly small because they claim only the savings due to restoring equipment to its original operation. For this study these savings are assumed to be 3 percent of building energy use.

Expected Useful Life

There are inherent limitations to the lifetime of the treatment provided by this measure. The improvements may be superseded by operational changes, and the remaining lifetime of the treated unit may be limited.

Window Film (C-7)

Window films are thin layers of polyester, metallic and adhesive coatings that allow some light to pass through but greatly reduce the amount of solar radiation passing through the window. These films provide some barrier to heat loss through the window. It is a highly cost-effective measure with wide application.

Measure Applicability

This measure is applicable in 90% of the commercial sector. While all buildings would benefit from the installation of this measure, buildings with 25% or greater of total outside wall area containing windows, single pane windows and south/south-west facing windows will receive greater benefit from this measure.

Incremental Cost

Energy Star lists the incremental cost of window film ranging from $1.35 to $3.00 per square foot of film.

Average Annual Expected Savings

During the cooling season 60% of a building's heat load is generated by solar heating though windows. During the heating season, up to 25% of a buildings heat loss is through window conduction. Window films greatly reduce these energy loads. For typical building installation, annual energy savings are assumed to be 4 kWh/yr per square foot installed.

Expected Useful Life

This measure is assumed to have a relatively short useful life.

Integrated Building Design (C-8)

This measure applies to new construction where careful design and specific engineering can get beyond the rules of thumb, leading to the use of smaller equipment more carefully matched to load. Integrated design refers to an approach commonly used to design energy efficient new commercial buildings. Essentially, the design process lowers building loads, and then carefully matches HVAC equipment to the lowered load. In practice the most significant characteristic of efficient new commercial buildings is significantly reduced lighting loads and often reduced plug loads. The other important characteristic is enhanced building shell performance through improved insulation and solar shading, and enhanced daylighting. Taken together these improvements result in significantly altered lighting, heating, and cooling loads. Typically, the cooling loads will be significantly reduced, while the changes to the heating loads are more complex. The reduced internal gain from lighting etc will actually increase the gross heating loads, which the shell improvements may reduce somewhat through insulation or emphasized solar gain.

The altered heating and cooling loads will usually not conform to established equipment sizing rules of thumb, which generally result in oversized equipment. A primary objective in integrated design is to down size or eliminate the HVAC equipment leading to more efficient operation, and often leading to installation cost savings. It is notable that the shell improvements will usually result in more stable and comfortable interior wall and glazing surface temperatures that permit alternative and reduced means of heating and cooling distribution which can lead in turn to reduced fan or pump energy, leading to significantly more efficient heating and cooling distribution strategies. This reduction in distribution can also result in reduced installation costs. The integrated design process usually employs building modeling, but as more efficient new commercial building experience develops, a few basic strategies are emerging which can be used without recourse to costly building modeling. (see: New Buildings Institute, Core Performance Guide).

Measure Applicability

This measure is applicable in 100 percent of new commercial construction, but in national chain or franchise designs, the integrated design may already have been done at the corporate level, or getting to a level of integrated design may require interaction at the corporate design level that may not be possible at the local level.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. The incremental costs of efficient new commercial buildings developed through integrated design are quite building specific, and may range widely from about $3.50/square foot to negative incremental cost. But in general, the incremental cost will be the net of some increased costs for various building elements (such as lighting, external shading elements, insulation, more efficient equipment, more sophisticated controls, etc), and some decreased costs resulting from reduced equipment sizes and simplified distribution strategies. There are examples of highly efficient new commercial buildings that have negative incremental costs, but a good rule of thumb is to assume that the incremental cost will be of the order of $1.75/square foot, or about $0.35/first year kWh saved.

The particular incremental cost for a real building could be quite complex to estimate. Therefore in order to minimize overhead, utility programs that provide incentives for integrated design will base the incentives on modeled and deemed per square foot estimates of energy savings for principal occupancy types (retail, schools, offices, etc) for various HVAC systems and measure packages.

Average Annual Expected Savings

The savings due to integrated design will include the savings due to efficient lighting, efficient HVAC equipment, and controls. Taken as a package these savings can easily be on the order of 20-40 percent of the standard code compliant design. The current US tax code allows preferred treatment for new buildings that are 50 percent better than code or lighting systems that are 30 percent better than code.

Expected Useful Life

Integrated design can be expected to last the life of the building.

Efficient Package Refrigeration (C-9)

This measure consists of an efficient packaged and optimized new refrigeration system.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the efficient packaged refrigeration costs about $0.15/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use in applicable sites by 10 percent.

Expected Useful Life

Efficient package refrigeration will be considered operational 8760 hours per year with standard refrigerator operation life.

Electronically Commutated Motors (C-10)

An electronically commutated motor is a more efficient motor with variable speed control capability. In fan and pump applications it can save energy by operating at a more efficient speed. Refrigeration applications involving case cooling distribution fans are especially favored because the power reduction leads to a lower refrigeration load.

Measure Applicability

This measure is broadly applicable throughout the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse and quite site specific. Based on NWPCC estimates, the premium upgrade costs about $0.33/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure can reduce a building energy use by 4 percent.

Expected Useful Life

Highly dependent on operational hours, electronically commutated motors are assumed to have a standard motor useful life.

Premium Motors (C-11)

This measure saves energy by reducing energy losses in motors. Motor energy use is preponderant in manufacturing applications where of the order of 40-60 percent of electric energy is used in motors, and these motor applications are frequently full-time operation or near full-time operation.

Motor efficiency varies with the size of the motor as is illustrated in the figure below.

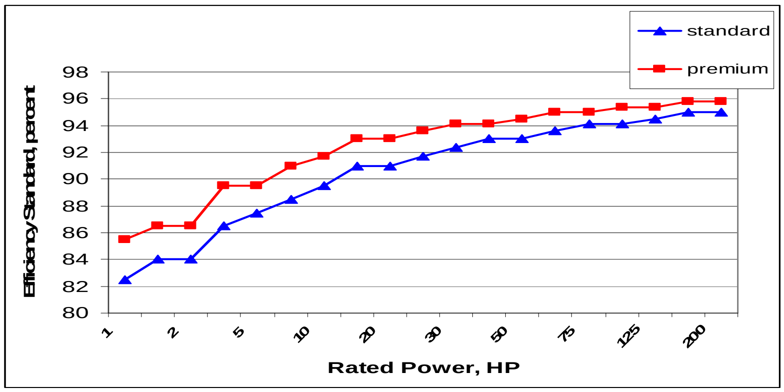

Figure 4. Motor Efficiency Specification NEMA Premium

The figure above shows the efficiency improvement to be gained by using the more efficient motor. While the efficiency gain is only about 2 percent for the smaller motors, it is important because the duty cycle of many motor applications is of the order of 5,000-8,760 hours/year.

In constant speed motor applications, an even greater electric energy savings may be available by properly matching the motor to its load. In particular, the efficiency of smaller motors in the 1-10 horsepower range can vary greatly with the duty load on the motor as illustrated in Figure 5. In this figure it is evident that if a smaller motor is oversized relative to its load, the efficiency can be reduced by of the order of 10 percent.

In motor replacement (and new motor) specifications, it is especially important to consider the fit of the motor to its load in terms of motor horsepower, speed, and starting torque. The greater portion of savings often rests with the proper match of the motor to its load.

A simple one-for-one motor replacement can have unexpected results. An important element in the use of higher efficiency motors is that the equilibrium speed of the higher efficiency motor is often slightly higher than the speed of the lower efficiency motor that was replaced. In fan and pump systems this slight increase in speed will increase the fluid throughput and power. So although a more efficient motor has been used, it may actually lead to an unintended but slight increase in flow and power unless the drive system is adjusted to compensate.

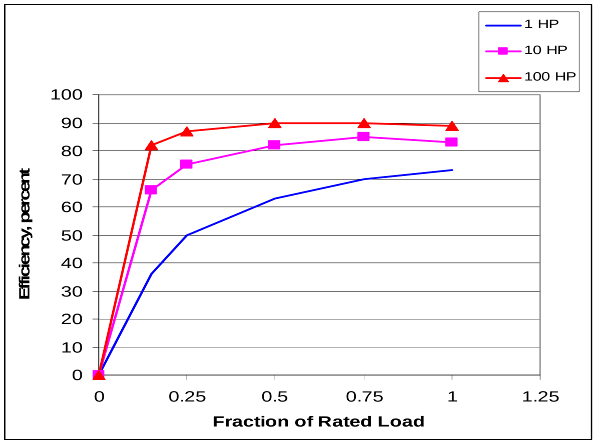

Figure 5. Typical Motor Operating Efficiencies versus Load

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will be very diverse, and dependent on the size of the motor.

Average Annual Expected Savings

The savings from an efficient motor must assume that the drive has been adjusted as necessary to give equivalent flow or drive effort, and the savings will then depend strongly on the duty cycle hours/yr.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard motor useful life.

Variable Speed Drives, Controls, and Motor Applications Tune-Up (C-12, C-13)

This measure saves energy by providing an efficient way to match a motor to a varying load. Motor controls, commonly referred to as variable speed or variable frequency drives, alter the frequency applied to the motor and thereby permit the motor to run more efficiently at lower outputs. This control capability is particularly important in process applications where a pump or fan is being controlled to maintain a particular and often varying fluid flow. Often the fluid flow is controlled by means of dampers or throttling valves that force the fan or pump motor to operate inefficiently. The savings associated with the proper speed control are most pronounced when the motor is operating at less than its rated capacity. At full capacity there may be little savings.

Situations involving fans, air compressors or pumps, (which is the most common commercial/industrial application of motors), have a very high energy sensitivity to flow rate; typically the energy varies as the cube of the flow rate. Attention to how the flow is controlled with the use of variable speed controls and elimination of excess flow can often lead to power reductions of the order of 50 percent with only minor reductions in flow. In this manner, variable speed motor control permits finer tuning and control of pumps, fans, compressors, and conveyers.

This is a very broad measure and the cost and savings are based on a complex fully-controlled application, here referred to as C14a. There is also a broad niche for single independent applications of these controls in matching a fan or pump to a fixed load that are much lower cost than a fully controlled application, but can still result in significant savings. This simpler application is here referred to as C-14b.

There is another genre of motors and controls referred to as brushless permanent magnet torque motors. These are very high torque motors that require minimal drive gearing and can be very precisely controlled. These have very good positioning capabilities and are used in machining and manufacturing assembly operations.

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPPC estimates, an aggregated estimate of the costs of adjustable speed drives is about $0.86/kWh/yr.

Average Annual Expected Savings

It is assumed here that an application of drive control can save about 20 percent of the total building energy.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard useful life.

Energy Star Transformers (C-14)

This measure saves energy by reducing energy losses associated with stepping down from high service voltages to typical service application voltages. In larger buildings and plants it is often more economic to distribute the power at high voltages to various floors and major areas where it is then stepped down to its ultimate application voltage through a transformer. These transformers are typically efficient (>95%) when they are properly loaded, but an oversized or under loaded transformer can operate at a much lower efficiency; therefore, it is important that the transformers be sized properly. However, even when the transformer is properly sized, it is important to use the most efficient transformer because all power passes through it.

Transformer efficiency varies with the size of the transformer as illustrated in the figure below.

Figure 6. Transformer Efficiency Specification NEMA TP-1

The figure shows the efficiency improvement to be gained by using the more efficient Energy Star labeled transformer. While the efficiency gain is only about 1 percent for the smaller transformers it is important because all power runs through it and the percentage savings will be taken off the top.

Measure Applicability

This measure is applicable in the new commercial and manufacturing sectors, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will vary with the size of the transformer. For this study, we take a 150 KVA transformer as the average.

Average Annual Expected Savings

Transformer savings are based on the size of the transformer, and are based on the power throughput of the transformer as well as standby losses, 8760 hours/year.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard useful life.

Efficient AC/DC Power (C-15)

A modern office environment has a multitude of electronic appliances, most of which are powered by a small transformer AC/DC converter. Standard transformer based converters are about 30-40 percent efficient. More efficient designs called switching power supplies operate with an efficiency of about 90 percent. The energy savings for this measure proceed from switching to the more efficient power supplies.

Measure Applicability

This measure is applicable in 100 percent of the commercial sector.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, the premium upgrade costs about $0.074/kWh/yr.

Average Annual Expected Savings

Electronics and computers use 12 percent of commercial energy on a US average basis. This equipment is often on 24 hours a day. It is assumed here that doubling the power supply efficiency from 45 to 90 percent would save at least 1.5 percent of the total building energy.

Expected Useful Life

This measure is assumed to have high usage which results in a relatively short useful life.

LED Outdoor Lighting (C-16)

LED lighting applications use much less energy than incandescent or metal halide lighting applications. At the present the color of "white" LED light is somewhat blue tinted and not always suitable for general interior applications. But this color is often suitable for outdoor applications and it is probable that LED lighting will find its place in many outdoor applications. The application considered here is an LED outdoor light, often referred to as a "cobra light", which is used to illuminate parking lots and outdoor areas.

Measure Applicability

This measure is still evolving but will likely be applicable to a large percentage of the commercial sector.

Incremental Cost

A significant and favorable cost impact for this measure is its long life, leading to maintenance savings in cases where the light is difficult to access. Incremental costs vary based on lighting intensity and usage requirements.

Average Annual Expected Savings

Measure savings proceed from the replacement of a 250 watt light by a 19 watt LED assembly.

Expected Useful Life

The expected useful life for this long-lived measure is highly dependent on replacement bulb quality and usage, with varied results between 10-30 years.

New and Retrofit Efficient Lighting Equipment (C-17, C-18)

Lighting efficiency is the major commercial efficiency measure. Lighting accounts for 35 percent of commercial energy, and lighting also accounts for significant cooling energy that is saved when lighting is more efficient. There are literally hundreds of combinations of more efficient lighting elements that can replace less efficient elements. The most prevalent lighting efficiencies are CFL replacement for incandescent, LED replacement for incandescent and for task lighting, and high efficiency fluorescent T5 replacements for high bay lighting and linear fluorescent lighting. This efficient lighting measure goes beyond the light sources only and includes daylighting controls, bi-level switching and occupancy sensors. Recent improvements in daylighting and lighting controls have been dramatic. Taken together it is common to find efficient lighting that can reduce lighting energy by 50 percent from the minimum code required levels.

Measure Applicability

This measure is applicable in 100 percent of the new commercial buildings and in 85 percent of the existing commercial sector.

Incremental Cost

The incremental cost for this technology is essentially the cost of the efficient lighting components. These costs will be very diverse and site specific. Based on NWPCC estimates, and averaging the full range of conditions, efficient lighting costs about $0.26/kWh/yr. For a retrofit application, the cost is increased by 25 percent to allow for installation constraints.

Average Annual Expected Savings

A comprehensive lighting retrofit or new building lighting can save about 25 percent of the 34 percent lighting end-use, in all 8 percent of building energy.

Expected Useful Life

The useful life of the wide variety of lighting equipment varies widely from one light source or ballast to another. However, these elements are the replaceable elements within an overall installed system that determines overall useful lifetime.

LED Exit Signs (C-19)

Typical existing exit signs are incandescent exit signs. This measure is designed to replace these typical exit signs with an Energy Star Light Emitting Diode (LED) Exit Sign which is more efficient than the incandescent versions.

Measure Applicability

In principal, this measure is applicable in the entire commercial sector, and there are no physical constraints to replacing existing exit signs, but to account for already installed LED exit signs the applicability is assumed to be 85 percent of the commercial sector.

Incremental Cost

The incremental cost of an Energy Star LED Exit Sign over an incandescent exit sign is in the order of $50.

Average Annual Expected Savings

The average annual expected saving for this replacement is 245 kWh/year.[24] In the average building considered in this analysis, there are assumed to be 6 exit signs.

Expected Useful Life

LED exit signs are very long-lived light sources.

[24] C&RD Database

LED Traffic Lights (C-20)

LED traffic lights[25] save energy because LED light sources are a much more efficient and long-lived light source than the incandescent bulbs they replace. They save energy but they also save in terms of bulb replacement costs. LED traffic lights have a variety of configurations. Each color (red, green, or yellow), each size (8 inch or 12 inch) and each type (thru lane, left turn bay, right turn bay, and don't walk large or small) has different incremental cost, savings and effective useful life values.

Measure Applicability

Measure applicability was not estimated due to lack of data on traffic lights in the DEO service territory. But for this analysis, it is assumed that there are 0.3 retrofittable intersections for every commercial building.

Incremental Cost

Depending on the color, size and type, the incremental cost ranges from $110 to $225. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light costs $200. These incremental costs do not assume an installation cost. It is assumed that the installation is done by the agency controlling the lights, and that it is more than paid for by the ongoing maintenance savings.

Average Annual Expected Savings

Depending on the color, size and type, the savings range from 111 to 808 kWh/year. For this analysis we consider LED traffic light replacements in groups of 10, approximately the number of lamp replacements necessary to refit an intersection. For this analysis we will assume the average replaced light saves 500 kWh/yr.

Expected Useful Life

Depending on the color, size and type, the expected useful life ranges from 3 to 16 years.

[25] All values for LED Traffic Lights are available in the C&RD Database.

Small Commercial LED Change-out (C-21)

The Small Commercial LED Change-out is a pilot measure to change from incandescent or halogen lamps to LEDs in restaurants and small/medium retail shops, typically mall shops or small street-front shops. LED prices continue to decline and with their long measure life will be cost-effective in many small commercial change-out applications. LED light sources are a much more efficient and long-lived light source than the incandescent or halogen bulbs they replace. They save energy but they also save in terms of bulb replacement costs.

Measure Applicability

Measure applicability will be determined through the pilot application. Care will need to be taken insure each project is individually cost-effective. This will depend primarily on equipment in place.

Incremental Cost

Depending on floor arrangement and types of display for on-floor merchandise, the type of LED will vary. Primarily, the LEDs installed will range from 10 to 16 Watts. Retail price per bulb is expected to range from $9 to $15, and price to the program is estimated at $6 to $15. Total assumed installation cost is $30 per bulb. The price will be the outcome of negotiation. It is expected that bulbs will be retrofit into existing sockets, and that likely fewer bulbs will be required than were originally in place.

Average Annual Expected Savings

Depending on the size, the savings range from 180 to 300 kWh/year per bulb. For this analysis we consider replacements in groups of 35, approximately the number of lamp replacements necessary to refit a small business in a typical mall shop. For this analysis we will assume the average replaced light saves 236 kWh/yr.

Expected Useful Life

The expected useful life is assumed to be 6 years with an average operation history of 4,000 hours per year.

Perimeter Daylighting (C-22)

This measure saves energy by reducing energy to lighting that is in or adjacent to day lit spaces. Some cooling energy savings are also possible because well controlled day lighting contributes less internal gain to a space. This measure controls lighting based on a well placed day light sensor. This measure also includes design and details to control glare or over lighting.

Measure Applicability

This measure is applicable in the new commercial sector, and in suitable retrofit situations.

Incremental Cost

The incremental cost for this technology will be very diverse. Based on NWPCC estimates, perimeter daylighting costs about $0.85/kWh/yr.

Average Annual Expected Savings

It is assumed here that a full application of perimeter daylighting can save about 3 percent of the total building energy.

Expected Useful Life

This measure is essentially a built-in measure and is assumed to have a standard useful life.

Low Flow Fixtures (C-23)

This technology consists of a new showerhead rated at 2.0 gpm at 80 psi (or 1.5 gpm @60 psi) and a swivel aerator for any kitchen faucets, and fixed aerators for the lavatory faucets. The current US standard for showerheads is 2.5 gpm. And measurements of the existing shower flows in building stock show a range of 2.75 to 3.75 gpm with frequent individual cases showing in excess of 5 gpm. Evaluations have shown that programs that replace with 2.0 gpm heads have greater savings than programs that replace with the standard 2.5 gpm shower heads. Program shower heads should be 2.0 gpm at 80 psi and with a lifetime scaling and clogging warranty. It is important also to be cautious about the use of “pressure compensating” showerheads. These are more prone to clogging, and can lead to unintentional increases in flow rate in low pressure situations such as well water systems or older systems with occluded piping. Customer acceptability is an important component in a showerhead program. Customers will remove new low flow showerheads if the quality of the showering experience declines with the new showerhead. Therefore it is important to research and test the showerhead chosen for the program carefully. In addition the old showerhead must be removed from the premises to decrease the likelihood of having it reinstalled.

Measure Applicability

This measure is applicable to circumstances where there is showering; such as, schools, hospitality, health clubs, etc. The best application will be a site where the water is heated electrically.

Incremental Cost

The incremental cost for this measure is taken as $1,000, reflecting the installation of 15-40 showerheads by appropriately licensed professionals. Because the cost of the showerhead varies significantly and quality is so important for this program, it is essential to test, choose, and pay for a high quality showerhead. This measure is so cost effective that even with a more expensive showerhead the program will still remain cost effective and a quality showerhead will ensure measure persistence.

Average Annual Expected Savings

The average annual savings for this measure are directly related to the daily number of showers taken. For this study the showering load is assumed similar to a residential one and the overall savings are taken as 6,000 kWh/yr, representing the savings from 15-40 showerheads. The flow of the showerhead used has a significant impact on savings. Programs should be designed around a 2.0 gpm showerhead as compared to a 2.5 gpm showerhead. Therefore the savings will be more than the 120–133 kWh per unit listed in DEER. In addition the climate is different and the inlet water temperature is lower so the savings in this DEO program will be greater. Several studies have measured final savings in terms of electric input to the tank, but usually these studies have included savings from comprehensive treatments including other measures including tank and pipe insulation, kitchen and bath lavatory aerators, tank thermostat set back, and leaky diverter replacement. Savings can vary from program to program depending strongly on the choice of showerhead. A significant but unquantified addition to savings is associated with the water and sewer savings.

Expected Useful Life

The lifetime of this equipment is the key to its cost effectiveness. If an adequate, even pleasant, shower can be provided through lifetime warranted equipment, then the practical lifetime of the equipment is the length of time until the equipment is replaced in the course of renovation. DEER uses a lifetime of 10 years for this measure. Normally showerheads will last longer but with renovations and changes in ownership the average showerhead useful lifetime will be somewhat shortened.

Solar Water Heaters (C-24)

The water heating end-use in commercial buildings is a smaller end-use than in residences. In the DEO service area large commercial water heating will be done by gas and it will not be a very good candidate for this measure. But the smaller commercial water heating applications will be residential scale in usage and often these smaller applications will be electrically heated. These are the candidate applications for this measure. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. Countless demonstration cases have shown that solar energy can supply all or a portion of this heating. The portion of the water heating load assumed by a solar water heater depends on the size of the solar water heater in relation to the size of the load. Field experience has shown that the best combination of system size to load favors the more moderately sized systems that can fully meet the summer water heat load, but that only meet about 40-50 percent of the non summer load. In physical terms, this is a system consisting of about 40-65 square feet of solar collector and an additional 80 gallon heated water storage tank and appropriate pumps and controls.

Measure Applicability

This measure is applicable to large commercial buildings with reasonably low hot water use, and the system is sized as if it were residential. This measure is taken as applicable to 25 percent of the commercial sector.

Incremental Cost

The installation of a solar water heating system involves a mix of building skills including plumbing, electrical, roofing and general carpentry. In the general market, a turn-key installation for one of these systems is in the range of $5,000-$7,000.

Average Annual Expected Savings

The savings from solar water heaters depend on site specifics, principally solar insulation, air temperature, incoming water temperature, and hot water usage rate. Considering these dependencies for the DEO service area, annual savings are determined for a system sized and designed to be within a cost effective range.

Expected Useful Life

Solar water heating systems are essentially plumbing fixtures that are certified products (Solar Rating & Certification Corporation - SRCC) and are often inspected by local building officials. A well designed system will have lifetime in excess of 25 years, even though the system will take some intermediate maintenance such as inspecting the pump and fluid level.

Heat Pump Water Heaters (C-25)

The water heating end-use in commercial buildings is a smaller end-use than in residences. In the DEO service area large commercial water heating will be done by gas, and it will not be a very good candidate for this measure. But the smaller commercial water heating applications will be residential scale in usage, and often these smaller applications will be electrically heated. These are the candidate applications for this measure. In the case of electrically heated water, the annual water heating energy is about 4,800 kWh/yr. The heat pump water heater is essentially a small heat pump drawing heat from the air by cooling and de-humidifying it and injecting this heat into a storage tank. Physically, this measure consists of a small, self-contained heat pump and a water storage tank and associated pumps and controls.

Measure Applicability

This measure is applicable to large commercial buildings with reasonably low hot water use, and the system is sized as if it were residential. This measure is taken as applicable 25 percent of the commercial sector.

Incremental Cost

The incremental cost of this measure consists of the cost of the heat pump water heater, water storage tank and installation plumbing and general construction labor. The siting of such a unit is important; it should never be sited in an attic, and freezing situations should also be avoided. Therefore, some special site adaptation and plumbing may be necessary.

Average Annual Expected Savings

For this study it is assumed that the heat pump water heater will perform with a coefficient of performance of 2.

Expected Useful Life

The useful life of this measure is assumed to be that of a similar appliance, a window air conditioner.

HE Food Prep and Holding (C-26)

This measure involves cooking and storage equipment that saves energy by keeping prepared food warm more efficiently, providing more efficient cooking methods and water conservation. The measures aggregated within this category are: convection ovens, combination ovens, steam cookers, efficient food holding cabinets and low-flow pre-wash sprayer nozzles.

Measure Applicability

This measure is applicable in portions of the restaurant, hospitality, and education sectors.

Incremental Cost

Incremental cost for this category of measures combines a weighted ratio of costs among the bundled measures. Individual measure costs range from $50 for a single spray nozzle with installation and $17,000 for a new combination oven.

Average Annual Expected Savings

It is assumed here that this bundle of measures will provide an average annual savings based on the individual penetration of each measure within the available population. Weighted averages were developed with the following assumptions:

Measure	**Market Penetration**
Spray Nozzles	35%
Convection Ovens	15%
Combination Ovens	7%
Steam Cooker	2%
Holding Cabinets	10%

Expected Useful Life

Measure life for this aggregate was based on a weighted average dependent on individual component potential market penetration rates.

Energy Star Clothes Washer (C-27)

Energy Star rated commercial clothes washers provide a marked savings increase over standard washers with higher volume wash loads and greater energy and water savings per cycle. Energy Star rates washers as Tier 1, Tier 2 and Tier 3 (MEF>1.80, 2.00, 2.20 respectively). For the purpose of this evaluation, Tier 1 washers were assumed to be the installed measure at all sites.

Measure Applicability

This measure is applicable in portions of the hospitality sector.

Incremental Cost

DEER lists the incremental cost of Tier 1 clothes washers as $347 per unit with an assumed installation cost of $116.

Average Annual Expected Savings

Savings are based on Tier 1 clothes washers with electric dryers. The average treated site is assumed to have 3 washers.

Expected Useful Life

This measure is assumed to have a standard useful life.

Restaurant and Grocery Audit (C-28)

This measure consists of an audit conducted by a restaurant and grocery energy professional to identify the potential for efficiency in a commercial kitchen and food storage facility. Savings proceed from small things such as leaky faucets and unnecessary equipment operation to larger things such as major process changes. Since kitchen equipment is energy intensive the audit includes identification of cost effective equipment changes.

Measure Applicability

This measure is applicable to grocery stores and related facilities and to commercial kitchens in the restaurant, hospitality, and education sectors.

Incremental Cost

The incremental cost for this measure is limited to the cost of the audit only. The cost of any major equipment changes is associated with other measures. The cost for the audit is assumed to be $.0738/kWh/yr.

Average Annual Expected Savings

It is assumed here this measure can reduce the energy use in an applicable facility by 8 percent for the average building considered in this analysis.

Expected Useful Life

This measure will have a relatively short life.

Grocery Refrigeration Tune-Up and Improvements (C-29)

This measure consists of cleaning heat exchangers and assuring proper airflow at the freezer cases and condenser coils. It also involves appropriate belt adjustment and refrigeration charge correction and the addition of a floating head pressure control if appropriate.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants.

Incremental Cost

Based on NWPCC estimates, the grocery refrigeration tune-up costs about $0.19/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure will save 6 percent of site electrical usage for the average building considered here.

Expected Useful Life

This measure is assumed to have a short useful life.

Refrigeration Casework Improvements (C-30)

This measure refers to improvements to refrigeration casework that can lower the refrigeration load. These include high quality insulated glass doors on the refrigeration case or other transparent refrigeration case covers that limit mixing of the warmer store air with the refrigerated air.

Casework improvements also include attention to two refrigeration case auxiliaries that emit heat into the refrigerated space. The first is the anti-sweat heater made part of the clear refrigeration door to melt frost that could accumulate on the door and obscure the view of the contents. These heaters are commonly on all the time when they are only needed during high humidity episodes with humidity greater than 55 percent. The control improvement is to control the anti-sweat heaters with a humidistat thus allowing operation only to times when it is needed. While this control improvement will depend on the store humidity and the specific heater size, the savings for a typical refrigeration case are estimated here to be 400 kWh/yr.

The second heat emitting auxiliary is lighting and small fans used to distribute the cooled air inside the refrigerated case. These fans typically use a small inefficient motor coupled to an inefficient fan blade. In a typical medium-sized refrigeration case the existing fans may use about 70 watts, with the efficient fans using only about 20 watts, for a savings during 8,760 hours/yr of 50 watts or about 450 kWh/yr/case.

Measure Applicability

This measure is applicable in portions of the grocery sector and in some restaurants.

Incremental Cost

Based on NWPCC estimates, an average refrigeration case upgrade costs about $0.33/kWh/yr.

Average Annual Expected Savings

It is assumed here that this measure will save 5 percent at a suitable site.

Expected Useful Life

This measure is assumed to have a standard useful life.

VendingMiser® and Vending Machine Timer Control (C-31)

The VendingMiser® is a controller placed on vending machines which powers down the lighted vending machine face during low use times while maintaining product quality. It cycles the machine to maintain temperature and uses occupancy sensors to control the lighting on the vending machine.

Measure Applicability

This measure is assumed to be applicable in 25 percent of the commercial sector.

Incremental Cost

According to DEER, the incremental cost for a VendingMiser® unit is $179 and installation costs are expected to be $35.50 in labor for a total incremental cost of $215.

Average Annual Expected Savings

Measure savings range from 800 to 1,200 kWh/yr, depending on the vending machine. Large machines with an illuminated front save 1,200 kWh/yr; and small machines or machines without an illuminated front save 800 kWh/yr.

Expected Useful Life

The expected useful life for this measure is the useful life of the associated vending machine.

Smart Plug (RC-1)

This measure consists of a power strip with load sensing capability. When the primary load is turned off, the secondary loads connected to the power strip are automatically powered down. This measure is typically used in home office spaces where support equipment (printers, projectors, etc.) may be left on after the connected computer is turned off.

Measure Applicability

This measure is applicable to residential home office space and some entertainment center applications.

Incremental Cost

The incremental cost for this measure is determined to be the cost of purchase of the smart plug.

Average Annual Expected Savings

Savings associated with this measure are based on home-energy use surveys, with typical household electronics usages and reasonable assumptions of secondary equipment usage patterns. It should be noted that the household loading due to electronics is increasing steadily and projected savings from this measure will likely increase over time.

Expected Useful Life

This measure will have a medium-term useful life.