EVALUATION OF THE EFFICIENCY MAINE TRUST BUSINESS INCENTIVE PROGRAM

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Prepared for:

EFFICIENCY MAINE TRUST

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1.1 Evaluation Objectives

Efficiency Maine contracted with Opinion Dynamics Corporation and subcontractor Michaels Energy to conduct an independent evaluation of their Business Incentive Program. The evaluation fulfills the statutory requirements that the Trust:

> (1) Arrange for an independent evaluation, at least once every 5 years, of each program that has an annual budget of more than $500,000, including an evaluation of the program's effectiveness in achieving goals specified in the law governing the Trust (35-A MRSA section 10104, subsection 10), and
>
> (2) Monitor and evaluate the delivery of electric conservation programs and assess the cost-effectiveness of programs (35-A MRSA section 10110, subsection 2, paragraph F).

This evaluation includes a process, impact, and cost-effectiveness analysis and focuses on the most recent fiscal year, FY2011 (July 2010 through June 2011). Changes from prior program years (FY2007 through FY2010) were assessed qualitatively, where relevant.

1.2 Evaluation Methods

The Evaluation Team conducted a variety of evaluation activities supporting the process, impact, and cost-effectiveness analyses:

- **Review of program materials:** We reviewed all available program materials for the Business Program, including design and implementation documents, marketing plans, marketing collateral, and training materials. Review of these materials provided necessary background information for the other research objectives.
- **In-depth interviews with program and implementation staff:** We conducted eight in-depth phone interviews with Efficiency Maine Trust and implementation staff involved in the design and administration of the Business Program. These interviews allowed us to fully explore details of program design and implementation.
- **Telephone survey of participants:** We conducted a telephone survey with 167 customers that participated in the Business Program in FY2011. The survey explored a variety of aspects of the customer's participation experience and addressed attribution of energy efficiency installations to program efforts (free-ridership and participant spillover).
- **Telephone survey of non-participants:** We conducted a telephone survey with 101 customers that have never participated in the Business Program. This survey supported the process evaluation and a qualitative assessment of non-participant spillover.
- **In-depth interviews with Qualified Partners:** We conducted 19 interviews with Qualified Partners to obtain feedback about the Business Program and collect

information about the market for energy efficient equipment.

- **Review of the Technical Reference User Manual (TRM):** We reviewed the 2010 TRM through a measure by measure check of assumptions, algorithms, and underlying references. We also checked certain assumptions against assumptions for similar measures in other efficiency programs.
- **Site visits:** We conducted site visits for 30 of the 178 completed custom projects and for the single largest prescriptive lighting project. The main objectives for the site visits were to: 1) determine the type, energy use, and operation of baseline equipment; 2) verify installation of the new equipment; and 3) monitor the energy use and operation of the equipment.
- **Engineering desk reviews:** We completed desk reviews for a sample of 70 prescriptive projects. The desk reviews included a thorough review of program files and a comparison to information for each project logged in the program's tracking database. We also cross-checked the energy savings estimates for individual measures against savings listed in the TRM.
- **Calculation of ex post (verified) gross and net impacts:** Based on the site visits and desk reviews, we determined the realization rate for projects completed in FY2011 and estimated ex post gross impacts. Based on results from the participant survey, we calculated a program-level net-to-gross ratio and ex post net savings.
- **Cost-effectiveness analysis:** We reviewed the assumptions and inputs underlying the program's benefit-cost model and ran the model to determine the cost-effectiveness of the program in FY2011.

1.3 Key Findings

1.3.1 Process Analysis

Program Participation and Satisfaction

The Business Program had a strong year in FY2011 and substantially increased participation and savings compared to FY2009 and FY2010. As in prior years, the manufacturing sector was a key driver of savings in FY2011. The share of gross energy savings from prescriptive lighting has decreased compared to prior program years (from 62% in FY2007 to 52% in FY2011) while the share from custom projects has increased (from 30% in FY2007 to 41% in FY2011). The average size of projects has fallen sharply since FY2007, from 49.1 MWh to 22.9 MWh.

Participants and Qualified Partners are generally satisfied with their participation in the Program.

Program Design and Implementation

The Program has made continuous adjustments and improvements to program design and implementation over the five-year period FY2007 to FY2011. Key changes included an improved electronic application and program tracking system and the introduction of a

"Qualified Partner" network.

Program Marketing and Outreach

Non-participant awareness of Efficiency Maine (68%) and the Business Program (33%) is relatively high for a non-utility program, but many of these businesses are not familiar with the specifics of the Program. While most non-participants hear about the Program through general media, trade allies are a key source of Program information for participants.

Qualified Partners

The introduction of the "Qualified Partner" status for trade allies in 2009 has been successful in focusing the list of program partners and increasing the quality of submitted applications. In FY2011, Qualified Partners represented 35% of participating contractors, 57% of total projects, and 71% of total energy savings. Most of the current Qualified Partners are electrical contractors.

Barriers

Upfront cost, lack of knowledge and information, and the economic climate are key barriers to the installation of energy efficient equipment and program participation for both participants and non-participants. Small businesses are more likely to cite price as a barrier compared to large businesses. However, despite the economic climate, many non-participants plan to install new equipment at their facility in the next two years and are interested in energy efficient options.

1.3.2 Impact Analysis

Impact Results

Ex ante (program-reported) gross energy savings for the Business Program in FY2011 were 44.0 GWh, or 113% of Program goals. As shown in Table 1-1, the program-level realization rates (RR) for both energy and demand savings are estimated to be close to one (or 100%), indicating that ex post (verified) savings from the evaluation are almost identical to those tracked by the Program (ex ante gross savings). This is true overall and for both the prescriptive and custom components of the Program.

The net-to-gross ratio (NTGR), which represents the fraction of gross program savings that we can reliably attribute to the program, was estimated to be 0.66. Applying the net-to-gross ratio to ex post gross savings yields ex post net energy and demand savings of 29.1 GWh and 5.6 MW, respectively for FY2011.

Table 1-1. Gross and Net Impacts for FY2011

	Ex Ante Gross	RR	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (KWh)					
Prescriptive	25,715,628	0.99	25,401,049	0.70	17,681,408
Custom	18,236,971	1.02	18,566,421	0.62	11,436,497
Total KWh	43,952,599	1.00	43,967,470	0.66	29,117,905
Demand Savings (KW)					
Prescriptive	5,883	1.01	5,955	0.70	4,145
Custom	2,263	1.09	2,471	0.62	1,522
Total KW	8,146	1.03	8,426	0.66	5,580

Source: effRT program tracking database, net and gross impact analyses.

Key findings from our desk reviews, TRM review, and on-site visits include:

Baseline Assumptions

Perhaps the largest source of uncertainty in the Business Program's energy savings estimates is the lack of baseline information collected for lighting projects, including the type, number, wattage, and efficiency of replaced equipment. The TRM addresses this by designating typical baseline wattages for each measure type. However, these baseline assumptions often apply to broad measure categories and are often not representative of the actual baseline conditions. Overall, the TRM baseline assumptions appear to fairly accurately represent replaced wattages, but there is significant variation between individual projects. It also appears that the program implementers often do not follow the TRM and instead use other undocumented sources of baseline information.

TRM Improvements

In our review of the TRM and in using the TRM in the project reviews, we identified several areas for improvement. These areas include the clarity and usability of the TRM, such as adding summary tables for certain measures. We also identified improvements that will likely result in more consistency and accuracy of savings estimates, such as additional lighting fixture types and wattages, and additional space types for occupancy sensor savings factors.

In addition, the Evaluation Team found several measure-specific assumptions and algorithms which we recommend revisiting. These are described in detail in the Gross Impact sections in the remainder of this report.

Data Discrepancies

In the course of our desk reviews of prescriptive projects, we found that data used in ex ante savings calculations did not always reflect the project documentation in the program tracking database (effRT). Examples include cases where the installed lighting wattage and hours of operation used for ex ante savings estimates did not agree with the program documentation, and cases where fixture types used in the savings calculations did not match invoices. Such discrepancies resulted in both under- and over-estimations of savings.

Compressed Air Projects

Ex ante and ex post savings for custom compressed air projects tended to differ significantly in part due to assumed CFM (cubic feet per minute) demand profiles in the ex ante calculations being quite different from what we metered on site. In addition, we found that the unloading curves[1] used in ex ante calculations were often incorrect and that corrections for operating pressure were often not taken into account.

1.3.3 Cost-Effectiveness Analysis

Based on our evaluation results, the estimated Total Resource Cost (TRC) test value for the FY2011 Business Program is 1.93.

The program-estimated TRC test value was 2.21. A few corrections to the Program Model reduced the TRC value to 2.15. Replacing ex ante values with ex post values further reduced the TRC value to 1.93. Since the program-level realization rates for energy and demand savings are close to 1.0, this latter reduction mainly stems from the application of the net-to-gross ratios.

1.4 Opportunities for Program Improvement

Based on our key process and impact findings, the following are opportunities for program improvements the Business Program may wish to consider:

Program Processes

- Consider differentiating marketing and outreach materials and methods between large and small businesses. Develop additional case studies that focus on small businesses or on additional sectors and that exemplify the expected annual savings in relation to upfront costs.
- Consider developing special offerings for small businesses that simplify the participation process.
- Consider implementing "trigger tactics" for outreach in future program years, as needed to meet program goals.
- Explore ways of cooperating more closely with the utilities and engaging Account Managers in the Business Program, where possible.
- Continue efforts to diversify the portfolio of projects away from prescriptive lighting.
- Continue to recruit more non-lighting contractors into the Qualified Partner network and target contractors who can provide "deeper" savings.
- Consider providing additional incentives for becoming a Qualified Partner.

[1] An unloading curve describes the power use of a piece of equipment when it runs at lower loads or speeds. Most devices do not have a linear relationship between the load they supply and the power it takes to run them. Therefore, operating at half load does not usually mean half the power is used.

Program Impacts

- Consider asking for baseline conditions on applications for all lighting projects (or those exceeding a specific level of savings or incentives) to allow for a more accurate determination of project and program savings.
- Implement updates to the TRM to improve its clarity and usability and the accuracy of ex ante savings estimates.
- Incorporate key external sources of assumptions into the TRM. If this is not possible, provide better documentation when sources other than the TRM are used to estimate savings for prescriptive projects.
- Review the program's quality control procedures to minimize the incidence of data discrepancies.
- Consider requiring compressed air studies in order to receive compressed air incentives. Assumed CFM demand profiles can be quite different from actual operation.

2. INTRODUCTION

2.1 Evaluation Objectives

Efficiency Maine contracted with Opinion Dynamics Corporation and subcontractor Michaels Energy to conduct an independent evaluation of their Business Incentive Program. The evaluation fulfills the statutory requirements that the Trust:

> (1) Arrange for an independent evaluation, at least once every 5 years, of each program that has an annual budget of more than $500,000, including an evaluation of the program's effectiveness in achieving goals specified in the law governing the Trust (35-A MRSA section 10104, subsection 10), and
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> (2) Monitor and evaluate the delivery of electric conservation programs and assess the cost-effectiveness of programs (35-A MRSA section 10110, subsection 2, paragraph F).

This evaluation includes a process, impact, and cost-effectiveness analysis and focuses on the most recent fiscal year, FY2011 (July 2010 through June 2011). Changes from prior program years (FY2007 through FY2010) are discussed qualitatively, where relevant.

The Evaluation Team conducted a variety of primary data collection activities supporting both the process and impact assessments:

- Telephone survey of participants
- Telephone survey of non-participants
- In-depth interviews with Qualified Partners
- In-depth interviews with program and implementation staff

Impact related tasks included:

- Review of the Technical Reference User Manual (TRM)
- Site visits to assess custom measure savings
- Desk reviews to assess prescriptive measure savings
- Calculation of ex post gross and net impacts

In addition, we reviewed the assumptions and inputs underlying the program's benefit-cost model and ran the model to determine the cost-effectiveness of the program in FY2011.

2.2 Program Description

The Business Incentive Program ("Business Program") provides cash incentives and technical assistance to help Maine businesses purchase and install energy efficiency measures to reduce electricity consumption and costs. All non-residential electricity customers – including commercial, industrial and institutional customers and including both public and private entities – are eligible to participate in the Business Program.

The Program offers two types of cash incentives, prescriptive and custom, both of which are generally available for retrofit applications or new construction. Prescriptive incentives are standardized incentives for certain qualified electric energy-efficient equipment, including lighting, HVAC equipment, system controls, and refrigeration. Custom incentives are available for other electricity-saving equipment that is not on the list of prescriptive incentives. Since late 2009, the Program has offered total incentives per participant of up to $300,000 per business per calendar year.

The Program is administered by a delivery team under contract to the Trust. The delivery team is responsible for program design and all aspects of program implementation, including application screening, incentive processing, outreach to participants, and engaging vendors, contractors, suppliers, and installers of energy-efficiency equipment. The program offers a Qualified Partner (QP) designation to those vendors, contractors, suppliers, and installers who wish to affiliate with the Program and who complete specialized training provided by the Trust. One of the key roles of the QPs is to assist Program participants in the process of selecting qualifying equipment and applying to the Program.

The Program is funded by the Conservation Fund (M.R.S.A. Title 35-A, section 10110) and the Regional Greenhouse Gas Initiative (RGGI) Fund (M.R.S.A. Title 35-A, section 10109). Total funding for the Program, including cash incentives and delivery costs, was $10.1 million in FY2011.

Since its inception in April 2003, the Business Incentive Program has provided over $25 million in cash incentives to over 3,500 Maine businesses to complete more than 7,000 energy efficiency projects.

2.3 Organization of Report

The remainder of this report is organized as follows:

- **Section 3: Evaluation Methods** provides a detailed summary of the data collection and other evaluation activities performed, including sampling and weighting approaches and precision estimates.
- **Section 4: Process Analysis** provides the findings of the process evaluation. Topics of analysis include program participation, program design and implementation, marketing and outreach, Qualified Partner participation and experience, barriers to energy efficiency and program participation, participant satisfaction, market trends and equipment purchases, and awareness of/interest in other Efficiency Maine Programs.
- **Section 5: Impact Analysis** presents the estimates of gross and net impacts for the Business Program in FY2011.
- **Section 6: Cost-Effectiveness Analysis** presents a review of the inputs and assumptions of the benefit-cost model, as well as the Business Program's cost-effectiveness results for FY2011.
- **Section 7: Findings and Recommendations** summarizes the findings from the process analysis, impact analysis, and cost-effective analysis, and provides recommendations for program improvement.

- **Appendix A: Compliance with ISO-NE Measure and Verification Requirements** provides information regarding the compliance of this evaluation with ISO-NE requirements.

3. EVALUATION METHODS

3.1 Process Methods

The process evaluation of the FY2011 Business Program is supported by several primary data collection activities as well as a review of program materials. Table 3-1 summarizes these evaluation activities. The subsections following the table provide details regarding each activity.

Table 3-1. Summary of Evaluation Activities

Evaluation Activity	Sample Design	Sample Size	Timing
Review of Program Materials	n/a	n/a	June/July 2011
In-Depth Interviews with Program and Implementation Staff	Purposeful sample of key program management, implementation, and design staff	8	June – Sept. 2011
Survey of Participating Customers	Census attempt of custom and prescriptive non-lighting projects; stratified random sample of prescriptive lighting projects	167	Oct./Nov. 2011
Survey of Non-Participating Customers	Proportional stratified random sample by employment size	101	Sept./Oct. 2011
In-Depth Interviews with Qualified Partners	Random sample of active, inactive, and demoted Qualified Partners	19	Oct./Nov. 2011

3.1.1 Review of Program Materials

The evaluation team reviewed all available program materials for the Business Program, including design and implementation documents, marketing plans, marketing collateral, and training materials. Review of these materials provided necessary background information for the other research objectives. It informed the development of the research instruments we used in our program and implementation staff interviews as well as customer and Qualified Partner survey efforts. In support of the Impact Evaluation, we also reviewed data tracking systems and project files. These activities are described in detail in Section 3.2 (Gross Impact Methods).

3.1.2 In-Depth Interviews with Program and Implementation Staff

Opinion Dynamics conducted eight in-depth phone interviews with Efficiency Maine Trust and implementation staff involved in the design and administration of the Business Program. These interviews allowed us to fully explore details of program design and implementation and explore the perspective of the people who are in direct contact with participating customers and Qualified Partners. As such, these interviews informed many of

our subsequent research activities.

All interviews were conducted by experienced project analysts and took place between June and September 2011.

3.1.3 Survey of Participating Customers

Opinion Dynamics conducted a Computer-Assisted Telephone Interviewing (CATI) survey with 167 customers that participated in the Business Program in FY2011. This survey supported both the process and net impact evaluations.

The survey explored a variety of aspects of the customer experience ranging from effectiveness of outreach efforts, perceptions of the program delivery process, experience with contractors/Qualified Partners and EMT technical staff, awareness of and interest in other opportunities for business customers, and program satisfaction. In addition, the survey explored attribution of energy efficiency installations to program efforts (free-ridership and participant spillover).

Interviews were conducted in October and early November 2011 by Opinion Dynamics' Utah-based telephone interviewing center.

Sampling

The sampling unit was the unique project contact. Based on the program tracking database, 1,162 unique individuals were listed as the project contact for the 1,918 FY2011 projects with energy savings. The sample frame consisted of 1,157 unique contacts from the program tracking database. Removed from the population were five contacts with invalid phone numbers.

To support estimation of free-ridership, we targeted the survey towards contacts representing three different types of projects: custom, prescriptive lighting, and prescriptive non-lighting. The sample frame included 940 contacts with a prescriptive lighting project, 117 contacts with a prescriptive non-lighting project, and 100 contacts with a custom project.

Table 3-2 summarizes the assignment of projects and contacts into end-use frames as well as the resulting number of contacts targeted by the survey.

Table 3-2. Summary of Sample Frame for Participant Survey

End-use Frame	Population		Sample Frame
	Projects	Unique Contacts	Unique Contacts
Custom	174	109	100
Prescriptive Non-Lighting	200	131	117
Prescriptive Lighting	1,544	1,024	940
Small	*1,312*	*903*	*801*
Medium	*208*	*155*	*118*
Large	*23*	*21*	*20*
Very Large	*1*	*1*	*1*
Total	1,918	1,162*	1,157

*Individual values don't add up to total since the same contact can have a project in more than one end-use frame.
Source: effRT program tracking database.

Given the small number of contacts in the custom and prescriptive non-lighting end-use frames (100 and 117, respectively), there was no sampling; we attempted to reach a census of contacts representing these types of projects.

For the prescriptive lighting end-use frame, the sampling approach was a stratified sample. Stratification was by energy savings of the project; stratum boundaries were determined using the Dalenius Hodges method:[2]

- Small: 1-15,000 kWh
- Medium: 15,001-100,000 kWh
- Large: 100,001-1,000,000 kWh
- Very large: 1,000,000+ kWh

Within these strata, we attempted to reach a census of the unique contacts representing medium, large, and very large prescriptive lighting projects. We drew a random sample of 415 contacts from the small lighting projects.

Survey Completes

Per the evaluation plan, the target for this survey was 175 interviews (55 custom, 55 prescriptive non-lighting, and 65 prescriptive lighting). However, given the limited number of available contacts for custom projects and prescriptive non-lighting projects (100 and 117, respectively), we increased the target number of interviews for the prescriptive lighting projects, once no more interviews with custom and non-lighting contacts could be cost-effectively completed.

The final number of completed interviews for this survey was 167. Table 3-3 summarizes the completed interviews by end-use frame. The table also compares the savings represented by the completed interviews relative to the savings in the population.

The response rate for the survey was 23%.[3]

[2] The Dalenius-Hodges method allows for the determination of strata boundaries that minimize coefficients of variation, given a fixed sample size and a fixed number of strata.

Table 3-3. Summary of Survey Completes

End-use Frame	Completes	KWh Savings		
		Population	Completes	% of Population
Custom	36	18,236,971	5,601,379	31%
Prescriptive Non-Lighting	32	2,861,503	452,972	16%
Prescriptive Lighting	99	22,854,125	7,098,303	31%
Small	*60*	*4,510,042*	*198,912*	*4%*
Medium	*31*	*7,171,364*	*1,002,828*	*14%*
Large	*7*	*7,394,278*	*2,118,122*	*29%*
Very Large	*1*	*3,778,441*	*3,778,441*	*100%*
Total	167	43,952,599	13,152,654	30%

Source: effRT program tracking database; participant telephone survey.

Weighting

For the process evaluation, we weighted results based on our stratification approach. Since the sample design involved over-sampling of custom, prescriptive non-lighting, and non-small prescriptive lighting projects, sample weights have to be applied to report results for all survey respondents. Sample weights are calculated by dividing the population proportion by the sample proportion for each stratum. For example, the sample weight for the custom end-use stratum is 0.40, calculated as (100/1,157) / (36/167).

Table 3-4: Process Weights for the Participant Survey

End-use Stratum	Population (Contacts)	Completed Interviews	Sample Weight
Custom	100	36	0.40
Prescriptive Non-Lighting	117	32	0.53
Prescriptive Lighting – Small	*801*	*60*	*1.93*
Prescriptive Lighting – Medium	*118*	*31*	*0.55*
Prescriptive Lighting – Large	*20*	*7*	*0.38*
Prescriptive Lighting – Very Large	*1*	*1*	
Total in Sample	1,157	167	

Source: effRT program tracking database; participant telephone survey.

[3] For additional information on survey dispositions and how the response rate was calculated, please see Appendix B.

For the analysis of free-ridership, we used a savings-weighted approach. The weight for each end-use stratum corresponds to its share of ex ante gross savings in the population. Table 3-5 summarizes ex ante gross energy impacts and kWh weights, by stratum.

Table 3-5: Free-ridership Weights for the Participant Survey

End-use Strata	Ex Ante kWh Impact Claimed	kWh Weights by Segment
Custom	18,236,971	0.41
Prescriptive Non-Lighting	2,861,503	0.07
Prescriptive Lighting	22,854,125	0.52
Total	43,952,599	

Source: effRT program tracking database.

Precision of Results

For the custom, prescriptive non-lighting, and non-small prescriptive lighting end-use frames, there is no sampling precision since we attempted a census of all project contacts; therefore, the error bounds for these frames are zero. For the small prescriptive lighting end-use frame, the estimated sampling precision for the net-to-gross-ratio result (based on energy savings) is *5% at a 90% confidence level*. Combining this precision level with the zero error bounds for the census-attempt end-use frames results in a ***0.5%* overall sampling precision for the net-to-gross-ratio *at a 90% confidence level.***

The estimated sampling precision for the process results (based on contacts) is ***6% at a 90% confidence level***.

It should be noted that in addition to sampling error, every survey effort has the potential for non-response bias. Non-response bias cannot readily be quantified. For the survey of participating customers, we attempted to minimize non-response bias by making a concerted effort to reach all customers in our sample. For customers in the census end-use frames, program staff conducted follow-up with non-respondents via e-mail. In addition, program staff called non-respondent customers in the large lighting frame to improve response rates. Our final net impact analysis included 30% of all FY2011 ex ante gross energy savings (31% of custom savings, 31% of prescriptive lighting savings, and 16% of prescriptive non-lighting savings). Given the efforts undertaken to minimize non-response bias and the strong coverage of our completed interviews, we have no reason to believe that non-response bias is an issue for this survey.

Reporting of Survey Responses

In this report, survey responses are generally reported as "valid" percentages, i.e., "don't know" responses are removed from the denominator. In certain cases, however, "don't know" responses do contain important information, e.g., if a large share of respondents give this answer or if a "don't know" response implies a "no" response (e.g., questions of awareness). Where we report percentages with all responses, including "don't know" responses, in the denominator, we note so in the text.

3.1.4 Survey of Non-Participating Customers

Opinion Dynamics conducted a Computer-Assisted Telephone Interviewing (CATI) survey with 101 customers that have never participated in the Business Program. This survey supported the process evaluation and a qualitative assessment of non-participant spillover.

The survey explored a variety of topics, including awareness of Efficiency Maine and the Business Program, knowledge and attitude towards energy efficiency, recall of program outreach, decision making process for capital investments, barriers to energy efficiency and participation in the Business Program, past and anticipated future equipment purchases, and interest in opportunities for business customers.

Interviews were conducted in September and October 2011 by Opinion Dynamics' Utah-based telephone interviewing center.

Sampling

The sampling unit was the Maine business. Based on the 2011 Edition of Tower Publishing's *The MarketMaker™*, there are 42,127 businesses in Maine.[4]

The sample frame consisted of 32,911 business records from the *The MarketMaker™*. Removed from the population were 9,216 records that:

- did not have a phone number (205 records),
- had a duplicate phone number with another record (5,843 records),
- were a program participant (based on phone number and/or company name (2,639 records), or
- did not have information on employment size (529 records).

The final sampling approach was a stratified random sample. Stratification was by employment size (1-9 employees, 10-49 employees, 50+ employees). However, when fielding the survey, we determined that the employment size in the *The MarketMaker™* database often did not match the employment size reported by survey respondents. As a result, we adjusted the distribution of business counts by employment size stratum in the population, based on survey responses.[5]

To better represent business with 10 or more employees, we oversampled the "10-49 employees" and "50+ employees" strata.

Table 3-6 shows, by stratum, the original and adjusted number and percentage of records in the sample frame as well as the number of completed interviews, by stratum.

[4] Note that because *The MarketMaker™* does not include Public Administration entities (SIC Division J), this survey effort excludes those entities although they are also eligible to participate in Efficiency Maine's Business Incentive Program.

[5] This was based on 167 total responses. Since we asked for employment size before the eligibility screening questions (previous participant, having the authority to make energy decisions), we have more sample points on employment size than completed survey responses (101).

Table 3-6: Sample Frame and Completed Interviews for the Non-Participant Survey

Stratum	Original Sample Frame		Revised Sample Frame		Completed Interviews	
	Count	%	Count	%	Count	%
1-9 Empl.	27,695	84%	26,328	80%	66	65%
10-49 Empl.	4,416	13%	4,867	15%	27	27%
50+ Empl.	800	2%	1,716	5%	8	8%
Total	32,911	100%	32,911	100%	101	100%

Source: *The MarketMaker™* database; non-participant telephone survey.

Weighting

Since we oversampled larger projects, we developed sample weights for this survey. Sample weights are calculated by dividing the population proportion by the sample proportion for each stratum. For example, the sample weight for the "1-9 Employees" stratum is 1.22, calculated as 80% / 65%.

Table 3-7: Sample Weights for the Non-Participant Survey

Stratum	% of Businesses		Weight
	Population	Survey Respondents	
1-9 Empl.	80%	65%	1.22
10-49 Empl.	15%	27%	0.55
50+ Empl.	5%	8%	0.66
Total	100%	100%	

Source: *The MarketMaker™* database; non-participant telephone survey.

Precision of Results

The estimated sampling precision for the 101 non-participant survey responses is ***8% at a 90% confidence level***.

Reporting of Survey Responses

As noted in Section 3.1.3 above, survey responses in this report are generally reported as "valid" percentages. For more detail on this, please see Section 3.1.3 above.

3.1.5 In-Depth Interviews with Qualified Partners

We conducted 19 interviews with Qualified Partners to obtain feedback about the Business Program. Topics included perceived customer awareness of energy efficiency and the Business Program, participation barriers, marketing and selling of energy-efficient equipment, communication preferences, training/resource needs, and satisfaction with the program. Qualified Partner interviews were also used to inform an assessment of non-participant spillover and provided qualitative information about the program's impact on the

market throughout the five years covered by this evaluation (July 2006 – June 2011).

Opinion Dynamics analyst staff conducted all Qualified Partner interviews in October and November of 2011.

Sampling

Based on a listing of all current Qualified Partners, we selected a random sample of 10 "active" Qualified Partners (defined as those with three or more projects in FY2011), five "inactive" Qualified Partners (defined as those with fewer than three projects in FY2011 who retained Qualified Partner status), and four demoted Qualified Partners (defined as those who were informed by Efficiency Maine after the close of FY2011 that they would no longer be part of the Qualified Partner network due to a failure to complete three projects through the program and failure to respond to outreach from program staff regarding continued participation).

3.2 Gross Impact Methods

3.2.1 TRM Review

Efficiency Maine's Technical Reference Manual (TRM) No. 2010-1 was issued on August 31, 2010. Prior to that date, the previous version 2007-1 issued March 3, 2007 applied. Our review of the 2010 TRM involved a measure by measure check of all assumptions, algorithms, and underlying references. Measure savings were also cross-checked against deemed savings for similar measures in other efficiency programs in New York, Massachusetts, and Michigan. Values of effective useful life were also checked for reasonableness and consistency with values used in other programs.

Lighting measures comprised the largest share of energy savings among both prescriptive and custom projects, so a majority of our review time focused on evaluating lighting savings estimates. Both energy and demand savings estimates were reviewed for all lighting measures, lighting controls, and exit sign measures, including an analysis of assumptions about operating hours and coincidence or savings factors. Our review of lighting measures also took into account how the program implementer was using the TRM to calculate program savings, resulting in some recommendations to help make the TRM clearer and savings easier to determine.

Our review also covered non-lighting measures, including motors, HVAC, refrigeration, and agricultural efficiency technologies. For these measures, we reviewed all algorithms and their definitions for clarity and accuracy. We confirmed that assumptions were consistent and uniform within the program, that they reflected the latest industry practices and empirical studies, and that they compared well to those used in other utility programs. We checked to see if weather-related variables represented Maine's climate.

Our review provides suggestions for improving the TRM in the future but does not make any immediate changes to the energy saving estimated for any measures. Results and recommendations from this TRM review are included in Section 5.1.1 of this report.

3.2.2 Site Visits

The Evaluation Team conducted site visits for 30 of the 178 completed custom projects and for the single largest prescriptive lighting project, which accounted for approximately 15% of all prescriptive savings. The types of custom projects inspected included ten lighting projects, eight compressed air projects, seven VFD projects, and five other miscellaneous energy efficiency projects.

The main objectives for our site visits were to: 1) determine the type, energy use, and operation of baseline equipment; 2) verify installation of the new equipment; and 3) monitor the energy use and operation of the equipment.

We scheduled and carried out site visits according to protocols and procedures written specifically for Efficiency Maine. These guidelines covered the scheduling of visits, etiquette and attire for site visits, development of monitoring and verification (M&V) plans, collection of verification information at the site, installation of monitoring equipment, and scheduling of a final visit to pick up data loggers.

Before conducting site visits we reviewed all available documentation for each project and developed a site specific M&V plan which listed what new equipment was installed, what the baseline equipment was, how the energy savings were calculated, and what we would check during our site visits to verify the measure installation and energy savings. In most cases, we checked nameplates and counted fixtures or equipment. The M&V plan also listed any other measurements we needed to make, and the type of measurement equipment and/or data loggers needed. As part of the M&V plan, a sample of equipment was chosen to be measured or monitored, with sample sizes large enough to meet 10% precision at 80% confidence.

Baseline Verification

Since the baseline, or pre-existing, equipment has usually been removed from the facility by the time of our site visits, we typically questioned the building owner or facility staff about the old equipment. We attempted to ascertain the type and model of any pre-existing equipment, and whether equipment operation changed after the new equipment was installed. We also asked for any specification sheets, maintenance manuals, or logged data still on hand for the pre-existing equipment.

Installation Verification

During each site visit, we collected all data identified in the M&V plan, including monitoring records (such as instantaneous spot watt measurements for relevant equipment, measured temperatures, data from equipment logs and Energy Management System/SCADA[6] system downloads), equipment nameplate data, system operation sequences and operating schedules, and a careful description of site conditions that might contribute to baseline selection.

Monitoring of Energy Use and Operation

In accordance with ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources (dated May 6, 2011), our M&V approach for most

[6] EMS/SCADA stands for "Energy Management System/Supervisory Control and Data Acquisition."

evaluated projects was based on Option A (Partially Measured Retrofit Isolation/Stipulated Measurement). This option involves either spot metering or longer term monitoring of power use and/or operating status of a sample of installed equipment over time. Spot measurements are made when equipment operation is well understood and not expected to vary over time. Longer-term measurements are made when equipment energy use or operation is expected to vary.

We applied Option D (Calibrated Simulation) for only one of the evaluated projects. Calibrated simulations are used for measures that are difficult to monitor and whose energy savings may be too small to distinguish from the entire facility's energy use. The building was modeled using eQuest software, and the model was calibrated to pre-EMS conditions using twelve months of billing data.

Appendix A presents more information on the four M&V options stipulated by ISO New England and our compliance with ISO New England M&V requirements.

Sampling

In FY2011, 178 custom projects were completed. Of these, 174 projects were part of the sample frame. Four projects were not included in the sample frame because they included a technical assistance study only and had no energy or demand savings associated with them.

The sampling approach was based on a stratified random sample. Stratification was by energy savings (kWh). Energy savings for the 174 FY2011 custom projects ranged from 839 kWh to 1,639,379 kWh. Using the Dalenius-Hodges method, we set strata boundaries at 75,000 kWh and 250,000 kWh. We used the Neyman Allocation[7] to allocate the available sample to the three strata.

Table 3-8 summarizes the three strata with respect to the number of projects, MWh, and KW in both the population and the sample. To meet precision targets, we conducted a census of projects in the stratum containing the projects with the largest savings (Stratum 3). We randomly selected projects in the medium and small savings strata (Strata 2 and 1).

As shown in the table, the resulting sample included 17% of custom projects, 70% of custom energy savings, and 56% of custom demand savings.

Table 3-8: Summary of Stratification for Custom Site Visits

Stratum	Population			Sample			Sample as % of Population		
	Projects	MWh	KW	Projects	MWh	KW	Projects	MWh	KW
1 – Small	127	2,381	431	10	255	40	8%	11%	9%
2 – Medium	33	4,400	713	6	1,037	101	18%	24%	14%
3 - Large	14	11,455	1,119	14	11,455	1,119	100%	100%	100%
Total	174	18,237	2,263	30	12,746	1,260	17%	70%	56%

Source: effRT program tracking database.

[7] The Neyman Allocation allows for an allocation of sample into strata that maximizes survey precision, given a fixed sample size.

In addition to the 30 custom site visits, we also conducted one site visit for a prescriptive lighting project. This project was the single largest prescriptive project and accounted for 15% of all prescriptive savings in FY2011.

Weighting

For the calculation of the realization rate for custom projects, we applied savings-based weights. The weight for each custom stratum corresponds to its share of ex ante gross savings in the population. Table 3-9 summarizes ex ante gross energy impacts and kWh weights, by stratum.

Table 3-9: Weights for Custom Site Visits

Stratum	Ex Ante kWh Impact Claimed	kWh Weights by Segment
1 – Small	2,381,439	0.13
2 – Medium	4,400,460	0.24
3 - Large	11,455,072	0.63
Total	18,236,971	

Source: effRT program tracking database.

Precision of Results

The relative precision of ex post gross energy impacts for custom projects is ***11.4% at 90% confidence*** and ***8.9% at 80% confidence***.

3.2.3 Desk Reviews

We completed desk reviews for a sample of 70 prescriptive projects. The types of projects reviewed included 56 lighting projects, four motor projects, four VFD projects, three HVAC projects, two refrigeration projects, and one agricultural project.

Our desk reviews included a thorough check of the project application, equipment specification sheets, invoices, inspection files, calculations, and any communications between program staff and customers that were available in the project files. We compared this information to information for each project logged in the program's tracking database, including measure types, quantities, operating hours, energy and demand savings, and other variables pertinent to each type of measure. We also cross-checked the energy savings estimates for individual measures against savings listed in the TRM.

The result of the desk reviews are *ex post* estimates of gross energy savings for each project in the desk review sample. These values were consolidated into an overall, weighted realization rate for all prescriptive projects completed in FY2011.

Sampling

In FY2011, 1,744 prescriptive projects were completed. The largest prescriptive project accounts for approximately 15% of all prescriptive savings. Instead of conducting a desk review, we completed a site visit for this project. As a result, we took this project out of the sample frame for desk reviews. All remaining 1,743 FY2011 prescriptive projects were part

of the desk review sample frame.

The sampling approach was based on a stratified random sample. Stratification was by energy savings (kWh). Energy savings for the 1,743 FY2011 prescriptive projects in the desk review sample frame range from 4 kWh to 930,594 kWh.[8] Using the Dalenius-Hodges method, we set strata boundaries at 10,000 kWh and 50,000 kWh. We used the Neyman Allocation to allocate the available sample to the three strata. We randomly selected projects in each of the three strata.

Table 3-10 summarizes the three strata with respect to the number of projects, MWh, and KW in both the population and the sample. The table also includes the prescriptive project that received a site visit.

As shown in the table, the resulting sample included 4% of prescriptive projects, 40% of prescriptive energy savings, and 31% of prescriptive demand savings.

Table 3-10: Summary of Stratification for Prescriptive Desk Reviews

Stratum	Population			Sample			Sample as % of Population		
	Projects	MWh	KW	Projects	MWh	KW	Projects	MWh	KW
1 – Small	1,343	3,675	1,241	12	22	6	1%	1%	0.5%
2 – Medium	328	7,191	1,971	13	234	57	4%	3%	3%
3 - Large	72	11,071	2,138	45	6,300	1,221	63%	57%	57%
Site Visit	1	3,778	534	1	3,778	534	100%	100%	100%
Total	1,744	25,716	5,883	71	10,334	1,819	4%	40%	31%

Source: effRT program tracking database.

Weighting

For the calculation of the realization rate for prescriptive projects, we applied savings-based weights. The weight for each prescriptive stratum corresponds to its share of ex ante gross savings in the population. By placing the prescriptive project that received a site visit in a separate stratum, results for this project are only applied to itself and are not extrapolated to any other prescriptive projects.

Table 3-11 summarizes ex ante gross energy impacts and kWh weights, by stratum.

Table 3-11: Weights for Prescriptive Projects

Stratum	Ex Ante kWh Impact Claimed	kWh Weights by Segment
1 – Small	3,674,903	0.14
2 – Medium	7,191,378	0.28
3 - Large	11,070,906	0.43
Site Visit	3,778,441	0.15
Total	25,715,628	

Source: effRT program tracking database.

[8] Energy savings for the largest prescriptive project are 3,778,441 kWh.

Precision of Results

The relative precision of ex post gross energy impacts for prescriptive projects is ***15.1% at 90% confidence*** and ***11.7% at 80% confidence***.

3.3 Net Impact Methods

We derive net program impacts by applying a net-to-gross ratio (NTGR) to ex-post gross program savings. This NTGR typically comprises two concepts, free-ridership (FR) and spillover (SO). Spillover can include participant spillover and non-participant spillover; due to budget limitations, this evaluation quantified participant spillover but not non-participant spillover.[9] We used self-reported information from the telephone survey with program participants to estimate both free-ridership and participant spillover.[10] We calculate the overall NTGR as (1 - FR + SO). The final ratio represents the percentage of gross program savings that we can reliably attribute to the program.

The following is a high-level description of the free-ridership and spillover concepts, the questions we used to assess both free-ridership and spillover, and the algorithms used to calculate each.

3.3.1 Free-Ridership

Free-riders are program participants who would have implemented the incented energy efficient measure(s) even without the program. We base free-ridership estimates on a series of questions that explore the influence of the program in making the energy efficient installations as well as likely actions had the incentive not been available. For each respondent included in the survey, we developed a free-ridership factor that consists of three scores:[11]

- Influence of Program Components. This score is based on a series of four questions. These questions asked respondents to rate the importance of four program components, on a scale of 0 to 10 (where 0 is not at all important and 10 is very important): the availability of the incentive, a recommendation from a program staff person, information or marketing materials provided by the program, and a recommendation by a Qualified Partner. Greater importance of the program components means a lower level of free-ridership. The final Program Components score is equal to the highest rating given to any one of these components.
- Overall Program Influence. This score is based on two survey questions. The first question asked respondents to rate the importance of the program compared to the importance of other factors, in their decision to implement the energy efficient equipment. To do so, we asked respondents to divide 100 points between program and non-program factors. The second question asked if they had learned about the program before or after they decided to implement the energy efficient equipment rather than standard efficiency equipment. This Overall Program score is equal to the number of points given to the program divided by 10. If respondents learned about

[9] Any non-participant spillover would increase the NTGR.

[10] See Section 3.1.3 for a discussion of the participant survey, including sampling and weighting.

[11] This algorithm is based on the basic rigor self-report method used in California.

the program *after* deciding to install energy efficient equipment, that value was halved. Greater importance of the program means lower a level of free-ridership.

- **Likely Action without Program.** This score is developed based on three questions: 1) the likelihood that the exact same equipment would have been installed without the program (on a scale of 0 to 10); 2) if the installation would have been done at the same time without the program; and 3) if the installation would have been done later, how much later. This score takes the response to the likelihood question and adjusts this value by the responses to the timing questions. A higher value (i.e., greater likelihood of participating without the program) means a higher level of free-ridership. Later implementation without the program means a lower level of free-ridership. (We reverse the score so that high values indicate high program attribution and low values indicate low program attribution. This step is necessary for combining this score with the other two scores and developing the final free-ridership score.)

The overall free-ridership score is the average of the three scores, divided by 10. The free-ridership score for each respondent thus ranges from 0 (0% free-ridership, 100% program attribution) to 1 (100% free-ridership, 0% program attribution).

Respondent-level free-ridership scores are then aggregated to the end-use strata and to the program overall, weighted by kWh savings.

3.3.2 Participant Spillover

Participant spillover refers to energy efficiency installations that were influenced by the program but did not receive an incentive. An example of participant spillover is a customer who installed energy efficient lighting equipment through the Business Program and, as a result of the positive experience, installs additional energy efficient equipment in the facility, but does not request an incentive for that additional equipment.

We measured participant spillover by asking a series of survey questions about energy efficient actions taken by respondents who had participated in the Business Program.

- **Additional Action Post-Participation.** The first question asked respondents if they had taken any actions to improve the energy efficiency of any of their Maine facilities after participating in the program, for which they did not receive an incentive from Efficiency Maine. If so, we asked if they had installed any of the following types of measures: lighting, cooling, refrigeration, motors, and variable frequency drives (VFDs).
- **Level of Program Influence.** For each measure type that they had installed without an Efficiency Maine incentive, we asked two screening questions: 1) The level of influence the program had on their decision to take the energy efficient action(s) (on a 0 to 10 scale where 0 means no influence and 10 means great influence); and 2) Why they purchased the equipment without getting an incentive.
- **Measure Details.** We then asked additional questions about the type and quantity of the installed measures, if two conditions were met: 1) The level of influence of the program on the action was an 8, 9, or 10; and 2) The reason for not requesting an incentive was not that the equipment did not qualify. The additional questions varied by measure type but generally collected information that would allow us to quantify

the savings associated with their actions.

To any installations that qualified as participant spillover, based on this series of questions, we applied TRM assumptions to estimate savings.

To determine the program-level spillover factor, we divided the estimated savings of the measures installed by survey respondents outside of the program (but influenced by the program) by the savings the survey respondents realized through the program.

$$Spillover = \frac{Energy\ Savings\ (Measures\ Installed\ by\ Respondents\ Outside\ Program)}{Energy\ Savings\ (Measures\ Installed\ by\ Respondents\ Through\ Program)}$$

3.3.3 Non-Participant Spillover

Due to budget limitations, this evaluation only included a qualitative assessment of non-participant spillover. To gauge the presence of non-participant spillover, the non-participant customer survey included a series of questions about energy efficiency installations in the past year:

- Were there any installations of high efficiency equipment, or other energy efficient upgrades, at the facility over the past year?
- If so, what type of equipment was installed or upgraded?
- If the respondent was aware of the Business Program before the call and at least somewhat familiar with the program (based on earlier survey questions): When did they learn about the program relative to the installation/upgrade of the equipment?
- If the respondent learned about the program before making the installation: Did the knowledge of the program influence the installation/upgrade? If so, how?
- What were reasons for not participating in the Business Program?

In addition, our in-depth interviews with Qualified Partners included questions about projects that would have qualified for an incentive through the Business Program but did not receive one. These questions included:

- Of installations that would qualify for incentives, approximately what percentage did NOT receive an incentive? Why did they not receive an incentive? What influence did the Business Program have on these installations?
- What effect did the Program have on your business? How did you change your business practices as a result of your involvement as a Qualified Partner?

3.4 Cost-Effectiveness Methods

The Opinion Dynamics team conducted a cost-effectiveness analysis of the FY2011 Business Program, using the GDS Associates Benefit/Cost Screening Model (Version 2.2, updated 9/26/11) which is used by Efficiency Maine for benefit-cost analysis.

As a first step we conducted a review of the assumptions within the existing model and

familiarized ourselves with the structure of the model. The source of information for values used in benefit calculations was the *Avoided Energy Supply Costs in New England.*[12] This report provides data broken out by region and is the best publicly available source for data on avoided costs and environmental adders in this region.

We then calculated the benefit-cost value for the Total Resource Cost (TRC) test, using ex post gross savings and net-to-gross results from the impact analyses of this evaluation. We compared the results of our TRC test to draft results developed by implementation staff using program ex ante data.

[12] Synapse Energy Economics, Inc. *Avoided Energy Supply Costs in New England: 2011 Report*. July 21, 2011 Amended August 11, 2011. (http://www.synapse-energy.com/cgi-bin/synapsePublications.pl?filter_type=Year&filter_option=2011&advanced=false)

4. PROCESS ANALYSIS

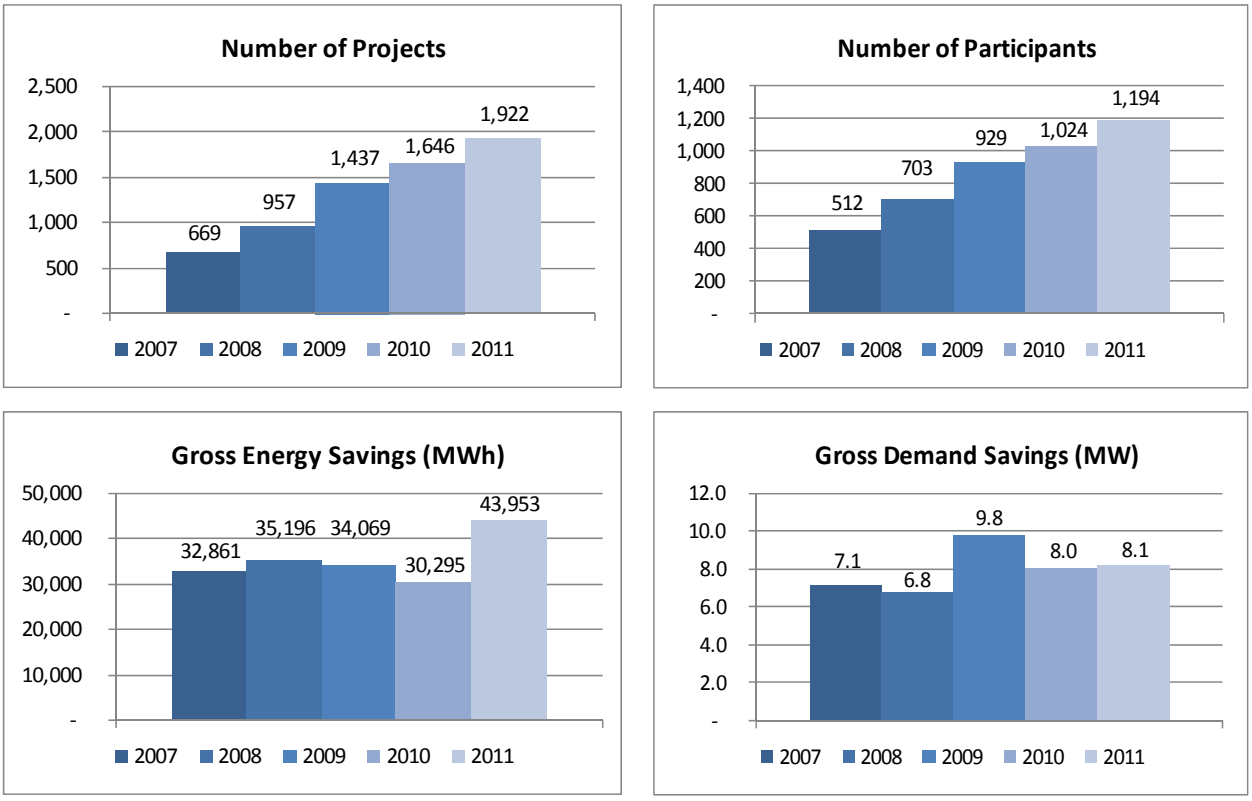
4.1 Program Participation

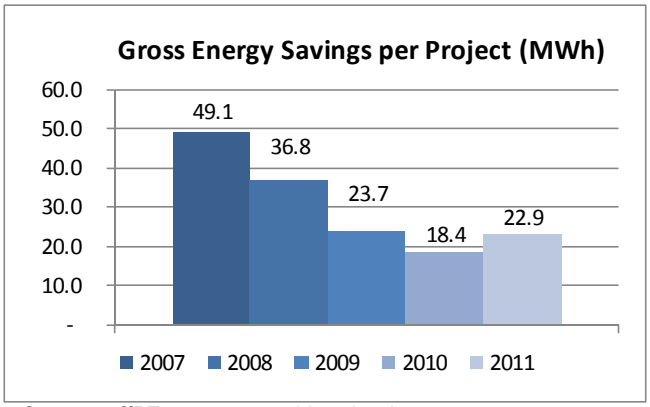
The Business Program experienced steady growth in participation over the five-year period FY2007 to FY2011. In FY2011, a total of 1,922 projects were completed by 1,194 participants, up from 669 projects completed by 512 participants in FY2007 (increases of 187% and 133%, respectively). Gross program savings also increased over the five-year period, albeit more slowly: ex ante gross energy savings increased from 33 GWh in FY2007 to 44 GWh in FY2011 (34%), while gross demand savings increased from 7.1 MW in FY2007 to 8.1 MW in FY2011 (14%).

The program met its ex ante gross energy savings goals in each year, except for FY2007 and FY2010, when economic conditions led to smaller projects (especially in the manufacturing sector, see next subsection) and slower growth in participation, resulting in an overall reduction in energy savings compared to the three prior years. Notably, the average project size decreased significantly over the five-year period, from 49.1 MWh in FY2007 to 22.9 MWh in FY2011.

Figure 4-1 summarizes program participation for the five-year period FY2007 to FY2011.

Figure 4-1. Summary of Program Participation FY2007 – FY2011





Source: effRT program tracking database.

Based on the participant survey, key reasons for participating in the program are the incentive (45%), reducing energy bills (44%), and replacing old equipment (25%). When asked about the single most important reason for participation, program participants most often mention reducing energy bills (37%) followed by the incentive (29%).

Participation by Sector

In FY2011, more than half of ex ante gross energy savings and one-third of ex ante gross demand savings were associated with projects implemented by the manufacturing sector. This sector accounted for the second largest number of projects in FY2011 (243, or 13%). With an average savings of 93 MWh per project, manufacturing projects are much larger than projects implemented by any other sector (average savings of 23 MWh per project). The eight largest FY2011 projects were all implemented by the manufacturing sector.

Other key sectors contributing to program savings in FY2011 were Retail and Office. All other sectors accounted for less than 5% of energy savings and 10% of demand savings, per sector. Table 4-1 summarizes the distribution of FY2011 projects, participants, and energy and demand savings by business sector.

Table 4-1. FY2011 Projects, Participants, and Ex Ante Gross Savings by Business Sector

Sector	Projects		Participants		Projects/ Particip.	Ex Ante Gross Energy Savings		MWh/ Proj.	Ex Ante Gross Demand Savings	
	#	%	#	%		MWh	%		MW	%
Manufacturing	243	13%	149	12%	1.6	22,544	51%	93	3.1	37%
Retail	206	11%	138	12%	1.5	4,216	10%	20	1.0	12%
Office	374	19%	204	17%	1.8	3,867	9%	10	1.0	12%
Schools	172	9%	70	6%	2.5	1,948	4%	11	0.6	8%
Warehouse	121	6%	84	7%	1.4	1,512	3%	12	0.5	6%
Health	63	3%	50	4%	1.3	1,369	3%	22	0.2	2%
Hospital	33	2%	14	1%	2.4	1,239	3%	38	0.2	2%
College	43	2%	16	1%	2.7	863	2%	20	0.2	2%
Grocery Store	42	2%	28	2%	1.5	715	2%	17	0.1	2%
Agriculture	41	2%	33	3%	1.2	453	1%	11	0.1	1%
Convenience Stores	72	4%	35	3%	2.1	416	1%	6	0.1	1%
Lodging	60	3%	45	4%	1.3	325	1%	5	0.1	1%
Garage/Repair	48	2%	37	3%	1.3	235	1%	5	0.1	1%

Sector	Projects		Participants		Projects/ Particip.	Ex Ante Gross Energy Savings		MWh/ Proj.	Ex Ante Gross Demand Savings	
	#	%	#	%		MWh	%		MW	%
Restaurant	53	3%	42	4%	1.3	215	<1%	4	0.1	1%
Other/Missing	351	18%	249	21%	1.4	4,034	9%	11	0.9	11%
Total	1,922	100%	1,194	100%	1.6	43,953	100%	23	8.1	100%

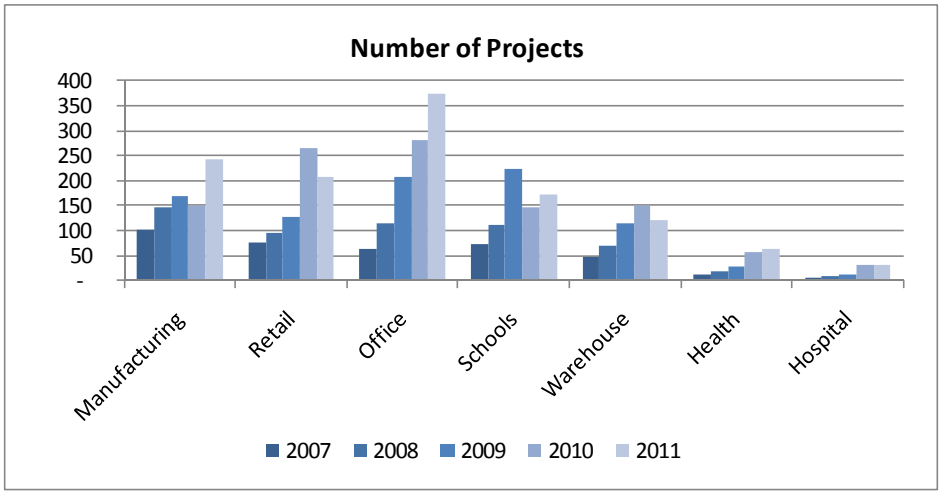
Source: effRT program tracking database.

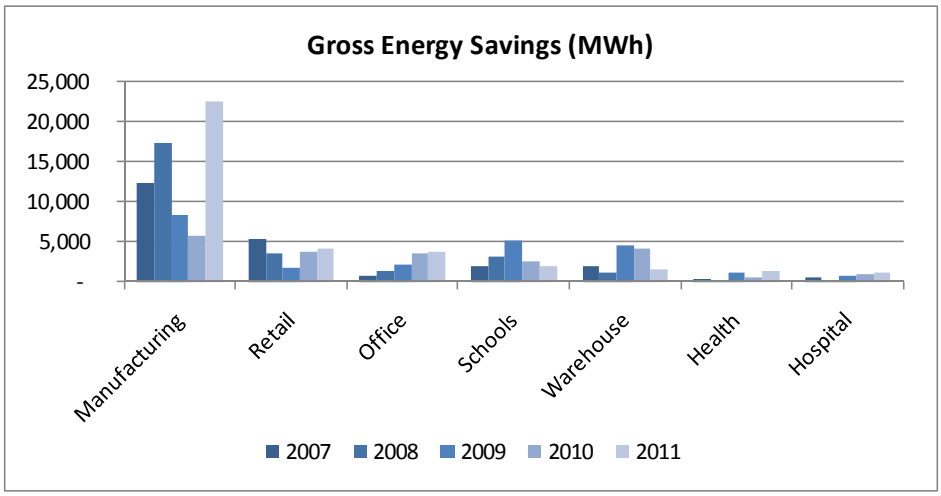
A comparison of the number of projects and ex ante gross savings by sector and year underscores the importance of the manufacturing sector in meeting program goals. Key trends over the five-year period include:

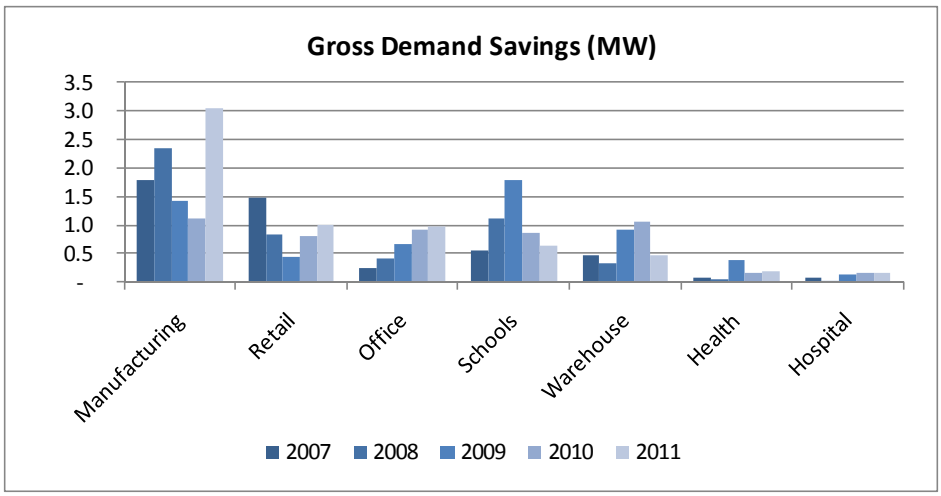
- Manufacturing accounted for the largest share of energy savings in all five years and generally has the largest average project size. The decline in both energy savings and average project size in FY2010 substantially contributed to the program not meeting its goals. In FY2011, program activity in the sector rebounded strongly.
- The number of projects in the Office sector has increased steadily over the last five years. The sector now accounts for the largest share of projects (19%). However, office projects tend to be among the smallest of all sectors.
- The average size of projects has declined by over 50% over the five-year period, from 49.1 MWh to 22.9 MWh. The average size of projects also declined in most sectors.

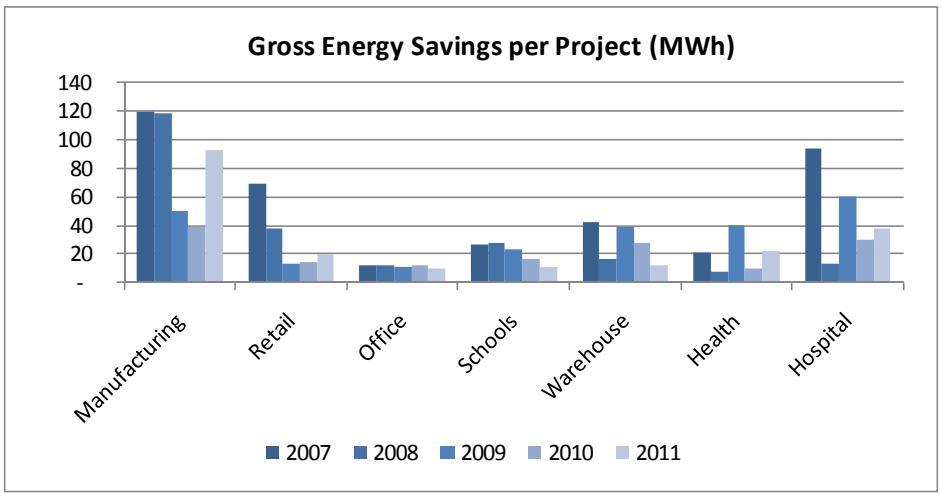
Figure 4-2 presents five-year participation and savings trends for the seven sectors contributing the most energy savings in FY2011.

Figure 4-2. Summary of Program Participation by Sector, FY2007 – FY2011 (Key Sectors)









Source: effRT program tracking database.

Participation by End-use

In FY2011, prescriptive lighting projects accounted for 80% of all Business Program projects, and 52% and 64%, respectively, of ex ante gross energy and demand savings.

Custom projects accounted for 41% of energy savings and 9% of all projects. Custom compressed air projects tend to be larger than other types of projects, with an average of 204 MWh per project (compared to 23 MWh for all projects).

Table 4-2 summarizes the distribution of FY2011 projects and energy and demand savings by end-use.

Table 4-2. FY2011 Projects and Ex Ante Gross Savings by End-use

End-use	Projects		Ex Ante Gross Energy Savings		MWh/ Project	Ex Ante Demand Savings	
	#	%	MWh	%		MW	%
Prescriptive Lighting	1,544	80%	22,854	52%	15	5.2	64%
Prescriptive VFD	20	1%	870	2%	44	0.1	2%
Prescriptive HVAC	62	3%	800	2%	13	0.3	4%
Prescriptive Motors	57	3%	673	2%	12	0.1	1%
Prescriptive Refrigeration	53	3%	363	1%	7	<0.1	1%
Prescriptive Agriculture	8	<1%	155	<1%	19	<0.1	<1%
Subtotal Prescriptive	*1,744*	*91%*	*25,716*	*59%*	*15*	*5.9*	*72%*
Custom Compressed Air	33	2%	6,726	15%	204	0.9	10%
Custom VFD	24	1%	4,058	9%	169	0.4	5%
Custom Miscellaneous	28	1%	3,716	8%	133	0.3	4%
Custom Lighting	90	5%	3,521	8%	39	0.7	8%
Custom HVAC	3	<1%	215	<1%	72	<0.1	<1%
Subtotal Custom	*178*	*9%*	*18,237*	*41%*	*102*	*2.3*	*28%*
Total	1,922	100%	43,953	100%	23	8.1	100%

Source: effRT program tracking database.

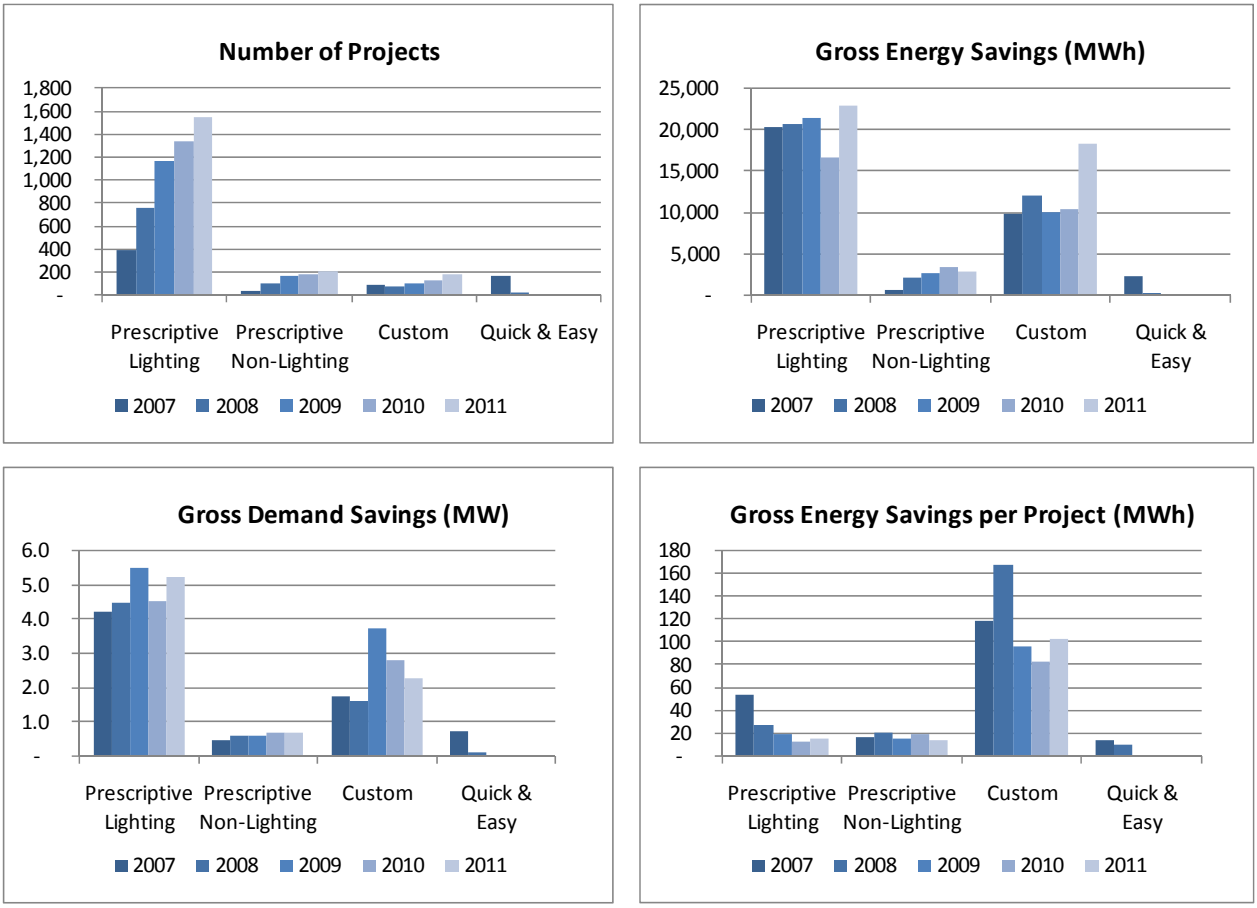
Over the five-year period, the mix of projects by type has been relatively constant: Between 55% and 62% of energy savings came from prescriptive lighting in FY2007 to FY2010. This share declined to 52% in FY2011, largely as a result of a jump in energy savings from custom projects. Custom projects accounted for between 29% and 41% of Business Program energy savings over the five-year period. These shares are fairly typical for business programs of similar maturity and show success in diversifying the portfolio of projects away from prescriptive lighting.[13]

Figure 4-3 presents five-year trends by type of project.[14]

[13] The Tri-Annual Plan lists deeper savings and looking "past lighting to other building systems" as a priority (p.51).

[14] The Program offered a "Quick and Easy" direct install program for small businesses. This offering was discontinued in FY2009.

Figure 4-3. Summary of Program Participation by Project Type, FY2007 – FY2011



Source: effRT program tracking database.

4.2 Program Design and Implementation

Goals

The Trust's Triennial Plan (for FY2011 through FY2013) sets overarching metrics and budget assumptions for the various energy efficiency programs under the administration of Efficiency Maine. Each program then establishes specific energy savings goals, based on available budgets.

Savings goals for the Business Program have fluctuated over the five-year period FY2007 to FY2011. During this period, the Program met or exceeded its goals in three of the five years. Program goals were not met in FY2007 and FY2010, when economic conditions contributed to slower growth in participation and smaller projects (see also Section 4.1 above). Table 4-3 presents the Business Program's energy savings goals and achieved ex ante gross savings for FY2007 to FY2011.[15]

[15] The program does not have formal demand goals but does track demand savings.

Table 4-3. Program Gross Energy Savings Goals and Achievements, by Fiscal Year[16]

Program Year	Goal (MWh)	Actual (MWh)	Share of Goal
FY2007	37,454	32,861	88%
FY2008	30,896	35,196	114%
FY2009	22,221	34,069	153%
FY2010	39,065	30,295	78%
FY2011	39,000	43,953	113%

Source: Efficiency Maine program staff.

Under Maine law (Title 35-A, section 10110, subsection 2, paragraph B), Efficiency Maine must dedicate at least 20% of system benefit charge dollars to benefit small businesses, which has been defined by Efficiency Maine as those with 50 employees or less. Given the make-up of the state's business community, the Program has satisfied this requirement each year between FY2007 and FY2011. In FY2011, small businesses accounted for 73% of total participants, 60% of total projects, and 37% of the $6.2 million in incentives paid.

Program Implementation

Since the beginning of FY2007, the Business Program has been implemented by Energy & Resource Solutions (ERS) and three subcontractors -- GDS Associates (GDS), North Atlantic Energy Advisors (NAEA), and Energy Federation Incorporated (EFI). ERS and GDS combine to implement most of the program, with ERS's primary responsibilities including application processing and technical review, and GDS handling the program's database and field delivery. NAEA serves primarily as an advisor to program design, including the measures and incentive levels offered, and EFI is responsible for processing incentive checks. In addition to the ERS implementation team, Burgess Advertising was responsible for program marketing and outreach from 2007 through the end of FY2011.

According to interviewed program staff, the interactions between Efficiency Maine and the implementation team as well as among the various implementation firms are smooth and well coordinated. In addition to a weekly manager meeting and bimonthly Technical Committee meetings, a lot of informal communication takes place.

Application and Participation Process

Participants in the Business Program can submit applications themselves or through their contractor (often a program Qualified Partner). Applications may be submitted online, via email or fax, or on paper. The program uses an electronic application and tracking process, with automated emails sent to the participant and the Qualified Partner, as well as to implementation staff, at certain points in the application process. The automated process also triggers certain follow-up actions, e.g., the program will follow up with an applicant after six months of inactivity following pre-approval. This system has been greatly improved over the past few years.

Participants must complete the project within one year of the application submission, although the program grants exceptions on a case-by-case basis. Projects with incentives of

[16] Note that the goals for FY2007-2010 include both Existing Buildings and Commercial New Construction, while the total for FY2011 only include Existing Buildings.

$2,500 or more require a pre-approval (16% of the program's FY2011 projects exceeded this threshold). For these projects, the program delivery team conducts a review of the project and, as appropriate, issues a pre-approval notification which must be signed by the participant and returned prior to project implementation.

Upon completion of the project, the participant submits the required invoices and documentation to the program. After review and possible inspection (discussed below), the application is sent to EFI for the incentive check to be processed and mailed to the participant.

More than half of survey respondents (56%) completed either the initial or final program application themselves. Of those that completed the application themselves, the vast majority (91%) found that the application forms clearly explain the program requirements and how to participate, and 66% rate the application process as easy (a rating of 7 to 10 on a 0 to 10 scale). Of those that did not complete the application themselves, the Qualified Partner/contractor completed 52% of applications and the supplier, distributor, or vendor completed 26%.

According to implementation staff, most submitted applications require some follow-up with either the Qualified Partner or the customer. This can occur at various points in the process, from an email early in the process to verify a missing field in the application, to technical questions during the pre-approval or final review, to issues uncovered in the inspection.

Overall, 7% of participants reported problems during their participation process. Most often noted were issues with paperwork but the overall incidence of this was low (3%). In addition, 21% of participants recommended better communication and program information as ways to improve the program.

Inspection Process

All projects that qualify for incentives of $5,000 and greater require a final inspection before the rebate may be processed and issued to the participant. This inspection consists of a spot check of installed equipment, conducted by implementation staff, and a comparison to the application. In addition, the program inspects 10% of projects under $5,000 and all self-installed projects. According to the program tracking database, the Business Program inspected 421 projects in FY2011, of which 232 were below $5,000. The program generally met its inspection goals (see Table 4-4).

Table 4-4. FY2011 Inspection Rates by Incentive Amount

Incentive Amount	Inspection Goal	Inspected	Not Inspected
Under $5,000	10%	13%	87%
$5,000 or more	100%	98%	2%
Total	n/a	22%	78%

Source: effRT program tracking database.

According to implementation staff, large custom projects most often pass inspection, as these projects usually involve a small number of large, expensive pieces of equipment and are well documented. Implementation staff also noted that inspections of small lighting projects most often find discrepancies between the application and the installation because it is easier to change the number of fixtures or specifications, such as ballast type, during

the course of the project. However, the rate of failed inspections is low.

Incentives

During FY2011, the Business Program limited each participant[17] to a total incentive cap of $300,000 per calendar year. According to the program staff, only seven projects exceeded $100,000 in FY2011 and only two reached the $300,000 cap. Notably, because the cap is calculated per calendar year and not per program year, a business may exceed the cap in a given program year, although this did not occur in FY2011. Program implementers noted that they sometimes work with businesses to schedule large capital projects to maximize their potential incentives. According to implementation staff, the incentive cap has increased over the life of the program, from $50,000 at the outset of the program to a high of $300,000. The current cap for FY2012 is $100,000.

In FY2011, a total of 1,194 unique participants completed 1,922 projects, resulting in $6.2 million in incentives. On average, each participant completed 1.6 projects for a total of $5,206 in incentives. The number of projects completed per participant ranged from 1 to 49, and the total incentives per participant ranged from $12 to the cap of $300,000. The mean incentive per project was $3,234. Small businesses (with 50 or fewer employees) accounted for the majority of unique participants and projects and 37% of total incentives. Table 4-5 summarizes these findings.

Table 4-5. FY2011 Incentives by Business Size

	Small (50 or fewer employees)		Large (more than 50 employees)		All
	#	%	#	%	#
Unique Participants	877	73%	317	27%	1,194
Projects	1,154	60%	768	40%	1,922
Incentives (millions)	$2.3	37%	$3.9	63%	$6.2
	Average		Average		Average
Projects per participant	1.3		2.4		1.6
Incentives per participant	$2,597		$12,424		$5,206
Incentives per project	$1,973		$5,128		$3,234

Source: effRT program tracking database.

The Business Program's technical committee reviews the eligible measures and incentive amounts annually. The committee bases its introduction of new measures and changes in incentive levels on the market penetration of the measures and on the experience of other business incentive programs in New England. Late in FY2011, incentives for NEMA Premium® energy-efficient motors were discontinued. Since FY2007, the program increased the incentive levels of some measures that lacked market penetration, such as VFDs, and decreased the incentives of measure that have become common, such as the shift from T12s to T8s. Due to budget constraints and to ensure cost-effectiveness, the program tries to keep incentive amounts as low as possible. Program implementation staff feel that the program cannot provide as high incentives as would be necessary to support some newer, less established technologies.

[17] Efficiency Maine defines unique participants as those businesses having unique tax identification numbers.

4.3 Program Marketing and Outreach

Marketing Design

Program marketing and outreach has undergone several changes during the FY2007-FY2011 period. From FY2008 through the end of FY2011, Burgess Advertising was under contract with Efficiency Maine to provide marketing services for the portfolio of EMT energy efficiency programs, including both residential and commercial programs. Burgess's primary responsibilities included development of annual marketing plans, implementation of advertising and public relations activities, website development, and the creation of marketing collateral to support the program's outreach to Maine households and businesses.

Starting in FY2012, responsibility for program marketing shifted from a single contract for all marketing services, to the program implementation team within each sector or program. According to staff, the goal of this change is to provide implementers with full control over the marketing to help them achieve their program's goals. Efficiency Maine is also engaging a contractor for overall, corporate marketing and outreach efforts to supplement that of the individual programs and to promote the general Efficiency Maine brand.

Over the course of the Burgess marketing contract, the marketing plan changed markedly. Focus of the Business Program marketing shifted from informing businesses of available incentives and increasing awareness of the Efficiency Maine brand to promoting the program's Qualified Partners as providers of technical assistance. In FY2007 and the beginning of FY2008, program staff were not authorized to contact businesses unless the business had made initial contact. Consequently, Burgess primarily marketed the program through print advertising in business publications at that time, to solicit phone calls to the program. Beginning in FY2008, Burgess added a mass market element (television and radio advertising) to the program's outreach. Because of the high cost, the program discontinued mass marketing in FY2010.

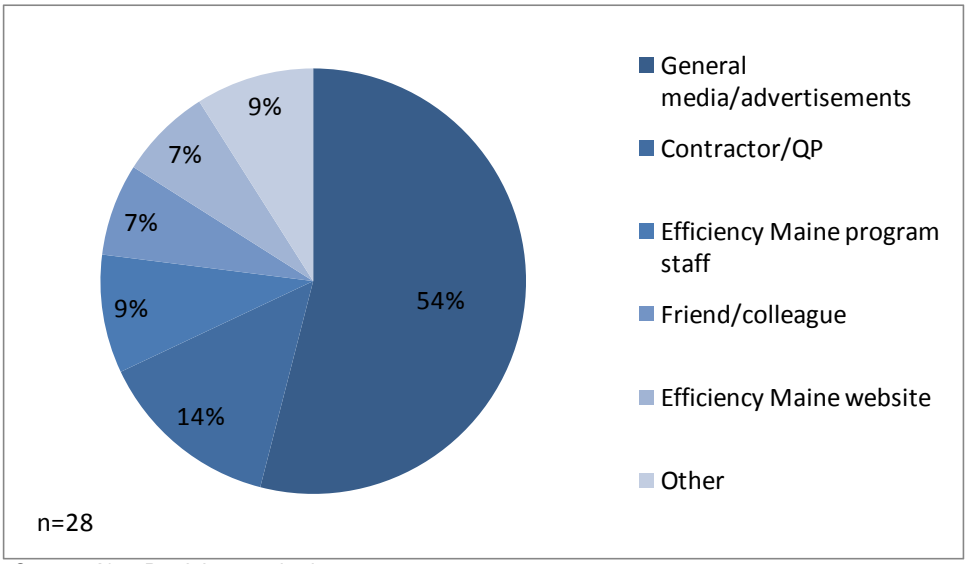
In FY2011, the primary marketing efforts by Burgess included print advertising, including a print ad campaign placed in *Maine Biz*; attendance at trade shows and other events; development of additional case studies; and co-operative advertising with Qualified Partners. In addition, the Program relied heavily on its network of Qualified Partners to promote the Program.

Program Awareness

Overall, among Maine businesses that have not yet participated in the Business Program, awareness of Efficiency Maine (68%) and the Business Program (33%) is relatively high. However, many of the non-participants that are aware of the Program are "not very" or "not at all" familiar with it (56%).[18] More than half of those who are aware of the Program (54%) first learned about it through general media (TV, radio, print advertising), suggesting that the program's past mass marketing efforts have been effective in raising program awareness.

[18] Awareness and familiarity are calculated as percentages of all responses, i.e., "don't know" responses are included in the denominator.

Figure 4-4. Non-Participants' Source of Initial Awareness of Business Program



Source: Non-Participant telephone survey.

However, mass marketing does not appear to be a major driver of program participation. Only 12% of program participants heard about the program through general media, while 53% heard about it from a trade ally – either a Qualified Partner or contractor (40%) or an equipment supplier, vendor, or distributor (13%). This suggests that the trade ally channel is very successful in providing customers with program information at the critical point of project decision making and implementation.

Table 4-6. Sources of Awareness of the Business Program
(Multiple Response)

Source	Participants (n=146)
Contractor/Qualified Partner	40%
Equipment supplier/vendor/distributor	13%
General media (TV/radio/ newspaper/magazine)	12%
Previous experience with Efficiency Maine	10%
Friend/colleague/word-of-mouth	8%
Efficiency Maine program staff	6%
Efficiency Maine newsletter/promo material	3%
Seminar/conference/training	4%
Efficiency Maine website	3%
Trade show	3%
Other	6%

Source: Participant telephone survey.

Qualified Partners interviewed as part of this evaluation confirmed that they generally promote the Program, whenever it is applicable. They reported that many of their customers (some estimate about half) are aware of the Business Program, but that nearly all require additional information regarding the program's specifics. Most Qualified Partners reported

that customer awareness of the program has increased over the past few years.

Preferred Methods of Outreach

Non-participating businesses indicate that flyers/ads/mailings (52%) and e-mail (43%) are the best ways of reaching their company with information about energy efficiency opportunities like the Business Program. Firms with less than 10 employees more often prefer flyers/ads/mailers as information sources (55%) compared to companies with 10 or more employees (37%).

4.4 Qualified Partners

Efficiency Maine introduced the "Qualified Partner" (QP) status for contractors in October 2009, replacing the program's previous "Trade Ally" designation. This change was made to focus the list of program-affiliated trade allies, which had grown to include over 600 mostly inactive firms. According to program staff, most Qualified Partners currently are electrical contractors that focus on lighting projects. However, efforts are made to recruit Qualified Partners specializing in other end-uses.

Qualified Partner Participation

In FY2011, 164 Qualified Partners completed projects through the Business Program. While Qualified Partners account for only 35% of the 468 contractors that submitted applications, they were associated with 57% of all FY2011 projects and 71% of ex ante gross energy savings.

Table 4-7. Project Information by Contractor Type

	Qualified Partners		Non-QP Contractors		Non-Contractor Projects		All
	#	%	#	%	#	%	#
Contractors	164	35%	304	65%	--	--	468
Projects	1,089	57%	662	34%	171	9%	1,922
Ex ante gross energy savings (MWh)	31,392	71%	10,159	23%	2,402	5%	43,953
	Average		Average		Average		Average
Projects per contractor	6.6		2.7		--		4.1
Energy savings per project (MWh)	28.8		15.3		14.0		22.9
Energy savings per contractor (MWh)	191		33		--		94

Source: effRT program tracking database

According to program staff, the Qualified Partner system has improved the quality of submitted applications and supporting documentation. While new Qualified Partners require significant assistance with their first few applications – as they become familiar with program processes – the applications and projects completed by more seasoned Qualified Partners generally have few quality problems. In fact, the program is considering reducing its target levels for inspections of projects implemented by Qualified Partners that have a track record of high quality projects. This would reduce program resources spent on inspecting

projects that have a low likelihood of problems.

Qualified Partner Requirements

To become a Qualified Partner, a contractor must complete a four-hour training on program processes, complete three projects during one fiscal year, submit proof of insurance, and sign a "code of conduct." Contractors that are not Qualified Partners may submit applications to the program, and program staff generally follow-up with these contractors to explain the program and the benefits of becoming a Qualified Partner.

The program has a process of "demoting" Qualified Partners who do not meet the requirement of three completed projects per fiscal year. However, before demoting a Qualified Partner, program staff reaches out to these Partners to determine the reasons for their lack of activity. In general, Partners who respond to this outreach and express interest in remaining a Qualified Partner are not removed from the Qualified Partner list.

The program's process of demoting inactive Qualified Partners appears to be working well. Based on our in-depth interviews, Qualified Partners who completed less than three projects, but who responded to program outreach and were not demoted, found the program to be valuable and desired to continue their participation. These Partners cited economic issues, their business' small size, or the timing of their joining the program as reasons for the low project count. Demoted Qualified Partners, on the other hand, generally are not planning to participate actively in the program going forward, largely because the program's offerings are not applicable to their primary business focus (e.g., solar heating).[19] Overall, the three-project requirement, with the opportunity for exceptions, appears to be a good way of actively managing the program's Qualified Partner list.

Benefits of Qualified Partner Status

According to the program staff, the benefits of becoming a Qualified Partner include a listing on Efficiency Maine's website, access to a dedicated website where they can view the status of their pending applications, co-operative advertising, and a monthly newsletter with program updates and technical articles. Additionally, Qualified Partners can participate in a quarterly advisory panel to provide feedback on the direction of the program. The program plans to highlight some Qualified Partners in future public relations events and to offer webinars on different technologies (such as LEDs) in FY2012.

Another benefit to being a Qualified Partner is the added credibility of being affiliated with the Business Program and the opportunity to use this affiliation when trying to secure new business. However, customers participating in the Business Program are generally not aware of their contractor's status as a Qualified Partner. Thirty-one percent of survey respondents said they do not know if their contractor was a Qualified Partner. In addition, of those who thought their contractor was a Qualified Partner, almost half (43%) actually did *not* use a Qualified Partner (based on the program tracking database). Consistent with this lack of awareness, many program participants do not place much importance on the Qualified Partner designation when implementing an energy efficiency project: 53% rate it as

[19] One of five interviewed demoted Qualified Partners had participated in the program for eight years, but due to the focus of the business (grocery refrigeration), only completed one to two projects per year. This Qualified Partner wished to maintain their status with the program.

important (a rating of 7 to 10 on a 0 to 10 scale) while 25% rate it as not important (a rating of 0 to 3).

Role of Qualified Partners

Qualified Partners and non-Partner contractors play a vital role in the Business Program. In addition to informing customers about the program and promoting the program incentive, Qualified Partners and contractors also influence the project's specifications. Key findings from the participant survey include:

- Forty percent of participants heard about the program from a Qualified Partner or contractor (40%).
- A Qualified Partner or contractor identified the opportunity for the incentive for 51% of FY2011 participants. This share was the same for participants who used a Qualified Partner and participants who used a non-Partner contractor. Qualified Partners or contractors more often identify the opportunity for the incentive for small businesses (56%) than large businesses (36%).
- A Qualified Partner or contractor was the most influential in specifying the details of the projects for 57% of participants. Qualified Partners or contractors are more likely to specify the details of prescriptive lighting projects (61%) than custom projects (40%) or prescriptive non-lighting projects (41%).

Qualified Partner Training

Qualified Partner training is offered every two to three months and provides contractors with details of the Program and how to submit applications. The training is conducted by representatives from Efficiency Maine, ERS, and GDS. Qualified Partners interviewed for this evaluation found the trainings to be very helpful in explaining the program and introducing the Business Program staff and had relatively few suggestions to improve the trainings. Most suggestions referred to the content introduced at the training, such as the online application submission, as opposed to the training itself. One Qualified Partner suggested that the program offer refresher training sessions annually or biannually.

Qualified Partner Satisfaction

Overall, the interviewed Qualified Partners reported high satisfaction with Efficiency Maine's Business Program:

- **Program overall:** All but two interviewed Qualified Partners consider themselves "very satisfied" with the program overall; the other two were "somewhat satisfied."
- **Measures eligible for incentives:** In general, interviewed Qualified Partners are satisfied with the measures the Business Program offers. Some recommended additions include an increased selection of LED measures, a prescriptive retrofit kit, and prescriptive automated controls measures. One Qualified Partner suggested that the program provide additional limited-time incentives for certain segments such as hospitals and schools as the program has done in the past.
- **Incentive amount:** Qualified Partners also provide generally high satisfaction ratings for the incentive amounts offered by the program. A few recommendations were for

higher incentives for LEDs and new construction.

- **Communication with program staff:** Nearly all interviewed Qualified Partners reported high satisfaction with the program's communications. Most noted that they receive updates and program information from the monthly e-mail newsletters. Many also commented that the program staff is always available to answer their questions and very helpful.

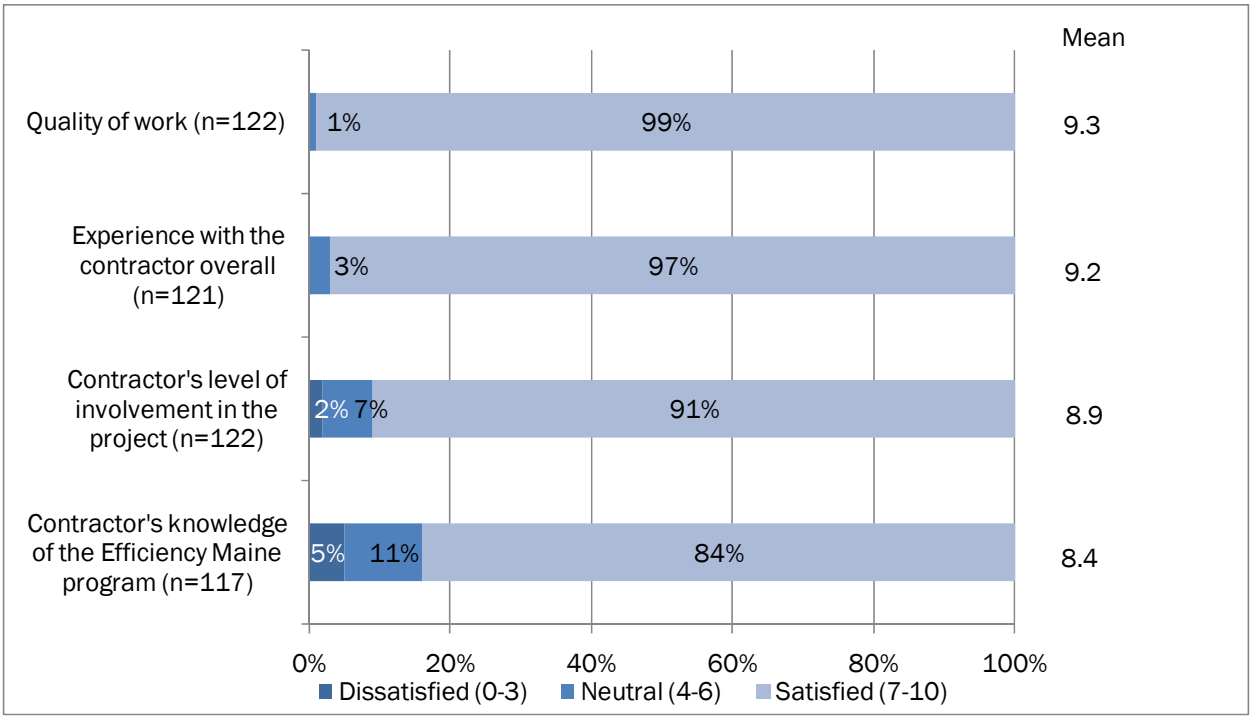
Given the high levels of satisfaction among Qualified Partners, they offered few recommendations for improvement. Several noted that the application and pre-approval turnaround time is very important and should be improved if possible. Another recommendation was to add more fuel types to the program to expand the potential market. One Qualified Partner, while praising the on-line application system in general, noted that it was cumbersome to use if you have many projects:

> *"I cannot emphasize enough that the online submission process is better, but it is not where it should be at. When I log in as myself, which I have to do, it should pop up my information as one of the Qualified Partners. I have to type all that in, every single time I submit an application, and I submit a few. […] I have customers that I submit multiple applications for in a year and again, every time I go on I have to fill out the entire form. There is no auto fill in the forms."*

Participant Satisfaction with Contractors

Participants report high satisfaction with their contractors. On a scale of 0 to 10, with 0 meaning "very dissatisfied" and 10 meaning "very satisfied," 59% of participants provide the highest rating of 10 to their contractor overall. They also give high ratings to the contractors' quality of work, involvement with the project, and knowledge of the program. Not surprisingly, 99% of surveyed participants would recommend the contractor they worked with to other people or companies. Figure 4-5 summarizes these results.

Figure 4-5. Participant Satisfaction with Contractor



Source: Participant telephone survey.

4.5 Barriers to Energy Efficiency and Program Participation

Qualified Partners identify the upfront costs and the overall economic climate of Maine as the primary barriers preventing businesses from installing energy efficient equipment. They note that many businesses are not installing any equipment at all, unless necessary, due to economic worries.

To further test barriers to the installation of energy efficient equipment, the non-participant survey included a series of statements and asked respondents to state their level of agreement with each.[20] The following statements were tested:

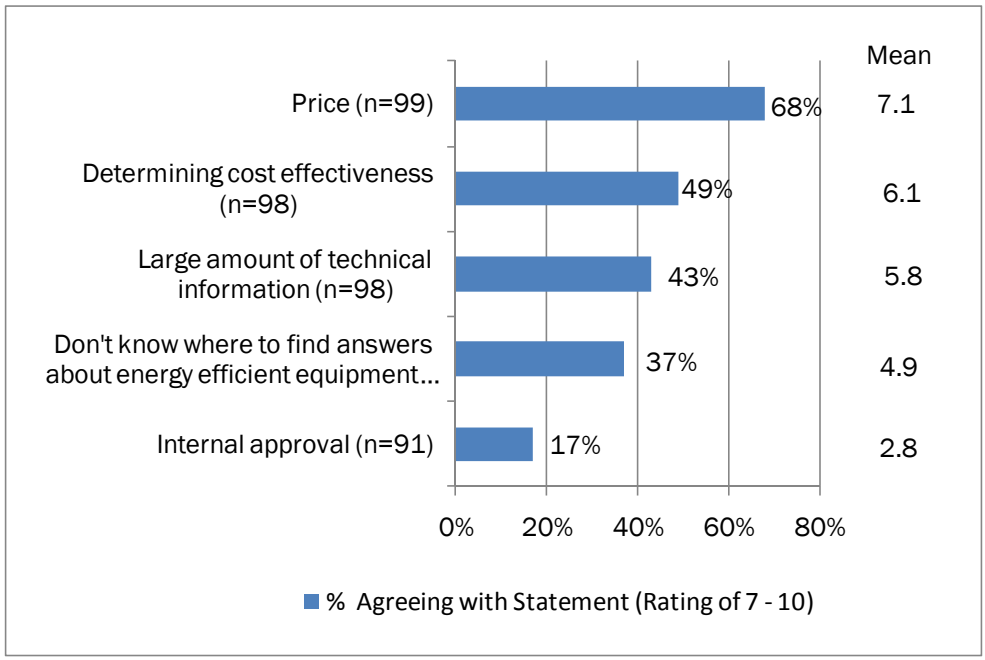
- Price is the biggest reason why your company might not buy a high efficiency item.
- It's hard to figure out if the extra money you might need to spend on an energy efficient piece of equipment is really worth it.
- It's hard to figure out what the best piece of energy efficient equipment to buy is because of all the technical information you need to find.
- If you had a question about the energy efficient equipment options available to you, you wouldn't know where to find the answer.
- It is difficult to get the internal approval you need in order to purchase a piece of energy efficient equipment.

[20] On a scale of 0 to 10, where 0 means "strongly disagree" and 10 means "strongly agree."

Not surprisingly, non-participants most often agree (a rating of 7 to 10) that price is the biggest reason for not buying a high efficiency item (68%). Businesses with fewer than 10 employees are more likely to cite price as a barrier (72%) than larger businesses (49%). Nearly half of respondents (49%) agree that "it is hard to figure out if the extra money you might need to spend on an energy efficient piece of equipment is really worth it." Few non-participants (17%) face internal approval barriers when considering energy efficient equipment.

Figure 4-6 summarizes non-participants' level of agreement with these statements.

Figure 4-6. Barriers to Purchasing Energy Efficient Equipment (Share of non-participants identifying barrier)



Source: Non-Participant telephone survey.

Interviewed Qualified Partners could think of few barriers keeping businesses from participating in the program, once they have decided to install energy efficient equipment. One Qualified Partner noted that some customers cannot participate in the program if their desired installation schedule does not allow for pre-approval by Efficiency Maine. Another Qualified Partner pointed to the fact that energy efficiency decisions are made at the design stage and that architects and engineers are often not designing projects with energy efficient equipment.

4.6 Participant Satisfaction

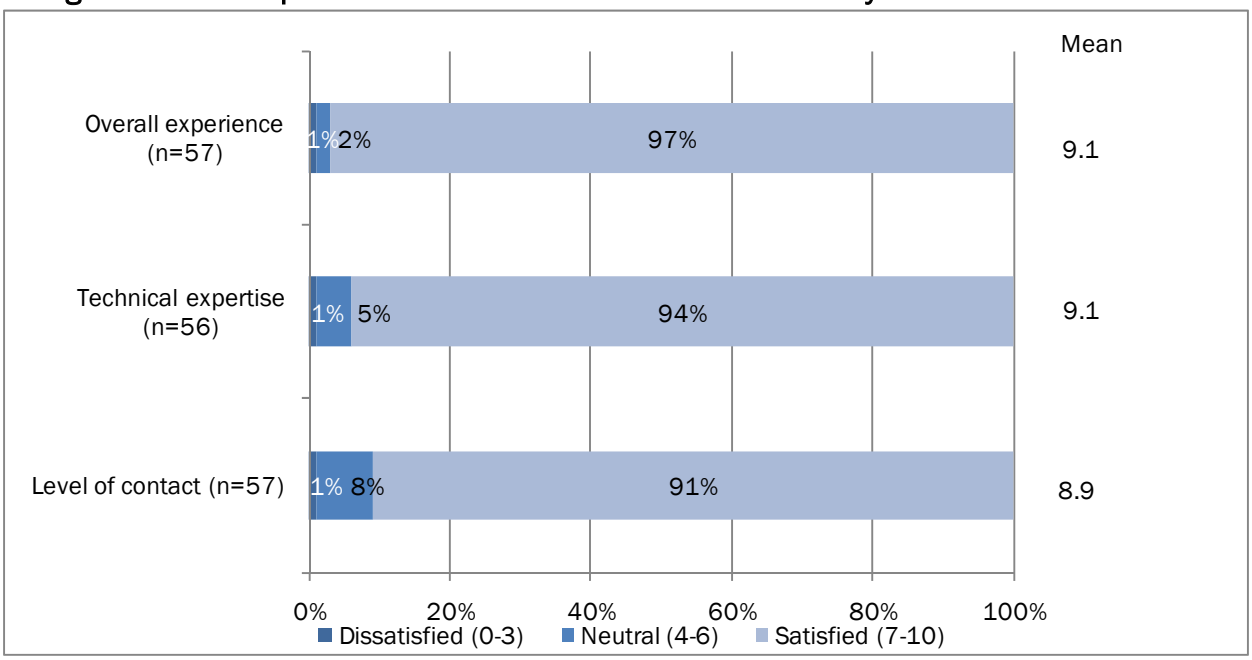
Overall, participants are satisfied with the Business Program and its elements. Both program staff and Qualified Partners reported that they receive few complaints from participants. General satisfaction with the program and its specific elements appear to be slightly lower than levels reported in the program's 2006 evaluation, but use of different scales prevents a direct comparison.

Satisfaction with Efficiency Maine Technical Staff

One-third of participants interacted with Efficiency Maine technical staff over the course of their project; of those, 52% reported one to two interactions, and 42% reported three to five interactions. In addition, 37% of participants report that the Efficiency Maine technical staff visited their facility prior to the project to perform a walk-through. Walk-throughs are more common at large businesses (67%) compared to small businesses (29%), and at participants with a larger project (67%) compared to participants with a small project (30%).[21] Most participants that had a walk-through prior to implementing the project (82%) found it to be helpful (a rating of 7 to 10 on a scale of 0 to 10). Those that did not find it valuable reported that it provided no new information.

Participants are very satisfied with Efficiency Maine's technical staff, with 97% reporting satisfaction with their overall experience. Notably, participants with prescriptive projects report higher satisfaction with their level of contact (95%) and the overall experience with technical staff (99%) compared to those with custom projects (63% and 81%, respectively).

Figure 4-7. Participant Satisfaction with Elements of Efficiency Maine's Technical Staff



Source: Participant telephone survey.

Satisfaction with the Business Program

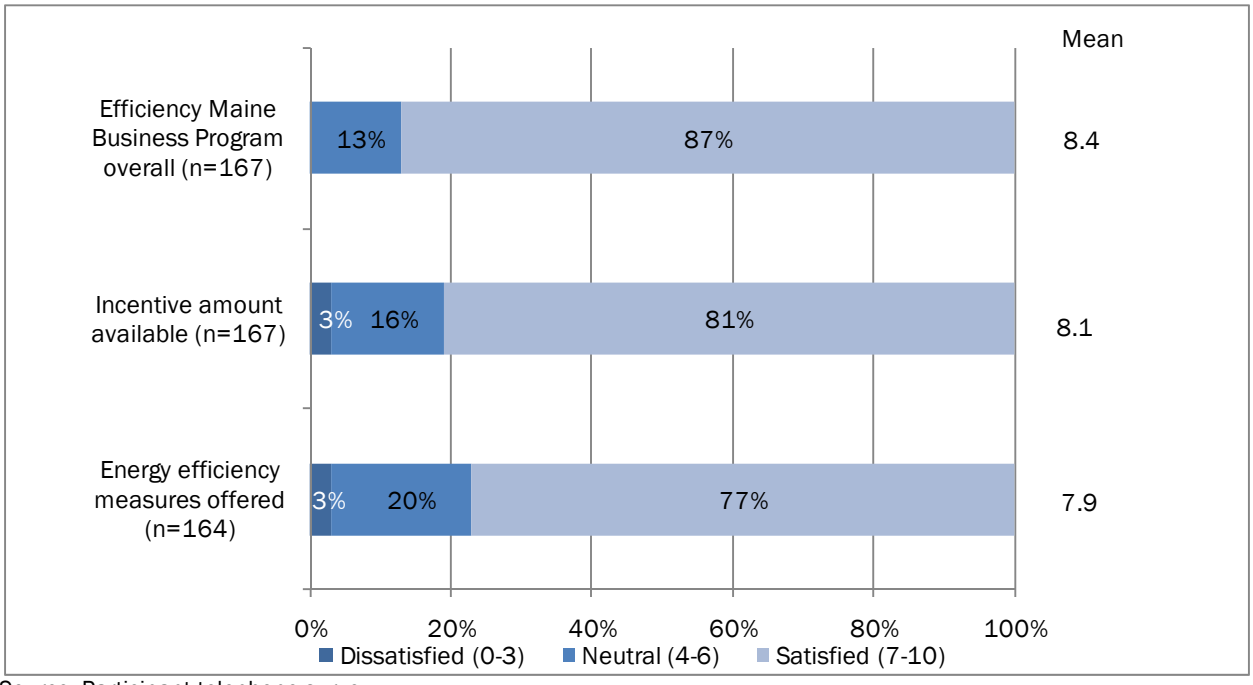
Participant satisfaction with the Business Program overall and two of its key elements (the level of incentives and eligible measures) is lower than satisfaction with certain other aspects of the participant's program experience (contractors, technical staff). Eighty-seven percent report satisfaction with the program overall,[22] which is lower than satisfaction levels reported for the 2006 evaluation – 99.5% rated their satisfaction a 4 or 5 on a scale of 1 to 5 – although the difference in scales makes the two values difficult to compare.

[21] Small projects are defined as having ex ante gross energy savings of 15,000 kWh or less.

[22] A rating of 7 to 10 on a scale of 0 to 10.

In addition, 81% are satisfied with the incentive amounts and 77% with the eligible measures. These values are also on the lower end of satisfaction levels generally observed for similar programs. Participants who implemented a custom project (92%) are more likely to be satisfied with the incentive amount than participants who implemented a prescriptive project (80%).

Figure 4-8. Participant Satisfaction with Elements of the Business Program



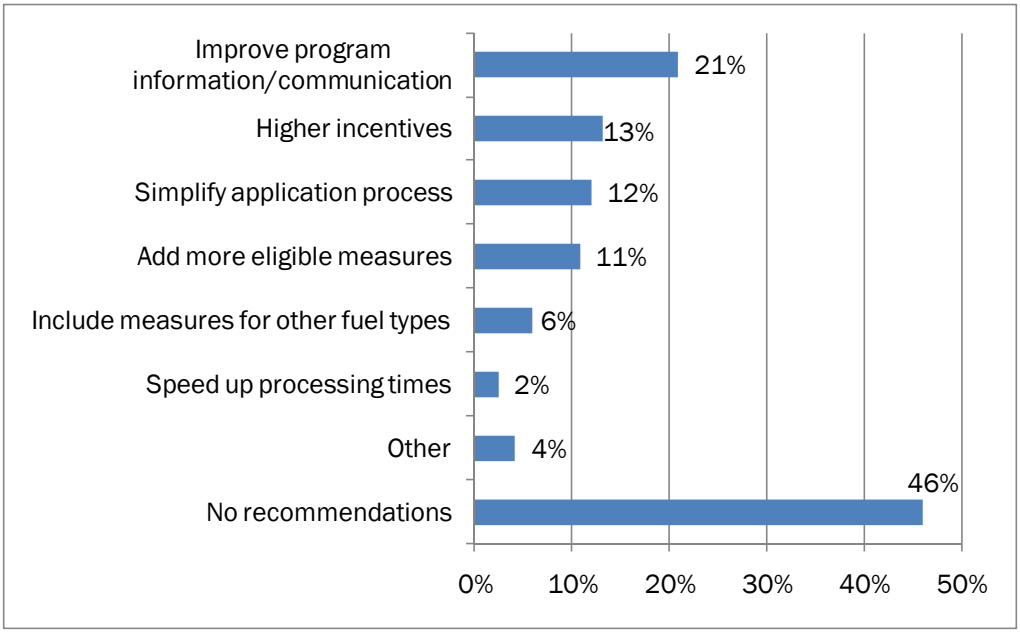
Source: Participant telephone survey.

Seven percent of participants report having had issues or problems during their participation in the Business Program. Many of these problems had to do with lost or denied paperwork. Other issues include a slow reimbursement process, inflexible program rules, questions about a new gas program, lack of familiarity with the application process on the part of the participant, and issues with the contractor. Approximately half of these issues (54%) were resolved to the participant's satisfaction.

Nearly all respondents either plan to (71%) or might (26%) participate in the program again. Those who do not plan to participate again state that they do not have any more eligible equipment to install or replace. Ninety percent of participants are likely to recommend the Program to another business, with 64% rating their likelihood as 10 on a 0 to 10 scale.

When asked how the program could be improved, 46% of responding participants gave no recommendations. As shown in Figure 4-9, participants most commonly recommend improvements to the program information. Higher incentives, a simpler participation process, and more eligible measures were also mentioned by several participants.

Figure 4-9. Participant Recommendations to Improve the Business Program



Source: Participant telephone survey.

4.7 Market Trends and Equipment Purchases

Efficiency of Existing Equipment

Most non-participants (64%) rate their facility as average in terms of energy efficiency; 29% rate their facility as efficient and 7% as not efficient.[23] Interviewed Qualified Partners provided a mixed view of the efficiency levels of existing equipment in the market. Some Qualified Partners found that many large commercial and industrial businesses have made the switch to energy efficient lighting but that penetration is much lower among smaller companies. Most Qualified Partners estimated that between 25% and 50% of the existing lighting equipment in Maine businesses can be considered energy efficient.

Non-participating businesses report varying levels of knowledge of the ways their company can save money by using energy more efficiently. Only 11% consider themselves "very knowledgeable" and 6% "not at all knowledgeable." The majority, 65%, rate themselves as "somewhat knowledgeable." Surprisingly, respondents with facilities that had an energy audit in the past (18% of non-participants) do not consider themselves more knowledgeable about energy efficiency than those who have not had an audit. In general, firms with 10 or more employees are more likely to have had an energy audit (36%) than smaller firms (14%).

[23] Ratings are on a scale of 0 to 10. 0 to 3 is considered "not efficient," 4 to 6 is neutral, and 7 to 10 is considered "efficient."

Decision Making

The majority of non-participants consults either a trade ally (41%; including contractor, consultant, supplier, or manufacturer) or the Internet (39%) when purchasing new energy-using equipment.

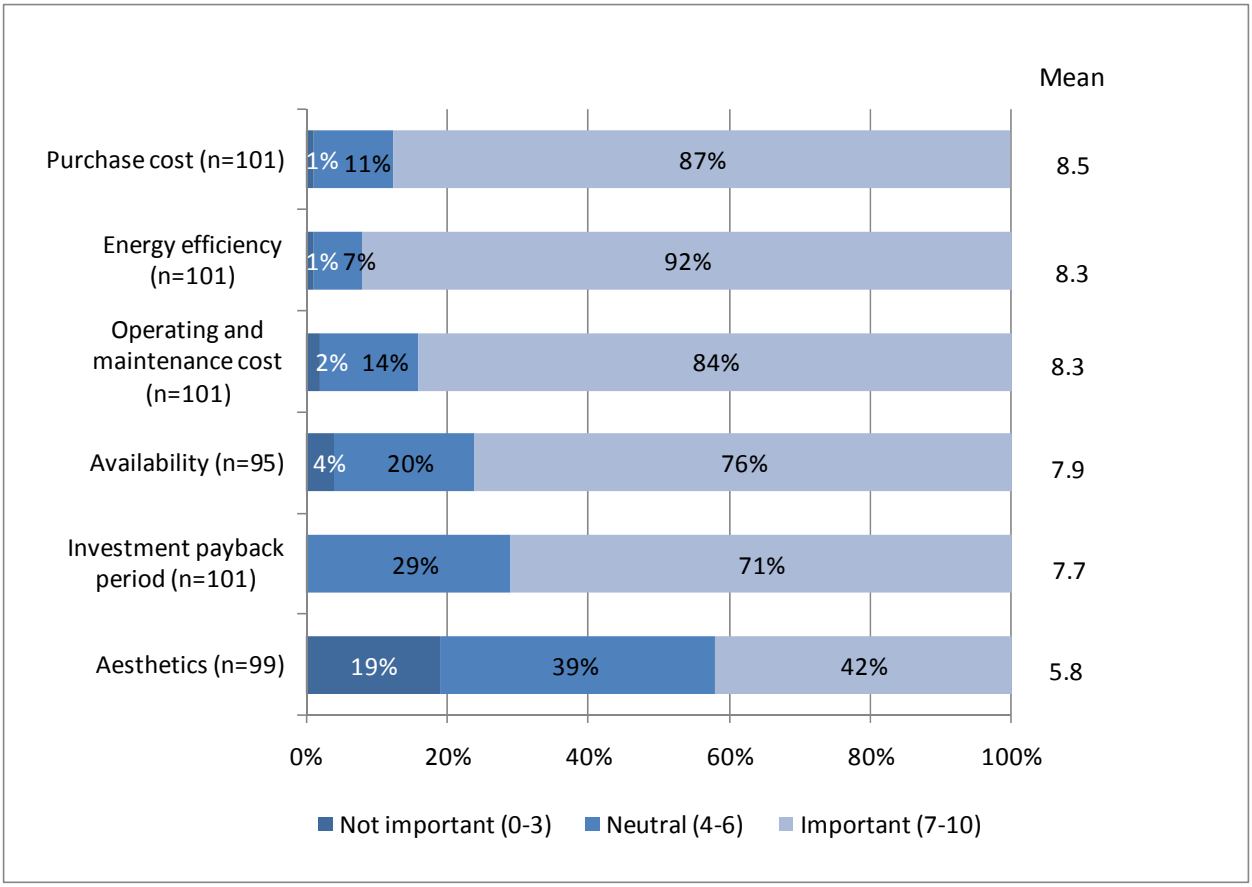
Table 4-8. Sources of Information and Guidance on Energy-Using Equipment (Multiple Response)

Source	Non-Participants (n=82)
Trade ally	41%
Internet	39%
Product literature/labels	12%
Personal experience	7%
Colleagues	5%
Reviews	4%
Other	8%

Source: Participant telephone survey.

Key factors in the selection of energy-using equipment are purchase cost, the equipment's energy efficiency, and operating and maintenance cost (Figure 4-10).

Figure 4-10. Importance of Factors When Purchasing New Energy-Using Equipment



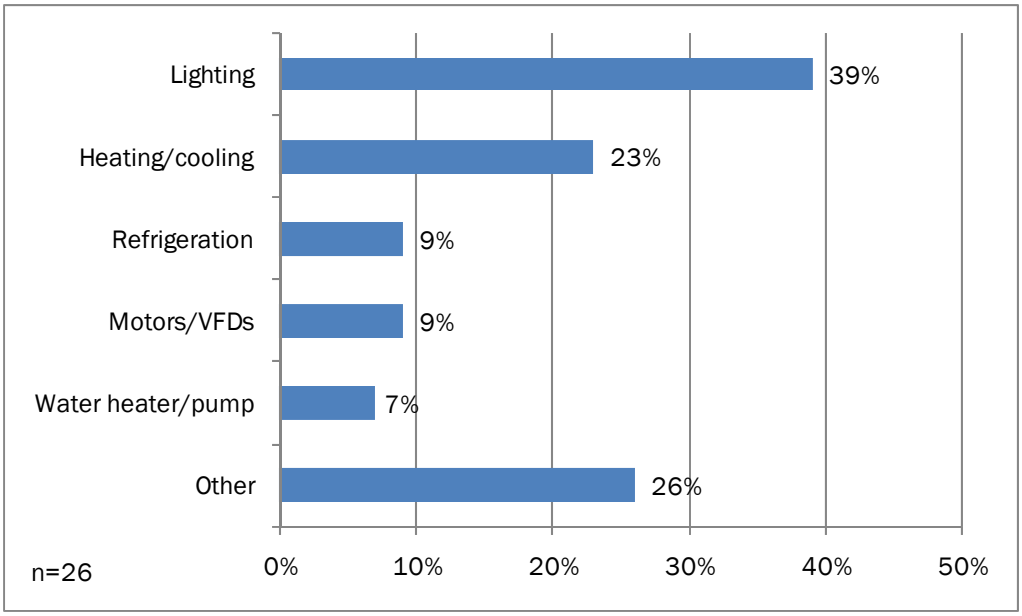
Source: Participant telephone survey.

Past Equipment Purchases

Overall, 27% of non-participants report that they have installed equipment or made other upgrades at their facility in the past year. Of these, the vast majority (94%, or 26% of all non-participants) claim that the installation was energy efficient.[24] Key characteristics of these energy efficient installations are:

- Almost equal shares of energy efficiency projects were to replace equipment that had failed (42%) and to replace equipment that had not yet failed (37%); 19% of installations were new projects.
- The vast majority (92%) cite saving energy or money as the reason for choosing high efficiency equipment as opposed to a less efficient option.
- Lighting (39%) and heating/cooling (23%) equipment accounted for the largest shares of past energy efficient equipment purchases. (See Figure 4-11.)

Figure 4-11. Type of Past Energy Efficient Equipment Installations



Source: Participant telephone survey.

Planned Future Equipment Purchases

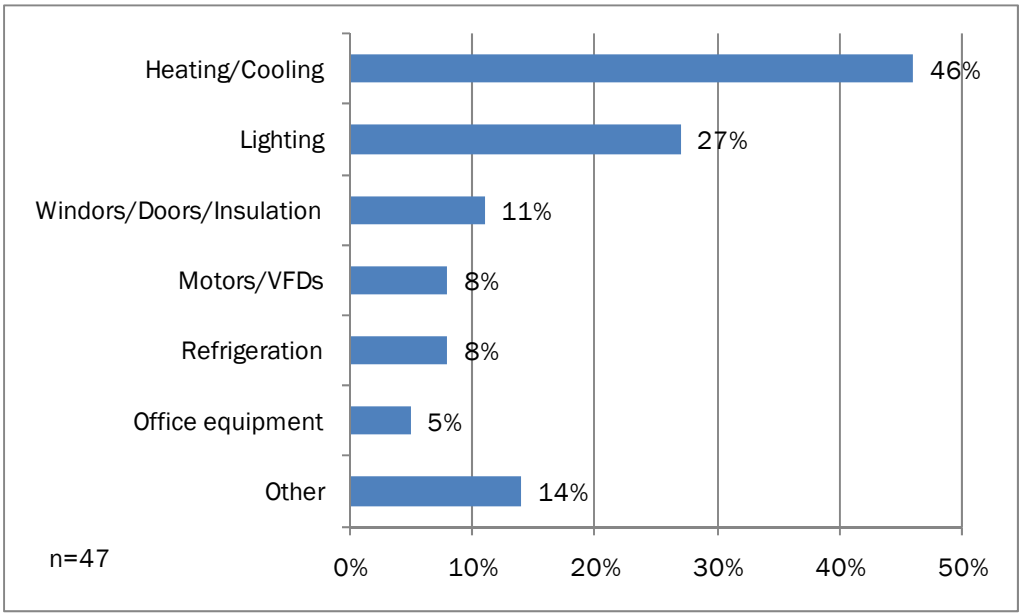
Thirty-four percent of non-participants plan to install new equipment at their facility in the next two years, and another 19% may install new equipment. Key characteristics of these planned installations are:

- Nearly half of the planned installations (46%) are heating or cooling equipment; 27% are lighting equipment. (See Figure 4-12.)
- Almost all planned installations are very likely (76%) or somewhat likely (19%) to be energy efficient.

[24] It should be noted that it is unknown if this equipment would have qualified for incentives through the Business Program. Customers often over-estimate the efficiency of new installations.

- Most respondents who are likely to install energy efficient equipment and who have at least some familiarity with the Business Program plan to participate in the program (24% are very likely; 53% are somewhat likely). These potential participants represent approximately 10% of all non-participants.

Figure 4-12. Planned Future Equipment Installations



Source: Participant telephone survey.

4.8 Other Efficiency Maine Programs

Our research also explored interest in two other programs Efficiency Maine is offering: The Pilot Direct Install Program[25] and the Building Operator Certification (BOC) Program.[26] Respondents were read a description of these programs and asked to rate their interest in participating in the future.

Most participants (79%) and non-participants (69%) are either very or somewhat interested in participating in the Pilot Direct Install Program. The main reasons for not being interested in participating in the Pilot are that they do not need upgrades and cost.

Interest in the BOC Program, which was asked of participants only, is lower than interest in the Direct Install Pilot: 51% of participants expressed some level of interest. Not surprisingly, the level of interest varies with the size of the participant and the size and type of project installed in FY2011: large businesses (with more than 50 employees) are more interested in this Program (67%) than small businesses (48%), participants with custom projects (75%)

[25] In the Direct Install Pilot, a contractor hired by Efficiency Maine will come in and install energy efficiency measures at the business location. The program covers a significant portion of the cost of the installation, and the business can pay their portion at the time of the installation or repay it over 1-2 years through a monthly no-interest payment on their utility bill.

[26] The BOC Program trains facility managers to improve energy efficiency, reduce electric and other fuel bills, reduce maintenance costs, and enhance building occupant comfort. This program consists of an eight-day course offered over a two-to-four month period. Efficiency Maine covers a significant portion of the training cost.

are more interested than participants with prescriptive projects (49%), and participants with projects greater than 15 MWh (73%) are more interested than participants with smaller projects (46%). The main reasons for not being interested in participating in the BOC Program are lack of applicability due to the size or nature of their buildings and time constraints. Twenty-one percent of participants were aware of the BOC Program prior to taking the survey, and 4% had already attended the training (either the respondent or someone else at their company).

Table 4-9 summarizes these responses.

Table 4-9. Interest in Efficiency Maine's BOC and Direct Install Programs

	BOC	Direct Install Program	
	Participants (n=167)	Participants (n=154)	Non-Participants (n=97)
Prior Awareness of Program	21%		
Prior Participation in Program	4%		
Level of Interest			
Very interested	18%	34%	32%
Somewhat interested	33%	45%	37%
Not very interested	15%	11%	11%
Not at all interested	33%	10%	19%

Source: Participant and non-participant telephone surveys.

5. IMPACT ANALYSIS

This section presents the results of our evaluation of the Business Incentives Program's gross and net impacts.

5.1 Gross Impacts

The gross impacts evaluation examined the energy and demand savings of the prescriptive and custom components of the Business Program. We conducted three subtasks contributing to the gross impact analysis, 1) a review of the Efficiency Maine Commercial Technical Reference Manual (TRM), 2) site visits to a sample of 30 custom projects and the largest prescriptive project, and 3) desk reviews of a sample of 70 prescriptive projects. The methods used for each component were discussed in Section 3.2 of this report.

5.1.1 Summary of FY2011 Gross Impacts

For each of the prescriptive and custom projects sampled, the Evaluation Team conducted an engineering review of the existing data and calculations in the files and tracking database. In the case of the sampled custom projects and the largest prescriptive project, we also collected additional information onsite through M&V site visits. This information was used to estimate ex post energy and demand savings for each project, along with the associated realization rates.

As described in Sections 3.2.2 and 3.2.3, the samples for both the prescriptive and custom project evaluations were stratified by energy savings into strata for small, medium, and large projects.

Table 5-1 summarizes the ex ante and ex post energy and demand savings and associated realization rates for each sample stratum. We weighted the realization rates for each stratum proportionally to the stratum's energy savings, resulting in overall weighted realization rates for the prescriptive and custom programs.

Table 5-1. Prescriptive and Custom Sample Realization Rates by Stratum

Sampling Strata	Sample Size (n)	Gross Energy Savings (kWh)			Gross Demand Savings (kW)		
		Ex Ante	Ex Post	RR	Ex Ante	Ex Post	RR
Prescriptive Projects – Desk Reviews							
Very Large (>1,000,000 kWh)[1]	1	3,778,441	3,073,445	0.81	534	246	0.46
Large (50,001 – 1,000,000 kWh)	45	6,299,812	6,367,075	1.01	1,221	1,187	0.97
Medium (10,001 - 50,000 kWh)	13	233,969	197,198	0.84	57	51	0.89
Small (1 - 10,000 kWh)	12	21,785	30,098	1.38	5.6	8.6	1.52
Subtotal Prescriptive	71	10,334,006		0.99	1,819		1.01

Sampling Strata	Sample Size (n)	Gross Energy Savings (kWh)			Gross Demand Savings (kW)		
		Ex Ante	Ex Post	RR	Ex Ante	Ex Post	RR
Custom Projects – Site Visits							
Large (>250,000 kWh)	14	11,455,072	11,127,790	0.97	1,119	1,266	1.13
Medium (75,001 - 250,000 kWh)	6	1,036,767	1,272,945	1.23	101	135	1.35
Small (1 - 75,000 kWh)	10	254,571	217,616	0.85	40	23	0.57
Subtotal Custom	30	12,746,410		1.02	1,260		1.09
Business Program							
Total Business Program	101	23,080,416		1	3,078		1.03

[1]The Evaluation Team performed a site visit for the largest prescriptive project.
Source: effRT program tracking database; gross impact analysis.

Table 5-2 applies these weighted realization rates to the prescriptive and custom programs' ex ante gross energy and demand savings. With overall realization rates at the program level estimated to be close to one (or 100%), the Evaluation Team's estimates of actual energy and demand savings almost equal those tracked by the Business Incentive Program. This is true overall and for the prescriptive and custom program components.

Table 5-2. Program-Level Adjusted Gross Impacts

	Total Number of Projects (N)	Energy - kWh			Demand - kW		
		Ex Ante	RR	Ex Post	Ex Ante	RR	Ex Post
Prescriptive	1,744	25,715,628	0.99	25,401,049	5,883	1.01	5,955
Custom	174	18,236,971	1.02	18,566,421	2,263	1.09	2,471
Total	1,918	43,952,599	1.00	43,967,470	8,146	1.03	8,426

Source: effRT program tracking database; gross impact analysis.

Table 5-3 compares our realization rates to those estimated in the FY2006 evaluation. While there are significant differences between the 2006 and 2011 energy and demand savings realization rates for both the prescriptive and custom program components, these differences are less pronounced at the overall program level.

Table 5-3. Comparison of Realization Rates: FY2011 and FY2006

	Energy - kWh		Demand - kW	
	FY2011	FY2006	FY2011	FY2006
Prescriptive	0.99	1.46	1.01	1.34
Custom	1.02	0.98	1.09	0.78
Total	1.00	1.08	1.03	0.84

Source: Gross impact analysis; 2006 Evaluation Report.

Custom Project Impacts

Site visits were made to 30 custom projects. While the overall energy savings realization rate for these projects was 102%, we observed a range from 17% to 217%.

For the eleven lighting projects we visited, eight were found during monitoring to have different operating hours than in the application, and six had different numbers of fixtures than were found during the evaluation team's on site visits. One project did not take fixture dimming into account, and another did not include the interactive effects on refrigeration energy use.

The seven compressed air projects we reviewed had energy savings realization rates ranging from 91% to 158%. The most common problem was the use of incorrect load curves for the compressors and the use of calculations that did not reflect the actual operation of the compressors. In addition, we found that the unloading curves used were often incorrect, and corrections for operating pressure were often not taken into consideration.

In the nine pump, fan, and VFD end-use projects we visited, we found similar issues with load profiles as with the compressor projects. Also, in the VFD projects, we observed several cases where incorrect brake horsepower was used and one where the affinity laws for VFDs were misapplied.

The three remaining projects had energy savings realization rates of 40% to 82% and included: 1) an energy management system whose application calculations used incorrect scheduling, 2) a refrigeration system with incorrect numbers and sizes of motors, and 3) thermoelectric chillers that used more power than predicted.

Prescriptive Project Impacts

We carried out desk reviews for 70 prescriptive projects and one M&V site visit to the largest prescriptive project. The overall realization rates were 99% on energy savings and 101% on demand savings, but realization rates for individual projects varied greatly from a low of 21% to a high of 880%. Only five projects achieved 100% energy realization rates, and only two achieved 100% demand realization rates.

Frequently, the differences between ex ante and ex post values were due to the lack of specificity in the TRM and the application requirements, especially as it relates to the lighting measures. As discussed further in section 5.1.1, the TRM consolidates lighting measures into a relatively small number of fixture types, and the application does not require participants to give information about their baseline fixtures. The program implementer did not feel that the categories designated in the TRM accurately represent the installed measures; instead they developed what we consider an unreliable method of using a ratio to develop an estimate of the baseline wattage.

In addition, we found discrepancies between information used in the savings calculations and the information we found in the project documentation. This was especially true of baseline conditions, for which it was difficult to replicate the values used in the savings calculations. In a few cases, the equipment quantities, sizes, wattages, and operating hours did not match the values we found in the original application materials or in any updated application materials, calculations, communications between program staff and customers, or other notes in the files. In several cases, where site-specific baseline wattages were

utilized instead of values based on the TRM, there was no documentation for the sources of these values in the files for the projects we reviewed.

Prescriptive Lighting Project Reviews

Fifty-seven of the projects we reviewed were lighting projects. Energy savings realization rates for lighting projects varied greatly, from a low of 21% to a high of 880%. There were several reasons for these varying realization rates.

In almost all projects, the implementer did not use baseline wattages from the lighting measure tables in the TRM. Instead, they developed ratios of baseline to new wattages from the TRM tables and applied these ratios to cut sheet wattages to get baseline wattages. We do not agree with this ratio methodology, finding that it overestimated baseline wattage for some measures and underestimated it for others. We corrected almost all baseline wattages back to the TRM table values. We did not correct back to the TRM baseline wattages for the four LED Wallpack measures we reviewed. The installed LED Wallpack wattages were much smaller than the single 55 W fixture designated in the TRM, so we set baseline wattages to typical replacement wattages found from online manufacturer data about these fixtures.

In 2010, measure L40 of the TRM was updated to split T5HO fixtures from one category that included both 4- and 6-lamp fixtures into separate categories for 4-lamp and 6-lamp fixtures. The implementer continued to apply the single-category values, which skewed results for both fixture types.

Other discrepancies in lighting energy savings were due to incorrect fixture counts in ten projects, incorrect wattages for new fixtures in about 20 projects, and incorrect operating hours in four projects.

Prescriptive Motor & VFD Project Reviews

We reviewed four motor projects and four VFD projects in our sample. All of the motor projects achieved fairly low realization rates of 33% to 56%. Only one of these projects included calculations in the application materials we reviewed, and this project was using baseline efficiencies that were too low. For baseline motor wattages, the TRM references the minimum efficiencies allowed under the Federal Energy Policy Act of 1992 (EPAct) that went into effect in October 1997. The actual table containing these baseline efficiencies is not provided in the TRM. The implementer used values other than the EPAct values for the baseline efficiencies in the savings calculations for the motor projects we reviewed. This led to overestimations of all motor measure energy savings for these projects. No documentation was provided for the assumed baseline values of motor wattages used in the calculations. It is possible that the implementers are using pre-1997 motor efficiencies for all projects that yield higher-than-expected energy savings.

Savings from the four VFD projects we reviewed were calculated correctly. Three projects attained realization rates of 100%. The fourth project had a 91% realization rate, since a slightly incorrect fan size was used.

Prescriptive Refrigeration Project Reviews

Our sample included two refrigeration projects, both consisting of new cooler doors. Our

review found that one achieved a 100% realization rate, and the other a 68% realization rate. This second project did not use the wattages we found in the equipment cut sheets. We also found that the demand savings algorithm in the TRM assumes that all cooler and freezer door heaters are inactive at the same time, which is not likely to be the case. Also, the volume categories, standards, and energy savings of CEE and Energy Star appear to differ from what is in the TRM for these measures.

Prescriptive HVAC Project Reviews

The three HVAC projects we reviewed included a mix of new air conditioning units, demand control ventilation, and enthalpy economizers. They achieved realization rates of 93% to 115%. The discrepancies were associated with two errors in tonnage, use of SEER instead of EER, and the use of the wrong value for square footage cooled.

In the course of the HVAC project reviews, we also found that the assumptions associated with the free cooling hours (FCHr) used in the dual enthalpy economizer measure may not be correct. Also, the equations for DCV in the TRM are not clear and appear to need significant revisions. Both of these findings are discussed in more detail in Section 5.1.1.

Prescriptive Agricultural Project Reviews

We reviewed one agricultural project, a low-speed fan, which received a 100% realization rate.

5.1.2 Review of TRM

As part of the impact analysis, we reviewed the document "Technical Reference User Manual (TRM), No. 2010-1, Measure Savings Algorithms and Cost Assumptions", dated August 31, 2010. This review did not find any measures needing immediate correction of their energy savings values. The review did find cases of improvements that could make the TRM more usable and improve the clarity of its documentation. We also provide suggestions for reviewing and potentially updating the energy and demand savings values of four measures.

Lighting Measures

Summary table of lighting measures

The descriptions for each measure are typically located in the text under each measure's section. This makes it difficult to distinguish between measures and locate the appropriate measure, particularly in the case of the more numerous and similar lighting measures. A summary table of all lighting measures would be helpful, including at least measure code, description, project type (retrofit or new construction), existing fixtures, new fixtures, ballast factor, and fixture efficiency. Appendix C provides an example of such a lighting summary table.

Baseline information

We understand that Efficiency Maine's decision to not require baseline or pre-project information was aimed at reducing the customers' burden associated with completing the

application.[27] Unfortunately, this decision has created some uncertainty in both the calculation of energy savings and the precision of impacts. Not knowing the type of baseline fixtures that are being replaced is a key source of uncertainty in the energy savings calculations for lighting projects. The TRM tries to make up for this by designating wattages for a variety of typical baseline fixtures for each new fixture type. Unfortunately, the TRM currently does not specify how these wattages have been calculated and what types of fixtures they represent. While the TRM wattages may be representative of what has been replaced overall, on a project by project basis they are less precise.

Asking for baseline fixture information would bring more precision to the energy savings estimates. This information may not be extremely difficult for building owners and their lighting contractors to produce. Lighting contractors already routinely produce energy savings spreadsheets for their customers that include lists of all baseline and replacement fixtures. Furthermore, all other utility efficiency programs that we work with require that baseline fixture information be submitted with the application. While paperwork for efficiency programs is often considered a burden to customers, we have heard no specific complaints among the other efficiency programs we work with about the requirement to include baseline information.

Fixture types for each lighting measure

The methodology laid out in the TRM for calculating lighting energy savings is not being followed by the program implementer. The TRM specifies baseline and installed wattages in savings tables for each lighting measure. The TRM also allows use of wattages listed on fixture cut sheet for installed fixtures (although in most cases cut sheets do not include fixture wattages).

For many of the projects we reviewed, however, the implementer opted not to use the TRM installed or baseline wattages to calculate savings. Instead, it appears that they looked up the wattage of the installed fixtures from a third-party list and multiplied that by a "Savings Ratio" to calculate the baseline wattage. The "Savings Ratio" is derived from TRM values as the ratio of Installed Watts to Baseline Watts.

It is likely that the implementer takes this approach because they find the fixture categories listed in the TRM tables to be too vague and the wattage values imprecise. The implementer's method seems to bring the installed wattage closer to their actual values, but it has mixed effects on the baseline wattages, sometimes making them too high, and sometimes too low. Overall, use of this ratio tends to incorrectly increase the tracked energy savings.

Updating the TRM savings tables to include more fixture types would improve the accuracy of savings estimates. For example, measure L20 lists just two fixture types in its savings table, 1-2 lamp HPT8 or T5/T5HO systems, and 3-4 lamp HPT8 or T5/T5HO systems. It would be much more accurate to split this up into as many as twelve separate fixture types of 1, 2, 3 or 4 lamp fixtures using HPT8, T5 or T5HO technology.

[27] The program originally collected baseline equipment information. The Delivery Team under the oversight of the MPUC was asked to stop collecting baseline data in an effort to make program participation easier.

Wattage categories for LED Wallpack measures

Additional fixture types are particularly needed for the LED Wallpacks measure (measure codes S12 and S13). The TRM table only includes one fixture type with baseline power of 205 W and new fixture power of 55 W. Our evaluation identified new LED Wallpack fixtures drawing 13 W and 22 W of power, which are replacing fixtures with significantly lower wattage than a 205 W fixture. According to our research, these fixtures typically replace 100 W and 150 W metal halide fixtures, which use 128 W and 190 W each when their ballast energy use is considered. They may also replace incandescent fixtures of varying wattages.

Energy savings according to fixture sizes

The standard length of the lamps used in the lighting fixtures is not specified in the TRM description sections. The most frequently installed lamp size is 4 feet, which should be added explicitly to the text of the TRM.

For fixtures with non-standard lamp lengths, the TRM directs users to average values of watts. This is problematic for two reasons. First, the implementer does not appear to be using these average values. Furthermore, there are significant differences in savings between a 2-foot fixture, a 6-foot fixture, and an 8-foot fixture, and these average values do not capture these differences.

Descriptions of baseline fixtures and assumptions

For most measures, the assumptions made about the baseline fixtures are not detailed in the TRM and cannot be reviewed. Missing assumptions include, but are not limited to, the type of fixture, size, number of lamps, and type of ballasts.

Although including more fixture types and sizes means also including more detail about individual baseline fixtures and assumptions, adding this information would improve the TRM in three ways: 1) it can be more easily reviewed and updated in the future, 2) it will improve the reliability of the TRM energy savings estimates, and 3) it will make tracking program savings much easier for the implementation contractor.

Demand savings factors for lighting controls

The percent of lighting saved by controls (SVG factors, listed in the TRM for measures L60, L70, and L71) is being applied to both the kW and kWh savings calculations. The SVG factor is found either from project applications or by default from the "Energy Saved" tables included in each lighting control measure. For example, if not specified in the project application materials, a remote mounted occupancy sensor used in an open office is assumed to save 15% of both energy use and demand, and a sensor used in a warehouse is assumed to save 50% of the energy use and demand.

Using the same factor to adjust energy and demand savings is not correct. The reductions from controls of multiple fixtures are not likely to be concurrent, and do not always occur during peak hours. Instead, a coincidence factor should be used to adjust reduction in demand to account for the proportion of lighting that is being controlled at the same time.

There are several methods available to adjust demand savings separately from energy savings. In one method, such as is used in Massachusetts and New York, energy and

demand savings are found as follows:

Delta kWh = kW connected x (Hours base – Hours ee) or = kW connected x SVG

Delta kW = kW connected x DSF,

where the hours are site specific and baseline and energy efficient hours of use should be taken from the project applications or from default values of SVG. The demand savings factor, DSF, for occupancy sensors in the summer in New York is assumed to be 0.30 for interior lighting and 0.00 for exterior lighting (where all the savings is assumed to take place during off-peak hours). For Massachusetts, the summer demand savings factor is assumed to be 0.30 for "Large Retrofit" projects and 0.35 for "Small Retrofit" projects.

A slightly different method is used in Ohio and in California utilities (PG&E, SCE, and SDG&E), where

Delta kWh = kW connected x (Hours base – Hours ee) or = kW connected x SVG

Delta kW = kW connected x SVG x CF,

For occupancy sensors in Ohio, the SVG value is assumed to be 0.3 and the coincidence factor, CF, for occupancy sensors is assumed to be 0.15. In California, values of SVG and CF vary depending on the type of space. We have been able to find SVG and CF values for the following space types:

Table 5-4. Example SVG and CF Values by Space Type

Type of Space	SVG	CF
Offices	15%	0.81
Classrooms	35%	0.42
Industrial	45%	0.99
Storage/Warehouse	45%	0.84
Retail	15%	0.88

Source: "High Bay Occupancy Sensor – Integrated", Work Paper WPSCNRLG0073, Revision 1, Southern California Edison Company, Design & Engineering Services, September 18, 2007.

Operating hours assumptions

The default operating hours listed in the TRM do not always seem reasonable for each building type. The reference for Maine's lighting operating hours is a 1993 study of Orange and Rockland County Michigan's Small Commercial Lighting Program, which may be outdated. The table below compares the lighting operating hours assumed for Maine with similar assumed hours for Ameren Illinois and New York State. These hours are also put into context in terms of hours per day, days per week, and weeks per year.

Table 5-5. Lighting Operating Hour Assumptions by Building Type

Building Type	Maine				Ameren	NY State
	Hours/ year	Weeks/ year	Days/ week	Hours/ day	Hours/ year	Hours/ year
Office	3,435	52	5	13.2	2,808	3,100
Restaurant	4,156	52	7	11.4	5,278	4,182
Restaurant - Fast Food	--	--	--	--	--	6,376
Retail	3,068	52	7	8.4	4,210	4,057
Grocery/Supermarket	4,612	52	7	12.7	5,824	4,055
Warehouse	2,388	50	6	8	4,160	2,602
School	1,270	39	5	6.5	1,873	2,187
College	5,010	50	5	20	3,433	2,586
College Dorm						3,066
Health	3,392	52	5	13	6,474	3,748
Nursing Homes						5,840
Hospital	4,532	52	7	12.5	6,474	7,666
Hotel/Motel	2,697	52	7	7.4	4,941	3,064
Manufacturing	3,500	50	5	14	4,290	2,857
Manufacturing - 2nd Shift	--	--	--	--	--	4,730
Manufacturing - 3rd Shift	--	--	--	--	--	6,631
Other/Misc.	2,278	50	5	9.1	4,325	

Source: New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, Residential, Multi-Family, and Commercial/Industrial Measures, October 15, 2010; Internal communication between Lisa Gartland of Opinion Dynamics Corporation and Karen Kansfield of Ameren Illinois regarding the Act On Energy Business Program Lighting Measures, August 10, 2011.

In most cases, the program implementers do not use the operating hour assumptions listed in the TRM. Instead, they use the operating hours given by the applicant for each project on the project application. We recommend that Efficiency Maine increase hours assumptions for restaurant, retail, grocery, school, hospital and manufacturing facilities, and reducing them for colleges. These corrected hours can be used as default values when the applicant does not supply this information.

In addition, for measure L60, fixture-mounted occupancy sensors, savings factors (SVG) are only designated for three space types: gymnasiums, warehouses, and storage. These fixtures have also been installed in manufacturing/industrial spaces. It is not clear from the TRM what savings factor to use in these applications.

Non-Lighting Measures

Baseline efficiency tables for Premium Efficiency Motors

EPAct 1992 tables of motor efficiencies are referenced in the measure baseline write-up in the TRM, but these tables were not included within the TRM documentation. Due to recently adopted standards for higher motor efficiencies, the premium efficiency motor incentives have been dropped from the Efficiency Maine program. However, if these measures are ever

added in the future, we recommend including tables showing efficiencies for the baseline motors and incentivized motors by horsepower and RPM for both TEPC and ODP motors.

Free cooling assumptions for Dual Enthalpy Economizers

The free cooling hours (FCHr) do not seem to be set correctly in the dual enthalpy economizer measure. The definition of FCHr in the TRM states the hours were found as the typical weekday hours when outdoor temperatures in Portland, Maine, are between an upper limit of 70°F and a lower limit of 60°F. FCHr should instead be counted based on an upper limit in outdoor enthalpy of 28 Btu/lb, or outdoor dry bulb of 75°F and dew point of 55°F. The lower limit of 60°F should also be checked and possibly lowered, since commercial buildings may still be using indoor cooling when outdoor temperatures are as low as 50°F.

The same number of cooling hours has also been incorrectly assumed to apply to two different baselines: 1) where no economizer is used and 2) where a dry-bulb economizer is used. The definition of FCHr above only applies to a baseline case where no economizer is used. If a dry-bulb economizer is the baseline, the dry-bulb free cooling hours (FCHdb) should first be found as the typical weekday hours when outdoor temperatures are between 70°F and the revised lower temperature limit. The free cooling hours for a change to a dual enthalpy economizer (de) from a dry-bulb economizer baseline (db) would then be determined as:

FCH(de-db) = FCHr – FCHdb.

Algorithms for Demand Control Ventilation

The equations for demand control ventilation are not clear and appear to need significant revisions. The electrical energy savings due to demand control ventilation is based on the reduced need for ventilation air. Lower levels of ventilation during the cooling season mean less energy is needed to both cool and dehumidify outside air. While the demand and energy savings equations do seem to be accounting for sensible loads, they do not seem to include reductions in latent loads.

The equations are also not stated clearly to reflect both the assumptions made and the underlying engineering principles. The equations should be based on:

DCV energy reduction = (sensible heat load reduction + latent heat load reduction)/cooling EER

Sensible heat load reduction = flow rate x specific heat x delta temperature x % flow reduction

Latent heat load reduction = flow rate x latent heat of vaporization x delta humidity x % flow reduction

It is possible that both of these terms are buried in the existing equations. The demand equation calculates the space ventilation flow rate and multiplies it by a “Saving Factor”, but it is not clear how the “Saving Factor” was derived or what it represents. In addition, it is not certain that DCV reduces demand at all, especially during peak conditions, since the ventilation reductions vary considerably over time of day based on the number of occupants in the space.

In the energy equation, it is not clear how the 0.21 hrs/cooling day “Saving Factor” was derived. This represents only about 2.5% savings for an 8 hour day, when DCV systems have

been documented to reduce ventilation needs by at least 10% in office buildings.

There is also a variable denoted as CDD or "cooling design days" which is set to a value of 83 days. Looking up the reference for this value, ASHRAE 90.1-2004 Table D-1, Portland, Maine has 1,943 CDD50 (cooling degree days at a baseline temperature of 50°F, there is no reference to "cooling design days") and dry-bulb design temperature of 83°F. This CDD variable does not make sense in terms of this table, nor in the context of the energy savings equation.

Savings from DCV are also expected to vary depending on the building or space type, from a minimum of 10% for office buildings to 30% for restaurants and retail space, and potentially to higher values for schools and auditoriums.

Demand savings factor for Door Heater Controls for Cooler or Freezer

The demand savings algorithm assumes that all cooler and freezer door heaters are inactive at the same time. This is not likely to be the case. The demand savings should be adjusted by the Energy Star percent energy savings factor.

For reach-in coolers and freezers, the standards and energy savings at CEE and Energy Star referenced in the TRM appear to differ from what is listed in the Efficiency Maine TRM for these measures. It is possible that the standards we identified, which went into effect on April 1, 2009 for glass doors and Jan 1, 2010 for solid doors, are a different version than what is being used by the TRM.

The volume categories also differ from the TRM, with Energy Star/CEE using categories of < 15 cubic feet, 15-30 cubic feet, 20 to 50 cubic feet, and > 50 cubic feet.

5.2 Net Impacts

The analysis of program net impacts for FY2011 included a quantitative analysis of free-ridership and participant spillover and a qualitative assessment of non-participant spillover. For details about the methodology used for these analyses, please see Section 3.3 (Net Impact Methods).

5.2.1 Summary of FY2011 Net Impacts

Net program impacts are calculated by applying the net-to-gross ratio (NTGR) to ex-post gross program savings. The NTGR, which represents the percentage of gross program savings that we can reliably attribute to the program, is calculated as (1 – Free-Ridership + Spillover. In this evaluation, we only measure participant spillover.[28]

Based on the levels of free-ridership and participant spillover calculated above, the NTGR for the FY2011 Business Program is estimated to be 0.66. Table 5-6 summarizes the NTGR results.

[28] Any non-participant spillover would increase the NTGR.

Table 5-6. FY2011 NTGR

Component	Value
FR	0.342
Participant Spillover	0.004
NTGR	0.662

Source: Net impact analysis.

Applying the NTGR to ex-post gross program savings yields program-level net impacts of approximately 29,000 MWh and 5.5 MW. **The precision of net impact estimates is 10% at 90% confidence** (calculated by chaining the precision levels of the gross impact analysis and the net-to-gross analysis).

Table 5-7 summarizes the net impact results for prescriptive projects, custom projects, and the Business Program overall.

Table 5-7. Net Impacts for FY2011

	Ex Ante Gross	RR	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (KWh)					
Prescriptive	25,715,628	0.99	25,401,049	0.70	17,681,408
Custom	18,236,971	1.02	18,566,421	0.62	11,436,497
Total KWh	43,952,599	1.00	43,967,470	0.66	29,117,905
Demand Savings (KW)					
Prescriptive	5,883	1.01	5,955	0.70	4,145
Custom	2,263	1.09	2,471	0.62	1,522
Total KW	8,146	1.03	8,426	0.66	5,580

Source: effRT program tracking database, net and gross impact analyses.

Free-Ridership

Through our participant survey, we collected data to estimate free-ridership for three types of business projects: custom, prescriptive lighting, and prescriptive non-lighting. Survey respondent projects represented 30% of total program savings (31% of custom savings, 31% of prescriptive lighting savings, and 16% of prescriptive non-lighting savings; see also Section 3.1.3 above).

The program-level estimate of free-ridership is 0.34 (meaning 34% of savings are attributable to free-ridership). Lighting projects, which account for more than half of program savings, have the lowest level of free-ridership with 0.28. These values are slightly higher, but comparable, to levels of free ridership estimated in the 2006 evaluation report.

Table 5-8 summarizes the FY2011 free-ridership results, by project type, and compares them to values from the 2006 evaluation.

Table 5-8. Free-Ridership Scores, FY2011 Compared to 2006

Type	FY2011 Free-Ridership	2006 Free-Ridership
Prescriptive	0.31	0.27
Prescriptive Lighting	*0.28*	--
Prescriptive Non-Lighting	*0.50*	--
Custom	0.39	0.23
Program Overall	0.34	0.27

Source: Participant telephone survey, net impact analysis; 2006 Evaluation Report.

Of the 167 respondents to the participant survey, 28% had a free-ridership score of less than 0.25, 52% between 0.25 and 0.5, and 20% above 0.5. Not surprisingly, these three groups had markedly different responses to the three key questions used to calculate the free-ridership score:

1) the importance of the program incentive in the decision to implement the project (on a scale of 0 to 10, where 0 means "not at all important" and 10 means "extremely important");

2) the number of points, out of 100, given to program-related factors; and

3) the likelihood that the respondent would have installed the same equipment without the program (on a scale of 0 to 10, where 0 means "not at all likely" and 10 means "extremely likely").

Table 5-9 summarizes the average scores, given by respondents with the three levels of free-ridership, to these three questions.

Table 5-9. Responses to Free-Ridership Survey Questions

Free-Ridership	Survey Respondents		Importance of Incentive	Points to Program	Likelihood to Install without Program
	Number	%	Scale of 0-10	Out of 100	Scale of 0-10
<0.25	46	28%	9.1	74	3.0
0.25-0.5	87	52%	7.9	59	6.4
>0.5	34	20%	4.8	37	9.2
ALL	167	100%	7.5	58	6.1

Source: Participant telephone survey, net impact analysis.

Participant Spillover

Forty-four percent of participants report having implemented additional energy efficient equipment or upgrades at their facility since completing the project through the Business Program.[29] However, only 10% of these (9 respondents or 5% of all survey respondents) reported that the program had a strong influence (a score of 8, 9, or 10, on a scale of 0 to 10) on their decision to implement the measures.

[29] It should be noted that it is unknown if this equipment would have qualified for incentives through the Business Program.

Six of the nine respondents reported installing energy efficient lighting measures including linear fluorescent fixtures, pin-based CFL fixtures, screw-in CFL lamps, and LEDs. The other three installations included an HVAC control system and new motors. We estimated savings from these measures (approximately 56 MWh) by applying TRM values and assumptions. The estimated participant spillover ratio, calculated as spillover savings divided by program savings of all 167 survey respondents, is 0.4%. Table 5-10 summarizes these results.

Table 5-10. Participant Spillover

Spillover Savings (MWh)	Ex Post Savings for Survey Respondents (MWh)	Spillover Ratio
55.74	13,147	0.004

Source: Participant telephone survey, net impact analysis.

Non-Participant Spillover

Our qualitative assessment showed some evidence of non-participant spillover in FY2011. Our assessment included questions of non-participants as well as Qualified Partners.

Non-Participants

Overall, 26% of respondents to the non-participant survey report that they had installed high efficiency equipment at their facility over the past year.[30] However, of these, only 16% (five respondents out of a total of 101) were at least "somewhat" familiar with the Business Program; the vast majority, 72%, had not heard of the Business Program before taking the survey. Of the five respondents with high efficiency installations who were familiar with the program, one learned about the program after the installation and three said the program did not influence their project in any way. Only one respondent reported that the program influenced the installation, noting that the improvements had been recommended following an audit. This respondent completed a new lighting project, primarily to save energy/money; however, the respondent could not answer the question of why the project did not participate in the Business Program.

Qualified Partners

Interviewed Qualified Partners generally promote the program whenever it is applicable to the customer's equipment needs. Most interviewed Qualified Partners estimate that a majority (75% or higher) of their sales qualify for incentives through the Business Program and that the majority of those qualifying installations receive program incentives (only about 10-25% do not). Reasons for not submitting the project for an incentive include project timing and, for small projects, the effort required to submit the application.

Many interviewed Qualified Partners reported changes in their business as a result of the Program, including changes in the products they stock and how they promote energy efficient products, as well as a general increase in business. The majority also reported that they recommend high efficiency equipment more often as a result of the Program.

[30] It should be noted that it is unknown if this equipment would have qualified for incentives through the Business Program.

While our research was not designed to quantify non-participant spillover, Qualified Partner responses do indicate that 1) qualifying installations are being made without receiving an incentive and 2) Qualifying Partners have changed their business practices as a result of the Program. Since contractors are often instrumental in specifying equipment, it is likely that some of their unincented energy efficient installations would not have been made, without their involvement in the program. Additional, focused research would be required to develop an estimate of non-participant spillover as a result of the Business Program.

6. COST-EFFECTIVENESS ANALYSIS

6.1 Review of Benefit-Cost Model

Our review of the benefit-cost model included both inputs and assumptions, as well as a check of formulas and calculations.

Model Inputs and Assumptions

The model includes a table with basic assumptions and key inputs. For ease of reference, we present this table below. Overall, we found the assumptions underlying the Benefit-Cost Model to be reasonable.

Table 6-1. Ex Post Benefit Cost Model Assumptions and Inputs

No.	Term	Assumption	Source
1. Basic Assumptions			
1	Nominal Long Term Discount Rate	4.51%	AESC 2011, p. A-3 (based on 30 year T-bills as of February 2011)
2	Inflation Rate	2.00%	AESC 2011, p. A-3 (Consistent with 20 year historic average inflation rate of 2.16%, but slightly lower to reflect economic forecasts.)
3	Real Long Term Discount Rate	2.46%	Calculated using algorithm in AESC 2011, p. A-1 [(1+Nominal Discount Rate)/(1+Inflation Rate)-1]
4	Externality Adder - Electric	None	
5	Externality Adder - Other Fuels	None	
6	Environmental Adder - SOX (lbs/MWh)	1.568	AESC 2009, p. 6-72; (not updated in the 2011 study) - specifically for Maine
7	Environmental Adder - NOX (lbs/MWh)	0.715	AESC 2011, p. 6-88, specifically for Maine
8	Environmental Adder - CO2 (lbs/MWh)	1,132	AESC 2011, p. 6-87, specifically for Maine
9	Environmental Adder - Particulate (lbs/MWh)	None	
10	Environmental Adder - (lbs/MWh) - Other	None	
11	Program Start Date	Jun-10	
12	Total Program Duration (months)	12	
13	Number of months duration	12	
2. Funding Available			
14	Total Market Size (# of Customers)	Not required for this analysis	
15	Forecast Sales (kWh)		
16	Forecast Sales (MMBTU)		
17	Energy Efficiency SBC ($/kwh or mmbtu)		
3. Budget Allocations (Costs)			
18	Program Planning & Admin	$663,955.25	Efficiency Maine Trust Staff

No.	Term	Assumption	Source
19	Marketing & Advertising	$390,232.78	Efficiency Maine Trust Staff
20	Sales, Tech Assist	$3,894,139.34	Efficiency Maine Trust Staff
21	Evaluation & Market Research	$0	Efficiency Maine Trust Staff
21a.	Rebates / Incentives	$6,215,730.60	Efficiency Maine Trust Staff
4. Energy, Demand Loss Multipliers and Program-level Realization Rate			
22	Electric Energy Loss Multipliers	Various	Efficiency Maine Commercial TRM Dated 8/31/2010 (Table 1)
23	Electric Demand Loss Multipliers	Various	Efficiency Maine Commercial TRM Dated 8/31/2010 (Table 1)
24	Reserve Margin Multiplier	1	
25	T & D Loss Multiplier	1	Set to 1 as assume incorporated in Loss Multipliers in 22 and 23
26	Program-Level Realization Rate (in %)		Not used; incorporated in gross impacts from evaluation
5. Energy, Demand, T & D Factors			
27	LoadShape Factors	Various by energy period	Efficiency Maine Commercial TRM Dated 8/31/2010 (Table 2)
28	Coincidence Factors	Various by energy period	Efficiency Maine Commercial TRM Dated 8/31/2010 (Table 2)
6. Benefits			
29	Net Energy and Demand Savings	**Various based on end use**	Evaluation of program

Source: GDS Associates' Benefit/Cost Screening Model (Version 2.2, updated 9/26/11).

We reviewed the model to ensure that all values (benefits, costs, and discount rates) were in nominal terms to maintain consistency and avoid double counting of inflation. We found this to be the case.

The Program currently does not use a Societal Test and therefore does not include a discount rate suitable for this test. If the program moves to adding a Societal Test, we recommend using a different discount rate from the other tests. In the current model, the nominal discount rate used is the same across all types of cost-benefit analysis test. The assumption for the current model comes from the 2011 AESC Study, which states that for Maine in 2011 "the discount rate used for present value calculations shall be the current yield of long-term (10 years or longer) U.S. Treasury securities, adjusted for inflation"[31] – in other words the nominal discount rate. While we agree that the discount rate should be the same for the Direct Utility Test, Participant Test, RIM Test, and TRC test, we recommend using a different discount rate for the Societal Test.

The rate we recommend is the Social Rate of Time Preference (SRTP) discount rate. The SRTP is defined as the value society attaches to present, as opposed to future, consumption. It is based on comparing utilities across time and across generations and is determined by reference to the market rate of interest. The U.S. Environmental Protection

[31] Synapse Energy Economics, Inc. *Avoided Energy Supply Costs in New England: 2011 Report*. July 21, 2011 Amended August 11, 2011. Exhibit C-9, page C-24.

Agency supports using the SRTP in evaluating environmental projects.[32] We recommend using a discount rate range of 2%-3% such that there is an added level of robustness to the model as results tend to be very sensitive to changes in the discount rate.

We did not implement this suggestion within the current model.

Formulas and Calculations

We also checked the model for any formula errors, linking errors, or missing data errors. We found no errors with one exception. Our review showed that Row 7 in the 'Results Summary' sheet was incorrectly linked and needs to be revised such that changes in the type of test used in H12 in the 'Input' sheet would flow through and calculate appropriately in the 'Results Summary' sheet. This is a minor issue that will only make a difference if a different Societal discount rate is used.

6.2 Cost-Effectiveness Results for FY2011

The cost-effectiveness analysis was conducted in two steps: 1) the first step included revisions to the model and to ex ante inputs; 2) the second step included replacing revised ex ante values with ex post ones.

Table 6-2 summarizes the changes made to the model in each of the two steps and the effect of these changes on the TRC test value.

Table 6-2. Results of Cost-Effectiveness Analysis for the FY2011 Business Program

Model	Changes to Previous Model	TRC Value
Program Model (11/9/2011)	n/a	2.21
Revised Program Model	• Switched coincidence and allocation factors for C&I Other and C&I Shell measures • Broke out "Per Unit Total or Incremental Cost" and "Per Unit Rebate – Incentive" *by end-use*, based on program tracking database • Used actual Load Reduction Factor by end-use, based on program data, rather than average by end-use factor • Used ex ante from program tracking data	2.15
Ex Post Model	• Replaced ex ante gross impacts with ex post gross impacts • Replaced default net-to-gross assumptions with evaluated net-to-gross ratios	1.93

[32] Theory and Practice in the Choice of Social Discount Rate for Cost-Benefit Analysis: A Survey. ERD Working Paper No. 94. May 2007. (http://www.adb.org/documents/ERD/Working_Papers/WP094.pdf)

Revised Program Model

The program-estimated TRC test value is 2.21. Four adjustments were made to the Program Model. Of these, only the first resulted in a change of the TRC test value at the second decimal place or greater. The resulting TRC test value, based on the revised program model, is 2.15.

1. The coincidence and allocation factors in the program model appear to be switched for two measures: C&I Other and C&I Shell Measures. This change caused the change in the TRC test values from 2.21 to 2.15. Table 6-3 below presents the coincidence and allocation factors, as used in the Program Model and in the TRM.
2. The program model uses a single incremental cost value and a single incentive value, which is input under "lighting." The revised model breaks these costs out by end-use.
3. The program model applies load reduction factors, by end-use, that are based on FY2006-FY2009 program results. The revised model uses actual load reduction factor by end-use, based on FY2011 program data.
4. Ex ante savings in the Program Model are slightly higher (44,628,013 kWh) than savings in the program tracking database (43,952,599 kWh). The revised model uses the program tracking data.

Table 6-3. Differences in Coincidence and Allocation Factors

Measure Type	Model	Annual Demand Coincidence		Allocation of Annual Energy Savings by Season			
				Winter		Summer	
		Winter	Summer	Peak	Off Peak	Peak	Off Peak
Other - C/I	Program Model	63%	90%	44%	30%	15%	10%
	TRM	60%	56%	34%	37%	15%	14%
	Difference	*3%*	*34%*	*10%*	*-7%*	*0%*	*-4%*
Shell Measures (Heat & Cool) - C/I	Program Model	60%	56%	34%	37%	15%	14%
	TRM	63%	90%	44%	30%	15%	10%
	Difference	*-3%*	*-35%*	*-10%*	*7%*	*-1%*	*4%*

Source: Unknown for program Model. TRM values from Table 2 – Loadshapes & Coicidence Factors. *Maine Commercial TRM 8_31_2010-Final.pdf*.

Ex Post Model

The revised program TRC test value is 2.15. Two ex post adjustments were made to the Revised Program Model:

1. The Ex Post Model applies realization rates to ex ante gross impact to calculate ex post gross impacts. Because the realization rates are close to 1.0, this adjustment made no difference in the TRC test value at the second decimal place. (See
2. Table 5-1 for realization rates.)

3. The Ex Post Model replaces the default net-to-gross ratio of 1.0 with end use specific net-to-gross ratios, based on our net impact analysis. This made a substantial difference in the model results. Table 6-4 below presents the net-to-gross ratios, by end use.

The resulting TRC test value, based on ex post (evaluated) data, is 1.93.

Table 6-4. Ex Post Net-to-Gross Ratios by End Use

End Use	Measure Type	Spillover	Free Ridership	NTGR
Lighting	Lighting - C/I	0.4%	30%	0.71
Custom	Other - C/I	0.4%	39%	0.62
HVAC	Cooling - C/I	0.4%	48%	0.53
VFD	Continuous Running Equipment	0.4%	41%	0.60
Motors	Continuous Running Equipment	0.4%	50%	0.50
Agriculture	Other - C/I	0.4%	50%	0.50
Compressed Air	Other - C/I	0.4%	39%	0.62
Refrigeration	Process - C/I	0.4%	50%	0.50
Appliances	Appliances	NA	NA	NA
Special Offer	Other - C/I	NA	NA	NA

Note: NTGR shown here may not map directly to values shown elsewhere in the report as these are a blend of custom and prescriptive projects by end use.

Additionally, there were two other minor differences in the Program Model and Ex Post Model.

1. The real discount rate in the Program Model is 2.50% while the same value in the Ex Post Model is 2.46%. This made no effective difference, but is noted here. We chose to input the Ex Post value to be consistent with Table A-1 in the AESC report.
2. The environmental factors in the Program Model reflect the average New England values; we have input the Maine specific values in the Ex Post Model. This reduces the environmental benefits slightly. (See Table 6-5.)

Table 6-5. Environmental Benefit Base Values

Envrionmental Benefit	Ex Ante Model	Ex Post Model
CO_2 (lbs/MWh)	1,166	1,132
SOx (lbs/MWh)	1.592	1.568
NOx (lbs/MWh)	0.732	0.715

Source: AESC 2011 for CO2 and NOx; AESC 2009 for SOx.

7. FINDINGS AND RECOMMENDATIONS

7.1 Process Analysis

Program Participation

The Business Program achieved 113% of its ex ante gross energy savings goals for FY2011. The Program also exceeded its ex ante gross savings goals in FY2008 and FY2009 (but fell short of goals in FY2007 and FY2010).

The manufacturing sector was a key driver in savings in FY2011, with more than half of program ex ante gross energy savings and one-third of program ex ante gross demand savings. This sector accounted for the largest share of energy savings in all five years and generally has the largest average project size. Other key sectors contributing to program savings in FY2011 were Retail and Office. The Office sector accounted for the largest share of projects (19%) in FY2011.

The average size of projects has fallen sharply since FY2007, from 49.1 MWh to 22.9 MWh.

Prescriptive lighting accounted for 80% of all Business Program projects in FY2011, and 52% and 64%, respectively, of ex ante gross energy and demand savings. In contrast, there were fewer but larger custom projects: custom projects accounted for 9% of all projects and 41% of energy savings.

Recommendations

- While prescriptive lighting projects tend to be more cost-effective than other types of projects, the program should continue its efforts to diversify its portfolio of projects away from lighting. This might include targeting non-lighting contractors for participation in the Qualified Partner network; providing short-term special incentives or Qualified Partner bonuses for non-lighting measures; or targeting sectors with high non-lighting energy use with program marketing.

Program Design and Implementation

The Program has made continuous adjustments and improvements to program design and implementation over the five-year period FY2007 to FY2011. Key changes included an improved electronic application and program tracking system and the introduction of a "Qualified Partner" network.

Program Marketing and Outreach

Non-participant awareness of Efficiency Maine (68%) and the Business Program (33%) is relatively high for a non-utility program. More than half of those aware of the Program (54%) first learned about it through general media (TV, radio, print advertising), suggesting that the program's past mass marketing efforts have been effective in raising program awareness. While awareness is high, non-participants still require a lot of education about the Program as the level of familiarity is relatively low.

Trade allies are a key source of Program information for participants: 40% heard about the

program from a Qualified Partner or contractor and 13% from another type of trade ally (supplier, vendor, distributor). Qualified Partners generally promote the program, whenever it is applicable.

Non-participating businesses indicate that flyers/ads/mailings (52%) and e-mail (43%) are the best ways of reaching their company with information about energy efficient opportunities like the Business Program.

During FY2011, key marketing activities included print advertising, presence at events, development of new case studies, and cooperative advertising with Qualified Partners. In FY2012, responsibility for marketing shifts from an umbrella marketing firm to the program implementer.

Recommendations

- The program may want to consider differentiating its marketing and outreach between large and small businesses. While large businesses often have dedicated facility staff, small businesses more often lack the resources to make informed decisions about energy efficient equipment. Case studies of smaller businesses in sectors such as retail, offices, and schools might be helpful in demonstrating that the program can help small businesses overcome barriers of cost and lack of information. (Currently available case studies mainly focus on projects in manufacturing and agriculture.)
- While not needed to meet program savings in FY2011, the program should consider implementing "trigger tactics" for outreach in future program years (as has been done at times in the past, subject to budget availability).[33] These might include short-term special incentives for certain technologies or sectors, direct mail outreach, or Qualified Partner bonuses, e.g., for projects exceeding a certain savings threshold. With the shift of marketing responsibility from Burgess to the implementation team, there should be additional flexibility in adjusting marketing strategies based on the program's progress towards meeting its goals.
- Utility-run efficiency programs typically leverage pre-existing relationships of their Account Managers with large customers to recruit businesses with large savings potential into their programs. While Efficiency Maine does not have direct links to utility Account Managers, the program should explore ways of cooperating more closely with the utilities and engaging Account Managers in the Business Program where possible. This might help in attracting larger projects as well as participants with multiple business locations in the State.

Qualified Partners

Efficiency Maine introduced the "Qualified Partner" status in 2009, replacing the program's previous "trade ally" designation. This change has been successful in focusing the list of program partners and increasing the quality of submitted applications. The program manages its list of Qualified Partners through a flexible process of demotion of Partners that do not complete three or more projects per year.

[33] Trigger tactics are marketing activities that are initiated in response to certain outcomes, e.g., if program savings are short of program goals at certain times during the program year.

Qualified Partners represent 35% of FY2011 participating contractors, 57% of total projects, and 71% of total energy savings. Most of the current Qualified Partners are electrical contractors. In FY2011, Qualified Partners and contractors identified the opportunity for the program incentive for 51% of participants and were the most influential in specifying the details of the project for 57% of participants.

Participants are generally not aware of their contractor's status as a Qualified Partner.

Recommendations

- The program should continue to recruit more non-lighting contractors into its Qualified Partner network. Given the importance of contractors in marketing the program and specifying equipment, this would help the program to further diversify away from prescriptive lighting projects. Also targeted should be contractors who can provide "deeper" savings and design contractors and A&E firms.
- The program currently provides certain benefits for becoming a Qualified Partner. To further encourage more active participation, the program should consider providing additional incentives. This could include a bonus (or other reward) for trade allies that achieve certain levels of savings or listing Qualified Partners in the Directory by the number of projects completed or savings achieved. This would allow Partners to differentiate themselves from other Program Partners and might provide additional motivation to market the Program.
- If the Program strives to have active Qualified Partners, it should eliminate any barriers to increased participation. According to one very active Partner, the process of entering multiple projects into the application system is cumbersome since key information has to be re-entered with each application.[34] The program may wish to revisit some of the functionalities of the on-line application system to ensure that they do not pose a barrier to participation.

Barriers to Energy Efficiency and Program Participation

Upfront cost, lack of knowledge and information, and the economic climate are key barriers to the installation of energy efficient equipment and program participation. Nearly two-thirds of non-participants find that "price is the biggest reason why their company might not buy a high efficiency item." Small businesses (70%) are more likely to cite price as a barrier compared to large businesses (29%). Nearly half of respondents also find that "it is hard to figure out if the extra money you might need to spend on an energy efficient piece of equipment is really worth it."

Recommendations

- The program is in a position to address barriers of both cost and uncertainty about expected savings from energy efficiency. As noted above, additional case studies that focus on small businesses or on additional sectors and that exemplify the expected annual savings in relation to upfront costs could be helpful.
- The program discontinued its Quick and Easy component for small businesses in 2009. Given that both cost and technical information are greater barriers for small

[34] The application team was not able to verify this claim.

businesses, the program may consider developing special offerings for small businesses that simplify the participation process.

Participant Satisfaction

Participants give high satisfaction ratings for their contractors and Efficiency Maine technical staff. However, ratings for the Business Program overall, incentive amounts, and eligible measures are relatively lower. Satisfaction with the program overall is also lower compared to levels found in the 2006 Evaluation (although the values are difficult to compare due to different scales).

Overall, 7% of participants report having had issues or problems during their participation in the Program; 3% experienced problems with the processing of their paperwork. In addition, 21% of participants recommended better communication and program information as ways to improve the program.

Recommendations

- The scope of this evaluation did not include further exploration of potential issues of program communication and paperwork processing raised in the participant survey. We recommend that the program keep an eye on this issue and make adjustments to processes, as needed.

Market Trends and Equipment Purchases

Most non-participants report that the efficiency of their facilities could be improved and only 29% consider their facility efficient. Qualified Partners we interviewed provided a differentiated view of the efficiency levels of existing equipment in the market, with smaller businesses lagging behind larger ones. Most Qualified Partners estimated that between 25-50% of the existing lighting equipment in Maine businesses can be considered energy efficient.

The majority of non-participants consults either a trade ally (41%; including contractor, consultant, supplier, or manufacturer) or the Internet (39%) when purchasing new energy-using equipment. Key factors in the selection of energy-using equipment are purchase cost, the equipment's energy efficiency, and operating and maintenance cost.

Overall, 27% of non-participants report that they have installed equipment or made other upgrades at their facility in the past year. Of these, the vast majority (94%, or 26% of all non-participants) claim that the installation was energy efficient.[35]

More than half of non-participating respondents (53%) either "plan to" or "may" install new equipment at their facility in the next two years. Almost all planned installations are very likely (76%) or somewhat likely (19%) to be energy efficient, and most respondents who are likely to install energy efficient equipment and who have at least some familiarity with the Business Program plan to participate in the program (24% are very likely; 53% are somewhat likely). These potential participants represent approximately 10% of all non-participants.

[35] It should be noted that it is unknown if this equipment would have qualified for incentives through the Business Program. Customers often over-estimate the efficiency of new installations.

While customers generally tend to overestimate the efficiency level of their purchases and the likelihood of participating in a program with high social desirability, these responses suggest that despite the economic conditions, there are opportunities to engage new participants in the program.

Other Efficiency Maine Programs

Most participants (79%) and non-participants (69%) are either very or somewhat interested in the Pilot Direct Install Program that Efficiency Maine is currently testing in the small business sector. The main reasons for not being interested in participating in the Pilot are not needing upgrades and cost.

Twenty-one percent of participants are aware of the Building Operator Certification Program, and 4% have already attended the training. Approximately half of participants (51%) expressed some level of interest in the program. Not surprisingly, interest is higher among large businesses, participants with custom projects, and participants with larger projects (over 15 MWh).

Recommendations

- Participants and non-participants are interested in other opportunities for business customers. Given that these two programs target different types of businesses, targeted marketing should be used to promote them.

7.2 Impact Analysis

Baseline Assumptions

Perhaps the largest source of uncertainty in the energy savings calculations we reviewed is the fact that information on the type, number, wattage, efficiency of baseline equipment that is being replaced is not being collected. The TRM addresses this by designating typical baseline wattages for each measure type. Unfortunately, the TRM does not always specify the assumptions used and they are not always representative of the known baseline conditions. While the TRM wattages do appear to be fairly representative of what has been replaced overall, our reviews showed that on a project by project basis they are less precise. It also appears that the implementers do not always use the baseline assumptions in the TRM and instead use other undocumented sources of baseline information.

Recommendations

- We recommend that the Efficiency Maine Trust consider asking for baseline conditions for all projects, or those exceeding a defined minimum size.

TRM Improvements

In our review of the Efficiency Maine TRM and in using the TRM in the project reviews, we identified several changes that could improve the clarity, usability, as well as the consistency and accuracy of savings estimates.

The descriptions for each measure type are typically located in the text under each measure's section. There is no summary of all measure types allowing a quick comparison

that allows users to identify the appropriate measure type in any situation. This makes it difficult to distinguish between measures and locate the appropriate measure, particularly in the case of the more numerous and similar lighting measures.

The fixture categories and wattage values in the TRM do not always provide enough detail to accurately estimate savings. As a result, the implementers do not appear to always be using the methods and values described in the TRM.

Additional fixture types, and more specificity in lamp lengths are needed. This is especially true for LED Wallpacks - measure code S12 and S13. Also, the standard length of the lamps used in the lighting fixtures is not always specified in the TRM description sections. The most frequently installed lamp size is 4 feet, which should be added explicitly to the text of the TRM. For fixtures with non-standard lamp lengths, the TRM directs users to average values of watts; however, there are significant differences in savings between a 2-foot fixture, a 6-foot fixture, and an 8-foot fixture, and these average values do not adequately capture these differences. In most measures, the assumptions made about the baseline fixtures are not detailed and cannot be reviewed.

EPAct 1992 tables of motor efficiencies are referenced in the measure baseline write-up, but these tables were not included within the TRM documentation.

Recommendations

- We recommend adding a summary table of all lighting measures, including for each measure type, a description, whether it applies to new construction or retrofit, the new fixture types, the existing fixture types, and efficiency and ballast factor where appropriate.
- In order to improve the usefulness of the TRM and the accuracy of savings estimates, we recommend revising the savings tables to include more fixture types.
- We recommend that wattage values for specific non-standard lamp lengths be added to the savings tables. These entries should include both baseline and installed watts for fixtures using lamps of lengths other than the standard 4 feet.
- We recommend adding details about baseline fixture assumptions to the TRM, including the type of fixture, size, number of lamps, type of ballasts, etc. If the baseline consists of a set of fixtures, we recommend explicitly stating what fixtures are in the set.
- We recommend adding a table showing both the EPAct and NEMA Premium Efficiencies by horsepower and RPM for both TEPC and ODP motors.

Data Discrepancies

In the course of our desk reviews of prescriptive projects, we found errors associated with the use of data for savings calculations that did not reflect the documentation for the project files in the Efficiency Maine Reporting and Tracking System (effRT).

We found about 20 instances out of 54 lighting projects where the installed lighting wattage used did not agree with the program documentation. Sometimes this was because an incorrect wattage was taken from a spec sheet. Other times an incorrect ballast factor was used, or the correct ballast factor was used, but incorrect bulb wattage was used to

determine fixture wattage. Also, in a few cases, we observed from customer receipts that different fixtures were installed than what the application and ex ante calculations indicated. The operating hours in five of 54 projects were corrected to agree with application materials or other data contained in the project files.

Recommendations

- More care should be taken in reviewing project documentation and ensuring the proper data are inputted into savings calculations.

Lighting Controls and Operating Hours Assumptions

In our project review we identified several areas for improving the methods and assumptions in the TRM related to lighting controls and operating hours. The percent of lighting saved by controls (SVG factors, listed in the TRM for measures L60, L70 and L71) is being applied to both the kW and kWh savings calculations. The SVG factor is found either from project applications or by default from the "Energy Saved" tables included in each lighting control measure. Using the same factor to adjust energy and demand savings is not correct. The reductions from multiple controls of multiple fixtures are not likely to be concurrent, and do not always occur during peak hours. Instead, a coincidence factor should be used to adjust reduction in demand to account for the proportion of lighting that is being controlled at the same time.

For measure L60, fixture-mounted occupancy sensors, we found that savings factors (SVG) are only designated for three space types: gymnasiums, warehouses, and storage. These fixtures have also been installed in manufacturing/industrial spaces. It is not clear from the TRM what savings factor to use in these applications.

The default operating hours listed in the TRM do not always seem reasonable for each building type. The reference for Maine's lighting operating hours is a 1993 study of Orange and Rockland County Michigan's Small Commercial Lighting Program, which may be outdated.

Recommendations

- We recommend that the TRM for measures L60, L70, and L71 be updated so that the demand savings values vary independently from energy savings. More study is needed to decide which demand calculation and factors are most appropriate for the Efficiency Maine Business Incentive Program.
- We recommend adding more space types to the table of SVG values for measure L60.
- We recommend increasing operating hours for some space types (i.e., restaurant, retail, grocery, school, hospital, and manufacturing) and reducing them for others (i.e., colleges) based on more recent and relevant studies.

Dual Enthalpy Economizers

In our review of the cooling assumptions for the dual enthalpy economizer measure, we found that the free cooling hours (FCHr) may not be set correctly. The FCHr are currently based on upper (70 degrees F) and lower (60 degrees F) outdoor temperatures.

Recommendations

- We recommend reviewing the free cooling assumptions and consider using an FCHr based on the upper limit in outdoor enthalpy of 28 Btu/lb (or outdoor dry bulb of 75°F and dew point of 55°F). The lower limit of 60°F should also be checked and possibly lowered, since commercial buildings may still be using indoor cooling when outdoor temperatures are as low as 50°F.
- The same number of cooling hours has also been incorrectly assumed to apply to two different baselines: 1) where no economizer is used, and 2) where a dry-bulb economizer is used. The definition of FCHr above only applies to a baseline case where no economizer is used. If a dry-bulb economizer is the baseline, the dry-bulb free cooling hours (FCHdb) should first be found as the typical weekday hours when outdoor temperatures are between 70°F and the revised lower temperature limit. The free cooling hours for a change to a dual enthalpy economizer from a dry-bulb economizer baseline would then be determined as:

  FCH(de-db) = FCHr – FCHdb.

Demand Control Ventilation

The equations for demand control ventilation (DCV) are not clear and appear to need significant revisions. While the demand and energy savings equations do seem to be accounting for sensible loads, they do not seem to include reductions in latent loads. The equations are also not stated clearly to reflect both the assumptions made and the underlying engineering principles.

Recommendations

- We recommend that the DCV equations be reviewed and revised, and their documentation be improved.

Refrigeration

In reviewing projects involving cooler and freezer doors, we found that the demand savings algorithm assumes that all cooler and freezer door heaters are inactive at the same time. This is not likely to be the case. For reach-in coolers and freezers, the volume categories, standards, and energy savings of CEE and Energy Star appear to differ from what is in the Efficiency Maine TRM for these measures.

Recommendations

- The demand savings should be adjusted by the Energy Star percent energy savings factor.
- We recommend that the energy savings for these measures be checked to make sure they reflect the latest energy standards.

Compressors

Ex ante and ex post savings for compressed air projects tended to differ significantly in part due to assumed CFM demand profiles being quite different from what we metered on site. In addition, we found that the unloading curves used were often times incorrect. The

unloading curves should be taken from CAGI data sheets for VFD compressors, or from the compressed air challenge, if they are not available from the manufacturer. Also, corrections for operating pressure were often not taken into account. For example, a spec sheet for 100 psi compressor operation was used and the actual operation is at 110 psi.

Recommendations

- While the implementers do not have much control over the assumed CFM demand profiles being quite different from actual operation, many other business programs require compressed air studies in order to receive compressed air incentives (the studies are mostly reimbursed, and they cover the fixing of leaks). Efficiency Maine Trust may want to consider this option.
- Care should be taken to make sure that the correct unloading curves are used and that differences in assumed operating pressures are corrected for.

Variable Frequency Drives (VFDs)

In our review of variable frequency drive projects, we observed several cases where an incorrect brake horsepower was used. We also observed instances where the affinity laws for VFDs were misapplied, including it used on a 100 psi steam boiler feed water pump which has significant static head.

Recommendations

- Actual brake horsepower should be taken from the fan or pump curves, which we found were often supplied with the application.
- More care should be taken not to misapply the affinity laws for VFDs.

7.3 Cost-Effectiveness Analysis

Benefit-Cost Model Inputs and Assumptions

Overall, we found the assumptions underlying the Benefit-Cost Model to be reasonable.

The Program currently does not use a Societal Test and therefore does not include a discount rate suitable for this test.

Recommendations

- If the Program moves to adding a Societal Test, we recommend using a different discount rate from the other tests. We recommend using the Social Rate of Time Preference discount rate. We recommend using a discount rate range of 2%-3% such that there is an added level of robustness to the model as results tend to be very sensitive to changes in the discount rate.

Cost-Effectiveness Results for FY2011

The program-estimated TRC test value is 2.21. Review of inputs showed that the coincidence and allocation factors for C&I Other measures and C&I Shell measures were switched compared to values in the TRM. Correcting this error reduces the TRC value to 2.15. Other adjustments to the Program Model resulted in no change of the TRC value at the second decimal place.

Applying ex post gross impacts and net-to-gross ratios from our net impact analysis reduces the TRC value to 1.93. Since the program-level realization rates for energy and demand savings are close to 1.0, this change mainly stems from the application of net-to-gross ratios.

APPENDIX A: COMPLIANCE WITH ISO-NE MEASURE AND VERIFICATION REQUIREMENTS

The ISO New England Manual for Measurement and Verification of Demand Reduction Values from Demand Resources (M-MVDR) describes requirements and procedures to follow in order to ensure that energy savings impacts are properly evaluated and verified. Three aspects of our evaluation work required particular consideration of the ISO New England requirements:

- **Project Sampling.** When choosing our samples of prescriptive and custom projects for review, we made sure our final sample met an 80% confidence interval with a 10% level of relative precision.
- **M&V Options.** When deciding how to verify each custom project evaluation, we made sure to choose one of the four valid options for monitoring and analysis.
- **Equipment Sampling.** During custom site visits, we made sure we monitored a representative sample of each type of equipment.

Project Sampling

Sampling was used to select projects for more detailed desk review of prescriptive projects and M&V analysis of custom projects. Within the commercial programs, there was a large variation in the level of savings from project to project. In order to choose the fewest projects possible for review, yet still meet 80/10 levels of confidence and precision, we used a stratified sampling technique. This techniques first splits each program's projects into high, medium, and low energy savings groups, according to their ex ante kWh savings. The Dalenius-Hodges method was used to determine the boundaries between each stratum. We then chose a random sample, using the Neyman Allocation to tell us how many projects to sample from each stratum. We then checked that the results from our random sample are expected to exceed 80/10 levels of confidence and precision.

Based on ex ante values of tracked kWh savings, our final sample of 30 Custom projects for site visit work had an 8.9% relative precision at 80% confidence. This sample included 14 of the 14 high energy savings projects, 6 of the 33 medium energy savings projects, and 10 of the 127 low energy savings projects.

Our sample of 70 Prescriptive desk review projects (plus one site visit) had an 11.7% relative precision at 80% confidence. This sample included 45 of the 72 high energy savings projects, 13 of the 328 medium energy savings projects, and 12 of the 1,343 low energy savings projects.

M&V Options

For custom project evaluations, ISO New England requires that one of four monitoring and verification options be chosen. The option chosen depends on the type of energy efficient equipment being installed. Below are some descriptions of these options and the types of

projects for which they are best suited.

- **Option A: Partially Measured Retrofit Isolation/Stipulated Measurement.** This option involves either spot metering or longer term monitoring of power use and/or operating status of a sample of installed equipment over time. Measurement equipment used includes multimeters, current transducers, on/off loggers to record the power use and on/off status of equipment, and data loggers to record these measurements over time. Spot measurements are made when equipment operation is well understood and not expected to vary over time. Longer-term measurements are made when equipment energy use or operation is expected to vary. For evaluation measurements, longer-term measurements are usually made over a period of three to four weeks. Results are scaled up to annual use based on understanding how equipment use changes with weather, seasonal light levels, or production levels.
- **Option B: Retrofit Isolation/Metered Equipment.** Option B is similar to Option A, except that systems or groups of equipment are monitored instead of individual pieces of equipment. This type of monitoring is often done by measuring power use of building circuits at the electrical panel. For example, a circuit on the panel may feed power to all lighting on a building floor, a series of fan or pump motors, or an entire HVAC system. Measurements are usually made using current transducers and data loggers. As in Option A, measurements are typically made for three to four weeks, and are scaled up to annual values using our knowledge of system operation during different seasons.
- **Option C: Whole Facility/Regression.** Whole facility analyses are used for measures that directly use electricity but are difficult to monitor, such as envelope or gas measures. Billing data is collected for a period before and after the measure was installed, and analyzed using a simple comparison, or a more involved regression analysis, in order to estimate the energy savings.
- **Option D: Calibrated Simulation.** Calibrated simulations are used for measures that are difficult to monitor and whose energy savings may be too small to distinguish from the entire facility's energy use. Building energy modeling is done using the DOE-2.2 model, usually either eQuest or EnergyPro, which are software interfaces that help to set up and run DOE-2.2.

We followed Option A (Partially Measured Retrofit Isolation) for all but one of the Custom projects we evaluated. These projects were retrofits of discrete pieces of equipment, including eleven lighting projects, eight compressed air projects, seven VFD projects, and three miscellaneous projects (including an industrial blower, a refrigeration system and thermoelectric chillers). We followed two procedures for these 29 projects: 1) to spot-measure the power draw of a sample of equipment that operates at one setting and then monitor the on-off operation of this equipment for at least two weeks, or 2) to directly measure power draw of a sample of equipment over two weeks.

The final project in our Custom sample was a project where an Energy Management System (EMS) was installed to control both the lighting and HVAC systems. Option D (Calibrated Simulation) was used to evaluate this project's energy savings. During our site visit we collected important data about the building, its lighting, and its HVAC systems. We also monitored the lighting, fans, and HVAC set points in this building for a period of two weeks to

see how the lighting and HVAC system is being operated by the EMS. The building was modeled using eQuest software, and the model was calibrated to pre-EMS conditions using twelve months of billing data.

Equipment Sampling

During all of our site visits, we needed to monitor a representative sample of retrofitted equipment. Before choosing equipment to monitor, we first grouped equipment by its type and its operation schedule and/or the type of building space it served. For example, all lighting fixtures that served offices on the same daily schedule were grouped together, while lighting fixtures that served other space types (warehouses, manufacturing areas, restrooms, etc.) were assigned to their own groups. We then chose a statistically significant sample of each group of equipment to monitor. The equipment sample sizes were all based on calculations for a finite population size less than 200.

The sample size (n) for the finite population (N) less than 200 was calculated using the following equation

$$n = \frac{n'}{1 + \frac{n'}{N}}$$

where n' = number of samples in an infinite population

The sample size of an infinite population, n', is found based on 80/10 confidence intervals and levels of relative precision. We calculated the sample number to achieve a precision of 10% using the following equation, and utilizing a t value of 1.282, which corresponds to a two tailed 80% confidence interval of an infinite population, where

n' = number of samples in an infinite population

$c.v.$ = coefficient of variation as set by a default value or where it is known, and

$r.p.$ = precision

$$n' = \left\{ \frac{1.282 \times c.v.}{r.p.} \right\}^2$$

In our case, the value of n' is equal to 1.282 x 0.80 / 0.10 = 10.

In preparation for each site visit, we developed a site-specific measurement and verification plan (SSMVP) that specifies the equipment to be assessed and the sample size for each group of equipment. All sample sizes were chosen using the equations above.

APPENDIX B: SURVEY DISPOSITIONS AND RESPONSE RATES

Table-B1 presents the final disposition for the contacts included in the participant and non-participant survey sample.[36] The response rates were 23% for the participant survey and 5% for the non-participant survey (computed as the number of completed interviews divided by the number of eligible respondents). The cooperation rates for the two surveys were 51% and 15%, respectively (computed as the number of completed interviews divided by the total number of eligible sample units actually contacted).

Table-B1. Participant Survey Disposition

Disposition	Participants	Non-Participants
Completed Interviews (I)	167	101
Eligible Non-Interviews	313	1,075
Refusals (R)	*151*	*515*
Mid-Interview terminate (R)	*8*	*38*
Respondent never available (NC)	*153*	*522*
Language Problem (NC)	*1*	--
Not Eligible (e)	40	495
Fax/Data Line	*5*	*19*
Duplicate Number	*5*	*8*
Non-Working	*12*	*322*
Wrong Number	*18*	*18*
Unknown Eligibility Non-Interview (U)	251	1,395
Not Dialed/Worked	*145*	*900*
No Answer	*27*	*119*
Answering Machine	*77*	*358*
Busy	*1*	*13*
Call Blocking	*1*	*5*
Total Contacts in Sample	771	3,066
Response Rate	23%	5%
Cooperation Rate	51%	15%

Source: Opinion Dynamics CATI Call Center.

The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).[37] For various reasons, we were unable to determine the eligibility of all sample units through the survey process and chose to use AAPOR Response Rate 3 (RR3). RR3 includes an estimate of eligibility for these unknown sample units. The formulas used to

[36] Not all 1,157 contacts in the sample frame were included in the sample.

[37] *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2009. http://www.aapor.org/Standard_Definitions/1818.htm

calculate RR3 are presented below. The definitions of the letters used in the formulas are displayed in the table above.

$$E = (I + R + NC) / (I + R + NC + e)$$

$$RR3 = I / ((I + R + NC) + (E*U))$$

The cooperation rate is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of participants who completed an interview out of all of the participants with whom we actually spoke. We used AAPOR Cooperation Rate 1 (COOP1), the formula for which is shown below. The definitions of the letters used in the formulas are displayed in the table above.

$$COOP1 = I / (I + R)$$

APPENDIX C: EXAMPLE OF LIGHTING SUMMARY TABLE

A summary table of all lighting measures would be a useful addition to the TRM. Table-C1 provides an example of the information that should be contained in such a table.

Table-C1. Example of Lighting Summary Table

Measure Code	Description	Retrofit or New Construction	Existing Fixtures	New Fixtures	Ballast factor	Fixture Efficiency
L10	Relamp & reballast	Retrofit	T12	HPT8	---	---
L10.1	Relamp & reballast	Retrofit	T12		< 0.85	---
L15	New fixture	Retrofit	T12	HPT8 or T5	---	---
L16	New Fixture	New	---	HPT8 or T5	---	---
L15.1	New fixture – reduced wattage	Retrofit	T12	HPT8 or T5	< 0.85	---
L20	Fluorescent Fixture with Reflectors	Retrofit or New	2L 8' T12	HPT8 or T5	---	Reflectivity >= 87%
L25	Compact Fluorescent	Retrofit or New	Incan-descent	Hardwired CFL	---	
L30	High Efficiency Fluorescent Fixtures	Retrofit	T12	HPT8	---	Prismatic >83% Parabolic > 75%
L31	High Efficiency Fluorescent Fixtures	New	---	HPT8	---	Prismatic >83% Parabolic > 75%
L30.1	High Efficiency Fluorescent Fixtures – reduced wattage	Retrofit	T8	HPT8	< 0.85	Prismatic >83% Parabolic > 75%
L32	Low Glare HE Recessed Fixtures	Retrofit	T12	HPT8 or T5	---	Glare control & > 80%
L33	Low Glare HE Recessed Fixtures	New	---	HPT8 or T5	---	Glare control & > 80%
L32.1	Low Glare HE Recessed Fixtures – reduced wattage	Retrofit	T8	HPT8 or T5	< 0.85	Glare control & > 80%
L35	Pendant Mounted Indirect Fluorescent Fixtures	New	---	HPT8 or T5/T5HO	---	Ceiling refl., uplighting & fixture eff. > 80%
L40	High Intensity Fluorescent	Retrofit	HID	HPT8 or T5/T5HO	---	> 80%
L41	High Intensity Fluorescent	New	---	HPT8 or T5/T5HO	----	> 80%