2008 New Buildings Program Impact Evaluation

Prepared for
Energy Trust of Oregon

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Executive Summary

The Energy Trust of Oregon (ETO) retained the Cadmus Group, Inc., (Cadmus) to complete an impact evaluation of the 2008 New Buildings Program, a comprehensive effort to assist owners of newly constructed or substantially renovated commercial and industrial buildings to achieve energy savings through differing tracks. The program's four tracks include: Standard Track, Custom, ENERGY STAR, and LEED. These programs are described as follows:

- The Standard TrackTrack supports prescriptive equipment measures, such as lighting, motors, HVAC, and others, typically through deemed savings and rebate values.
- The Custom Track provides incentives to reduce a building's energy use below the minimally code-compliant value. Measures usually involve more complex energy savings analysis than do prescriptive measures.
- The ENERGY STAR Track assists participants in certifying their buildings through the Environmental Protection Agency's national energy performance rating system.
- LEED Track projects receive incentives for achieving energy savings as part of certification by the U.S. Green Building Council.

The 2008 New Buildings Program was implemented by a third-party program management contractor (PMC), Science Applications International Corporation (SAIC). ETO changed management contractors beginning with the 2009 program year. As part of the changeover process, SAIC staff printed all program documentation, including forms, emails, calculations, invoices, and specification sheets. ETO staff scanned the specific documentation for each evaluated project, and provided it to Cadmus. Unfortunately, it was often difficult to identify pertinent details in the files provided, and measure calculation spreadsheets could not be replicated because the PDF files only showed the spreadsheet calculation results. Cadmus often had to contact the relevant participants, contractors, and mechanical design engineers to obtain the electronic files needed to verify energy savings. Cadmus developed a sample of the 50 largest savings projects for evaluation. The sample experienced attrition, however, primarily due to participant refusals, oversampling of a particular building type, and issues related to simulation modeling. The sample attrition details are shown in Table 7. Where possible, projects removed from the sample were replaced with similar projects. The final sample contained 48 projects, representing 68% of the total program reported savings, as shown in Table 1.

Table 1. 2008 Program and Sample Total Quantities and Reported Savings

	Total Number of Projects	Total Number of Measures	Reported Electricity Savings (kWh)	Reported Gas Savings (therms)	Reported Combined Energy Savings (MBtu)[1]
Program Total	224	1,073	33,138,094	464,905	159,591
Sample Total	48	330	21,680,726	335,236	107,498

[1] MBtu is used throughout this report to indicate million Btu.

Cadmus evaluated the program through site visits and reviews of engineering calculations and models. Site visits validated proper installation and functioning of incented equipment, and provided operational characteristics data to support engineering analysis. The Standard Track measures primarily were evaluated using industry standard algorithms. Custom measures were analyzed through algorithms, detailed calculation spreadsheet reviews, simulation modeling, and/or short-term metering. Cadmus' subcontractor, Heschong Mahone Group (HMG) analyzed differences between baseline and as-built simulation models for LEED projects. Through the impact evaluation, Cadmus identified a variety of issues reducing the program realization rate, as shown in Table 2. The total combined reported energy savings (electric and gas) represented 159,590 MBtu. Cadmus calculated the total combined evaluated energy savings to be 137, 958 MBtu, for an 86% overall realization rate (see Table 25).

Table 2. Overall 2008 Program Realization Rates and Energy Savings[2]

Measure Category	Total Number of Measures	Reported Electric Savings (kWh)	Reported Gas Savings (therms)	Ex Post Electric Savings	Ex Post Gas Savings	Electric Savings Realization Rate	Gas Savings Realization Rate
Standard Lighting	546	6,731,354	0	8,126,552	-	121%	-
Standard Motors	62	1,922,886	0	1,825,995	-	95%	-
Standard HVAC	245	1,025,395	77,860	1,091,095	92,427	106%	119%
Standard Other	56	141,343	58,090	121,344	36,858	86%	63%
Custom	64	4,454,088	116,881	4,102,231	84,274	92%	72%
Custom Gas	10	0	58,191	-	55,583	-	96%
Custom HVAC	13	3,319,194	51,034	672,075	47,228	20%	93%
Custom Lighting	52	10,961,855	0	10,205,862	-	93%	-
Custom Motor	10	1,443,220	0	493,283	-	34%	-
LEED	15	3,138,759	102,849	1,473,062	103,761	47%	101%
Total	1,073	33,138,094	464,905	28,111,498	420,132	85%	90%

Primary issues reducing realization rates included:

- Incenting measures either just met building code requirements or were standard practice.
- Variations between reported and observed equipment quantities.
- Variations between actual operating conditions and deemed prescriptive assumptions for operating hours.
- Variations between Cadmus and PMC assumptions regarding calculation variables.
- Calculation errors.

[2] All savings values listed in the impact evaluation are gross values. The calculation of a net-to-gross ratio was outside the scope of this evaluation.

- Reduced facility usage as a result of unfavorable economic conditions.[3]

Most of these issues could be resolved through more effective implementation, particularly in the area of energy code requirements. The PMC should conduct a more rigorous review of the custom analysis calculations submitted by the participant or contractor to reduce incidence of errors. In addition, several measures identified, such as demand controlled ventilation, should not have been included as prescriptive measures due to the complexity and quantity of variables required to estimate savings. Several other measures appeared to be more appropriate to move from custom to prescriptive analysis, such as ENERGY STAR clothes washers and dishwashers.

[3] In some cases, such as with demand controlled ventilation, the reduced facility usage could actually increase measure energy savings.

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MEMO

Date: November 22, 2010
To: Board of Directors
From: Sarah Castor, Evaluation Project Manager
Jessica Rose, Business Sector Manager, New Buildings Program
Subject: Staff Response to the 2008 New Buildings Program Impact Evaluation

The results of the 2008 New Buildings Impact Evaluation show that overall realization rates for electric and gas - while lower than in previous program years - are still within an acceptable range. Low realization rates for certain categories of measures – including custom HVAC, custom motors, and "standard other" – were caused mainly by a small percentage of projects with incorrect assumptions or savings calculations, rather than systematic program errors. The program has been aware of the incorrect calculation of savings for LEED projects since 2009 and calculation methods were corrected going forward when PECI took over as Program Management Contractor (PMC) at the beginning of that year.

Since the transition to the new PMC, the program has instituted several other changes, including conducting routine evaluation of measures available and coordinating with planning and evaluation on a monthly basis to make updates due to changing standards and new codes. Currently, the program is undergoing a re-design that simplifies and standardizes many processes used to calculate savings in new buildings. It should also be noted that the program re-design eliminated program tracks that are referred to by evaluators.

To insure that savings calculations are performed correctly, the program has instituted simplified calculators that streamline a number of HVAC measures, including demand control ventilation, unitary HVAC equipment, VFDs, fan power, air-to-air heat exchangers, and economizers. All project submittals receive two complete reviews for compliance with program requirements. For Standard incentives, these reviews focus on the product cut sheets and invoices. A second review is conducted on all project documentation that includes checking measures against program requirements and state energy code, and reviewing all models and calculations for modeled or calculated projects. Realization rates for 2009 projects, to be evaluated in 2011, should provide a more accurate picture of the program as it currently operates under the new PMC.

The evaluator made several specific recommendations for program improvements based on 2008 project findings (in italics) which we will address as follows:

- *Provide adequate scrutiny of calculation spreadsheets; provide a second review of savings calculations for projects exceeding a relatively high savings threshold*
  The Technical Guidelines have been greatly enhanced and clarified since 2008 and program reviews are more stringent. The 2009-2010 Program Process Evaluation findings reflect this change in feedback from energy analysts that the current review is very strict. Second reviews are completed on all projects, regardless of size. The highest scrutiny of review is applied to those measures with the largest savings. Custom (modeled) project submittals undergo two complete technical reviews by a program engineer. These technical reviews focus on :
  - Alignment between the energy model, design or construction documents, and as-built building;
  - Compliance with the program's Technical Guidelines, specifically the baseline systems modeled;
  - Standard modeling review of overall energy use by end-use and correct input of building occupancy schedules;
  - Review of incremental costs.

  In addition, all LEED projects undergo two reviews by program engineers. The LEED reviews focus on:
  - Reasonableness of claimed energy savings;
  - Review of baseline for potential fuel switching;
  - Preparation of site verification form from LEED Letter Template or building plans.

- *Confirm measure requirements relative to state code*
  Existing and new Standard Track measures are continually evaluated to ensure they exceed the Oregon energy code. Currently, the program has two sets of measures – one for projects permitted under 2007 code and one for projects permitted under 2010 code. All Custom or modeled measures are evaluated to ensure they exceed the relevant code. The Standard Track measures for each project are checked to make sure they meet program requirements. Quality assurance includes strict review of cut sheets provided by project teams, site verification upon completion for all projects receiving over $10,000 and 10% of all other projects (multiple site visits are conducted if additional verification is needed).

- *Remove incentives for LED exit signs*
  LED Exit signs were removed from the program.

- *Move demand control ventilation (DCV) projects to the Custom track*
  A more complex calculator for DCV measures has been developed as part of the HVAC calculator and will replace the Standard Track measure.

- *Maintain ENERGY STAR appliances in the Standard track*
  While track is a project level designation, and may not be changed to Standard for appliances within a Custom project, we will insure that savings and incentives are calculated in a the same manner as standard track appliance measures. Whenever possible, appliance measures are segregated out of Custom track projects and paid through the Standard measures.

- *Segregate prescriptive and custom lighting*
  The current project review process should catch redundant incentives of any measure type. In addition, the program is eliminating Standard Track lighting and shifting to only Lighting Power Density-based incentives calculated in a lighting calculator. This shift will eliminate the possibility of redundant incentives.

- *Improve consistency among measure categories*
  Evaluation will review the measure categories applied to projects and make sure they are consistent and sufficiently descriptive.

- *Require building simulation model contractors to sign release forms*
  The program is now collecting model files for all LEED and modeled projects going forward. The application terms and conditions have also been updated to specify that project owners agree to provide Energy Trust with the energy simulation models and inputs.