FINAL REPORT

2009 New Buildings Program Impact Evaluation

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Prepared by:

The Cadmus Group, Inc. / Energy Services
720 SW Washington Street, Suite 400
Portland, OR 97205
503.467.7100

Prepared for:

Energy Trust of Oregon

Executive Summary

The Energy Trust of Oregon (ETO) retained the Cadmus Group, Inc., (Cadmus) to complete an impact evaluation of the 2009 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 tracks are described as follows:

- The Standard Track supports prescriptive equipment measures, such as lighting, motors, HVAC, and others, through deemed savings.
- 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 2009 New Buildings Program was implemented by a third-party program management contractor (PMC), Portland Energy Conservation, Inc. (PECI). Participants also initiated a portion of completed projects under a previous implementer, Science Applications International Corporation (SAIC). ETO changed management contractors beginning with the 2009 program year.

Cadmus developed a sample of the 31 largest savings projects for evaluation to match the evaluation level achieved for 2008 projects. The sample experienced attrition, however, primarily due to participant refusals 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, and Cadmus added or replaced projects to maintain the same level of total evaluated savings. The final sample contained 34 projects, consisting of 316 measures, which represent 68 percent of the total program reported combined savings, as shown in Table 1.

Table 1. 2009 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	189	1,071	20,715,091	640,716	134,751
Sample Total	34	316	14,406,517	423,636	91,519

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. Cadmus evaluated

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

Standard Track measures primarily using industry standard algorithms. Custom measures were analyzed through algorithms, detailed calculation spreadsheet reviews, simulation modeling, and/or energy management system trend data. Cadmus engineers and a subcontractor, SBW Consulting, analyzed differences between baseline and as-built simulation models for LEED projects. Cadmus analyzed ENERGY STAR Benchmarking projects by examining differences between baseline and as-built energy use intensities (EUI) using utility billing data. Through the impact evaluation, Cadmus identified a variety of factors reducing the overall program realization rate, as shown in Table 2. The total combined reported energy savings (electric and gas) represented 134,751 MBtu. Cadmus calculated the total combined evaluated energy savings to be 129,201 MBtu, for a 96 percent overall realization rate (see Table 21).

Table 2. Overall 2009 Program Realization Rates and Energy Savings

Measure Category	Total Number of Measures	Reported Electric Savings (kWh)	Reported Gas Savings (therms)	Evaluated Electric Savings (kWh)	Evaluated Gas Savings (therms)	Electric Savings Realization Rate	Gas Savings Realization Rate
Standard Lighting	521	7,059,897	0	7,117,845	-	101%	N/A
Standard Motors	165	894,512	0	709,732	-	79%	N/A
Standard HVAC	250	501,223	181,551	498,784	198,372	100%	109%
Standard Other	61	189,609	18,205	216,298	22,749	114%	125%
Standard Census[2]	4	228,000	108,675	91,981	3,038	40%	3%
Custom	10	618,792	18,629	616,498	18,476	100%	99%
Custom Shell	10	181,717	75,942	40,076	84,008	22%	111%
Custom HVAC	9	3,688,784	40,213	4,133,523	20,768	112%	52%
Custom Lighting	16	1,271,887	0	1,117,040	-	88%	N/A
Custom Motor	4	125,768	0	141,955	-	113%	N/A
ESTAR	2	245,680	21,813	0	27,402	0%	126%
LEED	19	5,709,222	175,688	5,374,037	233,344	94%	133%
Total	1,071	20,715,091	640,716	20,029,136	608,621	97%	95%

* 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.

Primary factors affecting realization rates included:

- Actual operating conditions differed from deemed prescriptive assumptions for operating hours.
- Actual equipment operation patterns differed from expected patterns.
- Incented measures just met building code requirements.
- Equipment quantities observed differed from reported quantities.

[2] Cadmus evaluated the census of package terminal heat pump and tankless water heater measures in the program population. Since the census was evaluated, the achieved results were not extrapolated to the remaining program population.

The 2009 program realization rate of 96 percent represents an improvement over the 2008 program realization rate of 86 percent. Factors contributing to the higher realization rate included longer actual lighting operating hours than deemed, better performance from LEED buildings, and conservative assumptions in some deemed savings estimates. However, Cadmus also noted problematic issues with deemed savings estimates and the savings methodology for Standard Track measures, particularly package terminal heat pumps, tankless water heaters, and demand controlled ventilation. We also determined that one facility inappropriately received incentives through both the Standard and ENERGY STAR Tracks; removing the duplicative savings reduced the realization rate. Overall, the 2009 implementer performed a reasonable level of review and quality control to achieve high average project savings realization rates.

Energy Trust of Oregon
851 SW Sixth Avenue, Suite 1200
Portland, Oregon 97204

Telephone: 1.866.368.7878
Facsimile: 503.546.6862
energytrust.org

EnergyTrust of Oregon

MEMO

Date: September 30, 2011
To: Board of Directors
From: Sarah Castor, Evaluation Sr. Project Manager
Jessica Rose, Business Sector Manager, New Buildings Program
Subject: Staff Response to the 2009 New Buildings Program Impact Evaluation

The 2009 program year was one of significant change for New Buildings. In addition to the change in Program Management Contractor (PMC), the commercial new construction market experienced a significant slowdown as a result of economic conditions. Despite these challenges, the results of the 2009 New Buildings Impact Evaluation show that the program increased its electric and gas realization rates over 2008.

Since the transition to the new PMC, the program has instituted several changes, including:

- a redesign of the participation process, program tracks and incentive structures, with the goals of simplifying the program experience for participants and motivating them to make their buildings even more energy efficient
- conducting routine evaluation of measures available
- coordinating with planning and evaluation on a bi-monthly basis to make updates due to changing standards and new codes
- instituting 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, to insure that savings calculations are performed correctly
- completing two reviews on all project submittals for compliance with program requirements
- reviewing all models and calculations for modeled projects
- correcting the calculation of savings for LEED projects
- modifying the ENERGY STAR offer.

The evaluator made several specific recommendations for program improvements based on 2009 project findings (in italics) which we have already addressed, many as part of the 2010 program redesign, or will address as follows:

- *Remove incentives for LED exit signs*
  LED Exit signs were removed from the program in the second quarter of 2009.

- *Calculate lighting savings through lighting power density*
  An LPD based lighting tool was deployed with the program redesign beginning in the third quarter 2010. Projects under the 2010 code and/or after the program redesign must use the LPD calculator tool, while projects under the 2007 code can use standard measures.

- *Move demand control ventilation (DCV) projects to the Custom track*
  The program adopted a calculated savings approach to standard HVAC measures with the program redesign and deployed a comprehensive HVAC calculator (much like the lighting calculator the program has seen success with). This calculator includes DCV measures that replace the standard ones.

- *Review and revise deemed estimates for package terminal heat pumps (PTHPs), tankless water heaters, condensing tank water heaters, VSDs, and occupancy sensors*
  Energy Trust will review condensing tank water heater measures for the program. Actions have already been taken for the following measures:
  - PTHPs – savings were lowered to 1,000 kWh in December 2010.
  - Tankless water heaters – savings were updated in October 2010 which corrected an error in the incentive calculation that caused the unreasonably high savings estimate.
  - VSDs – savings and incentives are now calculated through the HVAC calculator
  - Occupancy sensors – fixture-mounted occupancy sensors were added in February 2010; the 2010 lighting calculator tool calculates savings for occupancy sensors based on the number of fixtures controlled, whereas the prior calculator did not account for all fixtures controlled leading to under-claimed savings

- *Obtain energy simulation models during program year*
  Since the last evaluation report in late 2010, the program began collecting model files for all LEED and modeled projects. The application terms and conditions were updated to specify that project owners agree to provide Energy Trust with the energy simulation models and inputs as a condition of incentive payment.

- *Avoid combining ENERGY STAR buildings with other tracks*
  During the time the 2009 ENERGY STAR offer was available, it was limited to standard customers only. The reason was that savings opportunities were available beyond what was achieved though the installation of standard measures that could be captured through

ENERGY STAR requirements and review by a professional engineer. With the 2010 program redesign, ENERGY STAR was significantly modified: savings are no longer claimed through this track because they are difficult to verify, and incentives were significantly reduced from the original $25,000 potential to the revised $1,000 - $3,000 depending a building's score. The intent of the revised ENERGY STAR offer is to provide modest support for post-occupancy monitoring and behavior change while the program develops new approaches that serve a broad market and are verifiable. New opportunities through commissioning, acceptance testing, metering and reporting are now developing with program experience and the Path To Net Zero pilot.