# EVALUATION OF BUILDING EFFICIENCY PROGRAM 2004 & 2005

**Final Report**

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***Prepared for:***

**Energy Trust of Oregon**

***Prepared by:***

**ADM Associates, Inc.**
**3239 Ramos Circle**
**Sacramento, CA 95827**
**916-363-8383**

# EXECUTIVE SUMMARY

This report presents the results of the impact evaluation of the Building Efficiency (BE) Program that Energy Trust of Oregon (Energy Trust) offered for commercial buildings in Oregon during 2004 and 2005.

The main features of the approach used for the impact evaluation are as follows:

- Data for the study have been collected through interviews with BE program staff, review of program materials and processes, on-site inspections, end-use metering, and interviews with participating firms. Based on data provided by Energy Trust, sample designs were developed for on-site data collection for the impact evaluation and for the telephone survey to collect decision-making information for the net-to-gross analysis (and process evaluation). Sample sizes were determined that would provide savings estimates for the BE Program with ±10 precision at the 90% confidence level.
- On-site visits were used to collect data for savings impacts calculations, while telephone surveys provided the information for the net-to-gross analysis and process evaluation. The on-site visits were used to verify installations and to determine any changes to the operating parameters since the measures were first installed. Facility staff were interviewed to determine the operating hours of the installed system and to locate any additional benefits or shortcomings with the installed system. For some sites, monitoring of lighting, HVAC equipment, or motors/VFDs was conducted to obtain more accurate information on hours of operation. Table ES-1 shows the sample sizes for these various types of data collection. The 67 sites visited from the 2004 BE program accounted for about 77% of expected kWh savings and 44% of expected therm savings for program year 2004. The 80 sites visited from the 2005 BE program accounted for about 56% of expected kWh savings and 60% of expected therm savings for program year 2005.

*Table ES-1. Sample Sizes for Data Collection Efforts*

| ***Type of Data Collection*** | ***2004*** | ***2005*** |
|---|---|---|
| Project file review | 132 | 207 |
| Participant site visits | 67 | 80 |
| Short-term metering: | | |
| HVAC | 6 | 6 |
| Lighting | 17 | 16 |
| Motors | | 2 |
| VFD | 3 | 4 |
| Custom building | 3 | |
| Survey of participant decision makers | 52 | 90 |

The major findings and recommendations from the study of the 2004 and 2005 BE projects were as follows.

- Discrepancies between expected and verified savings were examined on a site-by-site basis for a sample of projects.
  - For lighting projects, the examination of individual sites focused on major discrepancies between expected and verified energy savings that could be attributed to (1) differences in the operating hours for the areas where the energy efficiency light fixtures were installed and (2) the use of fixture wattages that can be inconsistent from project to project. Data on operating hours for lighting were verified using monitored data, information obtained by interviewing facility personnel, and some physical evidence (e.g., posted operating hours of the facility). The monitored data revealed that in a majority of cases the difference between monitored and expected operating hours was at or less than 10% of the expected operating hours. Based on these results, it was concluded that the expected operating hours are highly consistent with the actual operating hours at the site.
  - For HVAC, Building, and VFD measures, most discrepancies were found where engineering calculations were used to estimate the energy savings in lieu of modeling, especially for those projects where weather data was not used as the basis of calculations. In such instances, very broad assumptions were made, which may not be applicable or consistent year round. However, discrepancies of more than 10% were found in 16 out 51 sites where HVAC, Building, Motor and VFD projects were implemented, and the majority of these discrepancies fall within the plus and minus 10-30% range. The source of discrepancies cannot be generalized for these measures. However, it is recommended that all of the measures other than lighting projects be reviewed and analyzed on a case-by-case basis.
  - Estimated realization rates for gas-saving 2005 BE projects, realization rates were lower than the realization rates for 2004 gas-saving projects or for electric-saving projects. Most of the gas-saving projects with lower realization rates were projects in which custom measures were installed to save gas. Because the measures were custom, the reasons for the lower realization rates differed case by case and no general reasons provide a complete explanation. However, in several cases it did appear that the heating usage estimated in this study through DOE-2 simulations was somewhat higher than had been used in developing the *ex ante* expected savings for the measures.
- Analysis of billing data for a set of participants confirmed the engineering analyses in showing that reductions in electric and gas usage occurred after energy efficiency measures were installed. However, the analysis of electricity billing data showed reductions, particularly for larger users, that were larger than expected, suggesting that other factors were also working to reduce energy use. The analysis of gas billing data showed reductions in gas usage that were consistent with but somewhat lower than the reductions estimated through the engineering analysis.
- In general, the monitoring performed for the 2004 and 2005 projects resulted in confirmation of the expected energy savings.

- The monitored data for lighting projects revealed that on average, the monitored data are consistent with the claimed hours.
- The monitored data for Building, HVAC and VFD projects confirmed the expected variation in operating loads introduced by the addition of the energy efficient hardware and/or improved control system.

- Although the monitored data are not used in the savings calculations for HVAC categories, which rely more on DOE-2 modeling, they serve as a good confirmation that the monitored system is operating as intended (e.g. HVAC, lighting or other building system). It is recommended that for the next evaluation, monitoring be performed whenever possible for all measures as an additional confirmation that the system is functioning properly, especially where an Energy Management System that provides data trending is not available.

Gross savings were estimated using proven techniques, including engineering calculations using industry standards and verification of computer simulations developed by program contractors to determine energy savings.

Survey-based techniques for estimating free-ridership in a program were applied to the data collected through a telephone survey of decision-makers. Data collected through this survey were also used to assess qualitatively the extent of program spillover effects.

The results of the impact evaluation of the Building Efficiency Program for 2004 and 2005 are summarized in Table ES-2.

*Table ES-2. Summary of kWh and Therm Savings and kW Reductions for Building Efficiency Program in 2004 and 2005*

| | ***Expected Gross*** | ***Realization Rate*** | ***Achieved Gross*** | ***Net-to-Gross Ratio*** | ***Achieved Net*** |
|---|---|---|---|---|---|
| | | | *2004* | | |
| kWh savings | 37,499,950 | 98.9% | 37,082,583 | 84.1% | 31,191,919 |
| Therm savings | 85,529 | 94.5% | 80,821 | 64.7% | 52,291 |
| kW reductions | Not available | Not applicable | 6,213 | 84.1% | 5,226 |
| | | | *2005* | | |
| kWh savings | 56,462,658 | 104.4% | 58,967,894 | 79.8% | 47,076,661 |
| Therm savings | 442,955 | 75.4% | 334,028 | 94.7% | 316,325 |
| kW reductions | Not available | Not applicable | 18,183 | 79.8% | 14,516 |