TETRA TECH

Subject **Focus on Energy Evaluation**

Review of Historic Energy Savings from the Home Performance with ENERGY STAR® Program

To Carol Stemrich,
Public Service Commission of Wisconsin

cc Monica Curtis and Sara Van de Grift,
WECC

From Laura Schauer,
Tetra Tech

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The Home Performance with ENERGY STAR® (HPWES) program has operated since the inception of the Focus on Energy program (Focus). During this time, however, the deemed savings values associated with home insulation measures have changed and the offerings of the program have altered significantly.

As originally conceived, the program primarily included home envelope or "shell" measures along with water heating and HVAC measures. In 2007, heating and cooling measures were shifted into a new program—the Efficient Heating and Cooling Initiative (EHCI). In another significant change, evaluation findings in 2006 reduced the deemed energy savings associated with shell measures.[1] These changes in the program concept and savings values have made it more difficult to track the energy savings performance of HPWES over time in a consistent way.

This memo reviews the energy savings trends related to HPWES. The analysis shows that although HPWES is a comprehensive program, customers are primarily choosing to install shell measures. The majority of kWh savings are achieved through insulation measures. The therms savings follows a similar trend with the inclusion of air sealing, which comprises approximately 25 percent of the program savings each year. The incidence of heating and cooling measures is relatively low compared to the shell measures.

The remainder of this memorandum provides the analysis methodology, which documents data sources and assumptions that affect the analysis, followed by a section documenting participation counts and per participant savings. The memo concludes with a measure level analysis.

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Analysis Methodology

This analysis uses two WECC program data sources for analysis: the HPWES program database and the EHCI database, which is used to capture heating and cooling measures associated with HPWES participants who are not captured within the HPWES program database. To estimate the energy savings, we use the variables "kWhSaved," "kWSaved," and "ThermSaved." These savings values are unadjusted in this analysis (e.g., by net-to-gross ratios).

Much of the analysis within this memorandum is done by year. We had two options when defining the year variable: we could run analysis by program year (which includes the 18-month contract period) or by calendar year. Because it was difficult to do comparative analysis using the 18-month contract period, we decided to define our year variable using calendar year. Additionally, WECC calculated their participation counts by calendar year. Using the same period allowed us to verify counts more easily. We did, however, create a program year variable should the PSCW prefer to see analysis by program year.

The analysis eliminated a number of cases form the HPWES data file. We forwarded to WECC an email requesting confirmation that eliminated these cases was appropriate. We can easily rerun the analysis should we determine the cases with the following conditions should be included.

- **HVAC only participants removed.** The HPWES participant database primarily associated participants within two classifications: HVAC and whole house (database field: *MeasureGrouping*). There were over 40,000 records flagged as HVAC participants that received only heating or cooling measures did not have a pre or post assessment. These cases represent approximately 85 percent of the participant population in the HPWES dataset. We eliminated participants that only received HVAC measures with no pre or post assessment from the analysis. It is not necessary to receive a post test when only HVAC measures are installed; however, discussions with WECC and a comparison of the participant counts reported by the program confirmed these cases should be removed. This analysis includes participants classified as whole house participants, including 129 cases that are also flagged as HVAC participants.
- **Measures removed.** A number of measures, as captured in the field *MeasureDescription*, were removed from the analysis. These measures, which were consistently not associated with a pre or post assessment or rating, are "kit" and "high pressure sodium lighting."

Participation and Average per Participant Savings

The program data provides participation information since 2001. Table 1 documents the number of participants with energy savings, along with the total energy savings in kWh, kW,

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[1] Tom Talerico and Rick Winch, Glacier Consulting Group, LLC. *Focus on Energy Evaluation: FY05 Savings Adjustments for Home Performance with Energy STAR® Insulation Measures.* July 14, 2006.

and therms by year. As the table shows, the participation counts varied by year, but in general increased through 2006, then jumped again in 2009 to a record 1,800 participants.

Table 1. Annual Participant Count and Savings

Calendar Year	Participant Count	kWh Saved	kW Saved	Therms Saved
2001	39	36,112	12	13,386
2002	188	215,579	73	81,105
2003	633	678,376	246	305,157
2004	955	934,577	373	444,292
2005	769	776,221	339	389,109
2006	1,017	750,197	356	462,319
2007	861	354,890	211	265,839
2008	981	441,635	242	308,797
2009	1,843	809,112	446	588,188
Total	**7,286**	**4,996,698**	**2,298**	**2,858,193**

The energy savings do not trend linearly with the participant count. As Figures 1 and 2 illustrate, the average therms savings values per participant steadily increased from 2001 through 2005, then began decreasing from 2006 through 2009. The average kWh savings reached its peak in 2002 and began decreasing steadily with a rapid drop between 2006 and 2007.

Figure 1. Average kWh Savings per Participant by Year

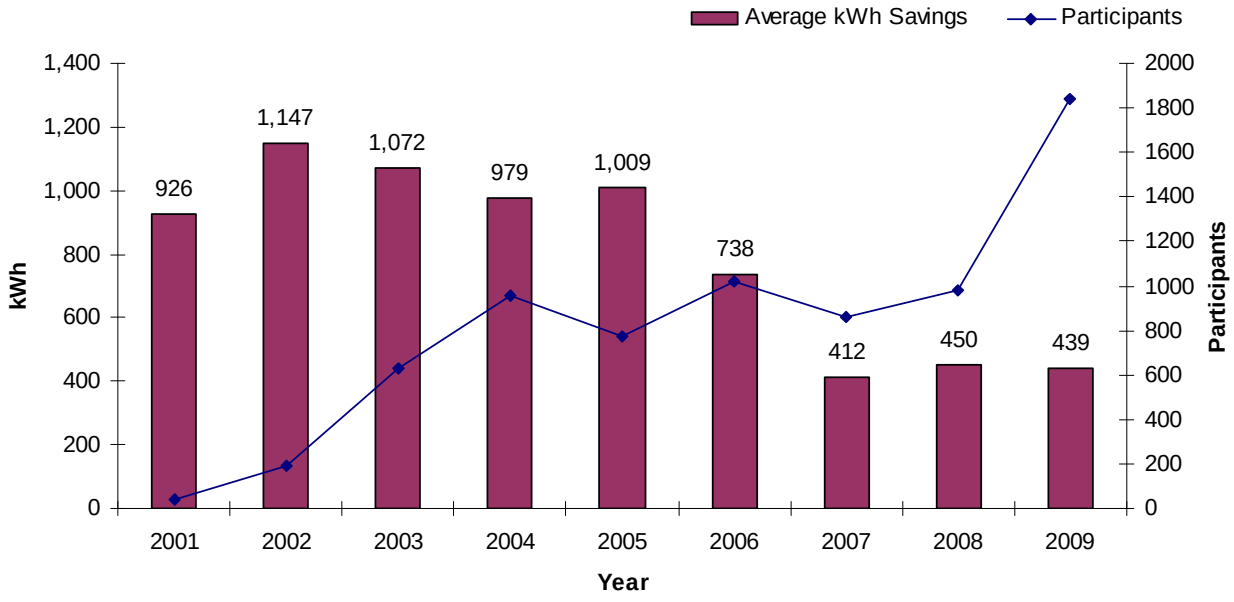
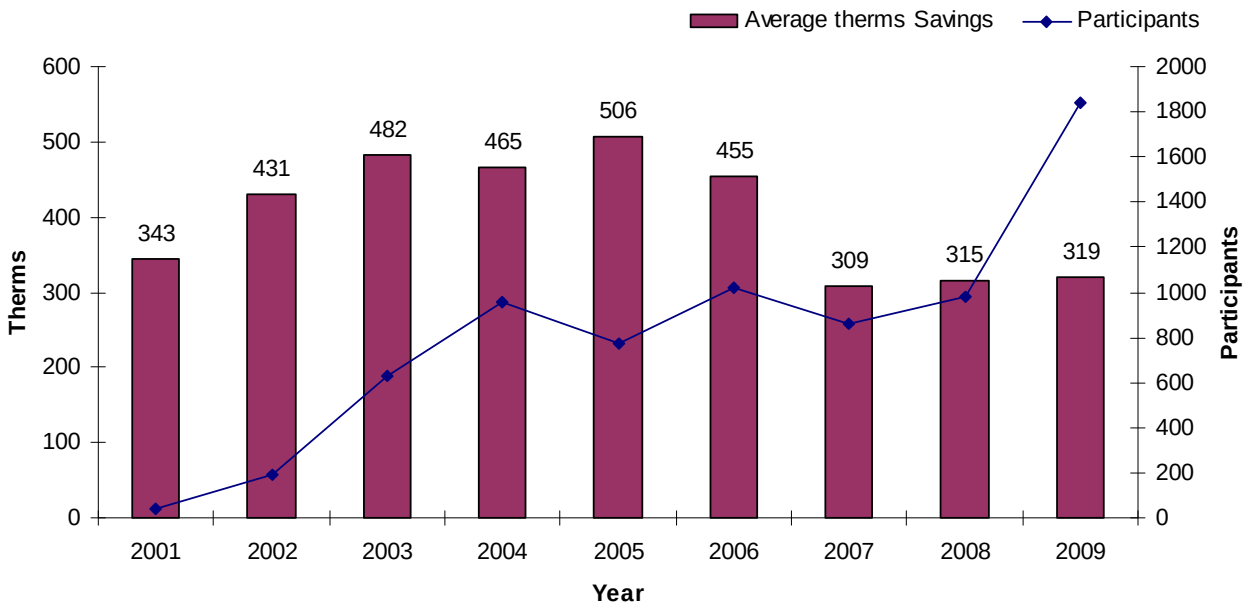


Figure 2. Average Therms Savings per Participant by Year



Note that in July 2006, the evaluation team recommended that the deemed savings for insulation measure be reduced.[2] Table 2 presents the revisions in the kWh savings, which were applied to participants in Fiscal Year 2005 (FY05) and onward.

The most significant changes in values were for sidewall insulation. The revised therms savings were 55 percent of the original value; the revised kWh savings were 29 percent of the original value. These changes are clearly reflected in the decrease in average therms and the even more significant decrease in average kWh savings per participant by year. The average savings levels off after 2006; deemed savings did not shift after this year.

Table 2. Revised Energy Savings by Measure

Measure	Previous Therms	Previous kWh	Revised Therms	Revised kWh
Attic Insulation	121	328	100	160
Sidewall Insulation	411	1,113	225	326
Foam Sidewall 1/8" Insulation	13	35	7	10
Foam Sidewall 1/4" Insulation	25	67	14	20
Foam Sidewall 1/2" Insulation	45	122	25	36
Foam Sidewall 1" Insulation	76	207	41	60
Floor Insulation	96	259	79	126
Sill Box Insulation	48	110	39	53
Interior Foundation Insulation	257	590	140	172
Exterior Foundation Insulation	89	204	49	59

[2] Tom Talerico and Rick Winch, Glacier Consulting Group, LLC. *Focus on Energy Evaluation: FY05 Savings Adjustments for Home Performance with Energy STAR® Insulation Measures.* July 14, 2006.

Measure-level Analysis

This section documents the measure-level analysis. We classified the measures into six categories. The categories are:

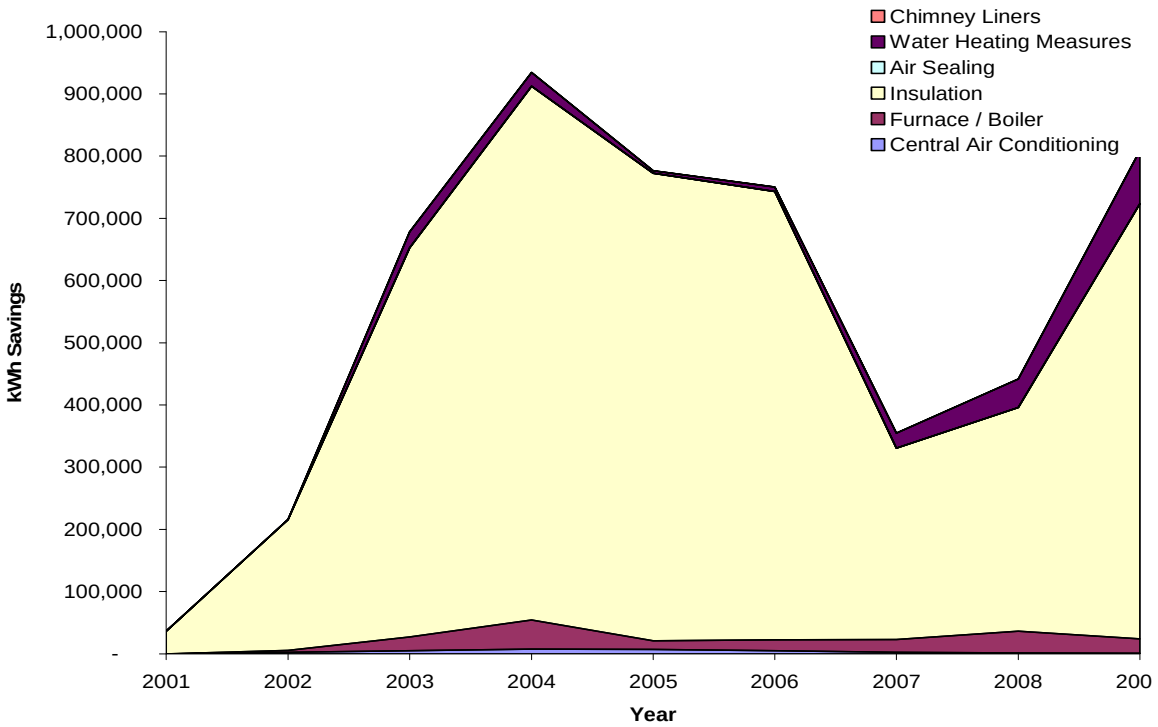
1. Central air conditioners
2. Furnaces and boilers
3. Insulation (attic, wall, sidewall, sill box, and foundation insulation)
4. Air sealing
5. Water heating measures (water heater replacements and repairs)
6. Chimney liners.

We first show the total savings by measure category, followed by a review of the percentage of annual savings resulting from each measure category. Because insulation comprises a significant portion of the savings throughout all years, we also document the installation trends by insulation type.

Total Savings by Measure Category

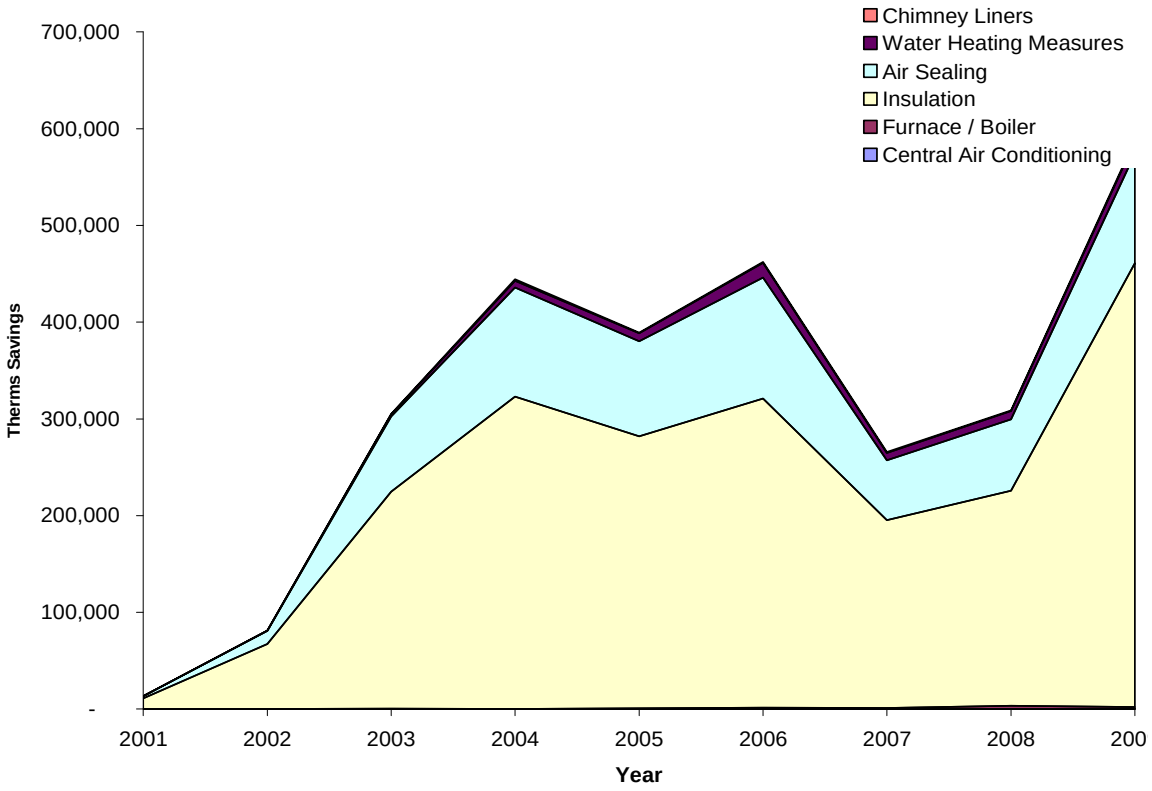
Figures 3 and 4 illustrate the total program savings by measure category. As is apparent through this visual representation of the savings, insulation measures comprise the majority of the program's kWh savings across all program years.

Figure 3. Total kWh Savings by Measure Category by Year



Insulation continues to be a strong savings driver when reviewing the therms savings by measure category; however, air sealing has increasingly become a more significant part of the program since in 2004. Furnace measures are a relatively insignificant component of the program.

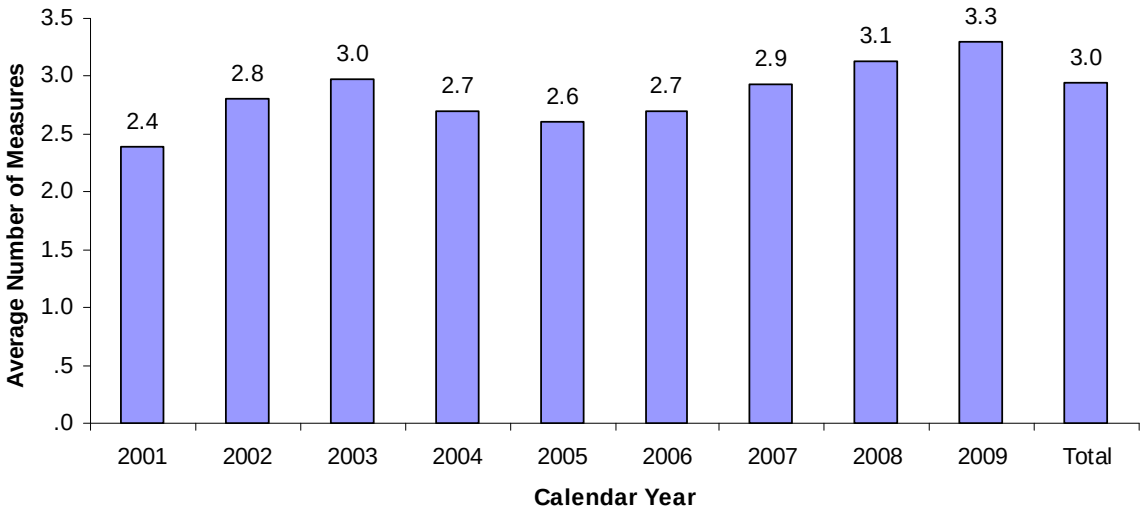
Figure 4. Total Therms Savings by Measure Category by Year



There was some, though not significant, variation in the average number of measures installed in each participant's home. The lowest average number of measures was in 2001, when the program installed an average of 2.4 measures per household (all of these households received insulation measures, but different types of insulation measures). The highest number of average installations per household was in 2009, when the program rebated an average of 3.3 measures per participant (Figure 5).

The average numbers of measures per participant is lower than what WECC reports. This discrepancy is due to the level at which we aggregated the measure data. This analysis aggregates the data to a measure group level, then counts the measure groups, compares to WECC's analysis, which does not aggregate the data to a measure group level. For example, we only classify sidewall insulation as one measure in this analysis whereas WECC captures sidewall installations as three separate measures (cavity, foam insulation R3, and foam insulation R5).

Figure 5. Average Number of Measures Installed by Year
(*Insulation Measures Types are Accounted for Separately, not as one category)*



Percentage of Savings by Measure Category

A review of the percentage of yearly savings by measure category tells the same story as the above figures but in a slightly different manner. Table 3 presents the percentage of kWh savings represented within each measure category by year. Nearly all savings are from insulation measures up through 2007. In 2007, 2008 and 2009 water heating measures began increasing in relative kWh savings; however, this shift in savings is related to a reduction in participants receiving the measure more so than an increase in installations.

Table 3. Percentage of kWh Savings by Year within Measure Categories

Calendar Year	Central Air Conditioning	Furnace or Boiler	Insulation	Air Sealing	Water Heating Measures	Chimney Liners
2001	0%	0%	100%	0%	0%	0%
2002	1%	2%	97%	0%	0%	0%
2003	1%	3%	92%	0%	4%	0%
2004	1%	5%	92%	0%	2%	0%
2005	1%	2%	97%	0%	0%	0%
2006	1%	2%	96%	0%	1%	0%
2007	1%	6%	87%	0%	7%	0%
2008	0%	8%	81%	0%	10%	0%
2009	0%	3%	86%	0%	11%	0%

Table 4 details the percentage of therms savings by year within each measure category. As seen below, air sealing is also a significant contributor to the program's therms savings; in fact, nearly a quarter of the therms savings claimed by the program are through air sealing measures.

Table 4. Percentage of Therms Savings by Year within Measure Categories

Calendar Year	Central Air Conditioning	Furnace or Boiler	Insulation	Air Sealing	Water Heating Measures	Chimney Liners
2001	0%	0%	83%	17%	0%	0%
2002	0%	0%	83%	17%	0%	0%
2003	0%	0%	73%	26%	1%	0%
2004	0%	0%	73%	25%	2%	0%
2005	0%	0%	72%	25%	2%	0%
2006	0%	0%	69%	27%	3%	0%
2007	0%	0%	73%	23%	3%	0%
2008	0%	1%	72%	24%	3%	0%
2009	0%	0%	78%	19%	2%	0%

Review of Insulations Installed

The following analysis presents the percentage of households that received various insulation types by year. As illustrated above, insulation is a significant component of the program's savings. This analysis shows that insulation installations have been fairly consistent across all years, with attic insulation being installed over three-quarter of homes each year, followed by sidewall insulation (Table 5).

Table 5. Percentage of Participants Receiving Insulation Measures by Insulation Type

Calendar Year and Population Size	Attic Insulation	Floor Insulation	Foundation Insulation	Sidewall Insulation	Sill Box Insulation
2001 (N=39)	79%	0%	5%	44%	18%
2002 (N=188)	89%	10%	8%	53%	29%
2003 (N=633)	84%	11%	15%	51%	41%
2004 (N=955)	82%	10%	12%	42%	25%
2005 (N=769)	82%	13%	12%	46%	7%
2006 (N=1,017)	79%	13%	14%	45%	16%
2007 (N=861)	76%	14%	17%	47%	41%
2008 (N=981)	80%	18%	20%	43%	48%
2009 (N=1,843)	84%	18%	25%	44%	62%