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**Subject** Focus on Energy Evaluation

**Recommendations for Targeted Home Performance with  
ENERGY STAR Energy Impacts**

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**To** Oscar Bloch,  
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**cc** Suzanne Harmelink,  
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contributed critical review and analysis

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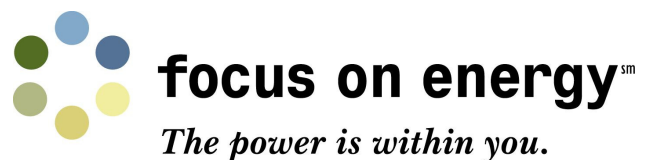
## Overview

The objective of this memo is to present the results of the analysis of Targeted Home Performance with ENERGY STAR (THP) savings over time and to recommend updated THP home energy impacts.

THP energy impacts are based on whole house savings for a program-served home. The basis of the reported energy impacts is a billing analysis of fiscal year (FY) 2002–2004 THP-served home<sup>1</sup>. Evaluators conducted the billing analysis in FY2004.<sup>2</sup>

The FY2004 billing analysis is the best estimate available for THP given the fact that it is based on actual billing data; however, the analysis was based on served homes in the first three years of the program. Additionally, the billing analysis does not capture any modifications to measure installation practices that may have taken place after FY2004, such as the addition of measures, increase or decrease of incidence of measures being installed, or increase in the number of certain measures being installed (e.g., CFLs).

This issue was raised in 2005 and evaluators reviewed THP's program tracking data to identify any programmatic changes and resulting modifications in per home savings to the FY2004 billing analysis. The analysis compared the average home savings per the deemed savings



<sup>1</sup> A home is counted as a one dwelling unit (i.e. a duplex counts as two homes).

<sup>2</sup> Lark Lee, Pamela Rathbun, and Laura Schauer, PA Government Services, Inc. *Low-income Public Benefits Evaluation Year 3 Low-income Program Evaluation—Volume III. Other Evaluation Deliverables: Technical Appendices D–H, Appendix F*, September 17, 2004.

reported by the program during the period of the impact analysis against the results of the billing analysis. From this comparison, evaluators recommended an adjustment factor, or realization rate, which accounted for the difference in the deemed savings and billing analysis while taking into consideration the additional measures installed through the program not included in the billing analysis.

This adjustment factor was then applied to the deemed savings reported by the program in subsequent program years. This approach allowed THP energy impacts to be based on the findings of the billing analysis, yet still recognized changes the program has made to increase savings per home. The reader is referred to the memorandum *Recommendation Adjusting Targeted Home Performance Energy Impacts* dated June 20, 2005, for a detailed discussion about this analysis.

The program has continued to make minor program modifications since 2005. In 2008, the PA evaluator, THP program manager, and the Public Service Commission of Wisconsin (PSCW) evaluation manager discussed and decided that the FY2004 billing analysis was still the best estimate of program savings since the program was still essentially the same in its approach and targeted the same customer segment. However, it was also agreed that an updated analysis of program measures was needed to capture changes in the program since 2005.

Based on the analysis detailed in this memorandum, evaluators recommend that the deemed savings per home in the THP program be updated to 1,636 kWh savings and 269 therms. This is an increase from the current per home values of 1,192 kWh and a slight decrease from the 295 therms being reported based on the 2005 memorandum.

For the electric impacts, the number of CFLs per home has risen dramatically and accounts for much of the increase in electric impacts. For the gas impacts, the changes have not been as significant.

## Approach

The updated per-home deemed savings values recommended in this memo largely follow the same approach as in 2005. The deemed savings values are compared to the billing analysis results to identify the realization rate, which is then applied to each program year's data. Additionally, evaluators reviewed the measures installed in the period of the billing analysis and determined any program modifications that would affect savings in subsequent program years.

There were two significant differences since the 2005 analysis.

1. While the program still tracked the measures installed in each home, the database no longer recorded savings values for those measures.
2. The deemed savings values for many of the measures had been updated through ongoing evaluation research and in response to requests for review of deemed savings values.

To address these issues, the deemed savings values currently being used in other program evaluations (current deemed savings values) were applied to all measures across all program years. This approach ensured that the savings values were consistent across the years and allowed a more accurate picture of changes in the program over time.

The updated measure level deemed savings values required the calculation of updated realization rates for the billing analysis home. These updated realization rates were then applied to the average per home savings in FY08 to derive updated deemed per home savings. This approach was chosen as a tradeoff for the additional costs of conducting a billing analysis.

The remainder of this memo provides more details on the analysis. This is followed by analysis of the trends in electric and gas savings for THP home, discussion about what is driving the trends, and data showing the trends in the percentage of participating homes receiving each measure.

## Realization Rate Analysis

Table 1 presents per home impacts using three sources. (1) The original deemed savings values recorded in WECC's tracking system, (2) the *current deemed savings values* for the measures implemented in THP as being used in other Focus Residential programs (i.e., Efficient Heating & Cooling Initiative & Home Performance with ENERGY STAR), which are applied to all measures in the program database regardless of when the measures were installed, and (3) the billing analysis reported in FY2004. Only measures included in the billing analysis (program period FY2002 through FY2004) are included in the analysis.

The realization rate is calculated as the ratio of savings per billing analysis to the current measure level deemed savings. As the data shows, the realization rate is 86 percent for electric impacts and 58 percent for the gas impacts.

While the deemed savings from the 2005 analysis is not pertinent for this reporting, it is interesting to review how that analysis compares to the current deemed savings analysis. The realization rate using the current deemed values is significantly higher than the rates reported in the 2005 analysis when the realization rates were 54 percent for electric impacts and 44 percent for gas impacts. This change indicates that the current deemed savings values more closely reflect the savings values being realized by participating homes as determined by the billing analysis.

**Table 1. Comparison of Realization Rates for Billing Analysis Home Using Original Tracking System Measure Level Deemed Values (2005) and Current Measure Level Deemed Values**

	Per Home Savings			Realization Rate Against Deemed Values from 2005 Analysis	Realization Rate Against Current Deemed Values
	Deemed Values Reported in 2005 Analysis <sup>3</sup>	Current Deemed Values <sup>4</sup>	Billing Analysis		
<b>kWh</b>	1,495	932	806	54%	86%
<b>Therms</b>	596	454	262	44%	58%

The next step is to apply the realization rates using the current deemed values to the FY2008 program data to come up with a per home savings value. An average per home savings is determined for FY2008 by applying the current deemed savings values to all measures and dividing the sum of those savings by the number of homes served. The realization rate (86 percent electric and 58 percent gas) is then applied to the per home savings to yield the adjusted home impacts.

As Table 2 illustrates, applying the realization rate against the current per measure deemed savings values results in deemed per home impacts of 1,636 kWh and 269 therms. This is an increase from the 1,192 kWh and a decrease from the 295 therms being reported for THP as a result of the 2005 analysis. This analysis is based on the FY2008 values.

**Table 2. Analysis of FY2008 per Home Savings (Based on 455 Homes)**

	Per Home Savings		
	Average Per Home Savings Using Current Deemed Savings	Realization Rate	Adjusted Average Per Home Savings
<b>kWh</b>	1,902	86%	1,636
<b>Therms</b>	464	58%	269

## Trends in Average Savings per Home

Table 3 shows estimated THP savings based on deemed savings from FY2002 to FY2008. The kWh savings per home has increased by 16.6 percent from 1,604 in FY2005 to 1,902 in FY2008. The current deemed savings values are used for this analysis.

Even though overall FY2008 savings are higher than FY2005, the deemed savings values were the highest in FY2006. FY2008 is down by one percent from FY2007 and eleven percent from FY2006.

<sup>3</sup> WECC-reported values are the energy savings for the measures installed recorded in WECC's tracking database at the time the sample billing analysis sample was extracted.

<sup>4</sup> "Current Deemed Values" applies the most recent deemed savings to the measures installed in homes of the billing analysis home. This was done to allow year-to-year comparisons of energy impacts to be made without having to account for changes in the deemed values being applied.

**Table 3. kWh Savings using Current Deemed Values**

	Home	Gross kWh	Savings Per Home
<b>FY02</b>	13	9,961	766
<b>FY03</b>	127	103,991	819
<b>FY04</b>	299	437,450	1,463
<b>FY05</b>	228	365,798	1,604
<b>FY06</b>	292	626,422	2,145
<b>FY07</b>	337	648,542	1,924
<b>FY08*</b>	338	642,969	1,902
<b>PTD</b>	1,634	2,835,133	1,735

\*through June 30, 2008

Table 4 shows estimated therms savings based on current deemed values. The therm savings per home based on current deemed values did not change significantly from FY2005 to FY2008. However, similar to electric savings, the trend analysis shows the savings increased in FY2006 and FY2007 and then decreased somewhat in FY2008<sup>5</sup>. The program reported an increase in numerous gas-related measures or services being provided to participating homes, which are highlighted in the measure-specific gas savings analysis later in this memo.

**Table 4. Therm Savings using Current Deemed Values**

	Home	Gross Therms	Savings Per Home
<b>FY02</b>	18	6,907	384
<b>FY03</b>	185	61,529	333
<b>FY04</b>	319	133,026	417
<b>FY05</b>	237	109,748	463
<b>FY06</b>	294	148,375	505
<b>FY07</b>	339	173,025	510
<b>FY08*</b>	340	157,898	464
<b>PTD</b>	1,732	790,509	456

\*through June 30, 2008

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<sup>5</sup> One of the explanations for the somewhat lower therms savings in FY08 may be the policy shift that homes with a primary heating bulk-fuel type (e.g., lp/oil/wood) are no longer eligible for the program.

Table 5. Savings using Current Deemed Values

	Homes	Gross kWh	Gross Therms	kWh Savings per Home	Therm Savings per Home
FY02	7	9,961	6,907	1,423	987
FY03	147	103,991	61,529	707	419
FY04	305	437,450	133,026	1,434	436
FY05	244	365,798	109,748	1,499	450
FY06	311	626,422	148,375	2,014	477
FY07	362	648,542	173,025	1,792	478
FY08*	352	642,969	157,898	1,827	449
PTD	1,728	<b>2,835,133</b>	<b>790,509</b>	1,641	457

\*through June 30, 2008

Note: Home for FY02 thru FY04 were provided by WECC.

## Measure-specific Trend Analysis

The graphs and tables at the end of this memorandum (Figures 1 through 4 and Tables 6 through 9) illustrate how the incidence of installation of measures has changed over the years. The analysis below summarizes those trends and indicates which measures changes appear to have had the most impact on the THP electric and gas savings. As the summary shows, there is a shift in the percentage of homes receiving specific measures, which affects the savings resulting from the program.

### *Electric measure trends*

Several measures were installed more frequently in FY2008 than in FY2005, which are contributing to the higher kWh savings in FY2008. Highlights of this electric measures analysis are as detailed below. Only the most significant contributors to the shift in savings are listed below. While the program added other new electric saving measures during this timeframe such as freezers, which are installed in 10 percent of homes, their overall impact on savings was not substantial so they are not listed below.

- CFLs have the most impact on the kWh savings.
  - CFLs are the major contributor to FY2008 impact numbers. On a per home basis, CFLs contributed an estimated 546 kWh annual savings in FY2005 compared with 996 kWh annual savings in FY2008
  - The percent of homes receiving a CFL in the program did not change from FY2005 to FY2008. However, there was an increase in the number of bulb installations per home. In FY2005, 13.6 bulbs per home were being installed where as in FY2008 it increased to 24.8 bulbs per home.

- “Other insulation<sup>6</sup>” was installed in more homes in FY2008 than in FY2005 (39 percent of homes received other insulation in FY2005 and 55 percent of homes received other insulation in FY2008). This resulted in an additional 32 kWh average per home savings.
- SEER 14 Central A/C Replacement measure has increased from FY2005 to FY2008, where no home received the measure in FY2005 and seven percent of home received the measure in FY2008. The program shifted from SEER 13 to SEER 14 Central A/C Replacement during this timeframe.

Fewer homes received the following electric-related measures.

- Fewer homes received sidewall insulation in FY2008 than in FY2005. The number of homes receiving sidewall insulation was 41 percent in FY2005 compared with 26 percent in FY2008. This decrease resulted in a reduction of per unit savings of 48.6 kWh between FY2005 and FY2008.

### **Gas measure trends**

The program reported an increase in numerous gas-related measures or services being provided to participating homes. Highlights from these measures and/or services are as detailed below. Again, only the most significant contributors to the shift in savings are listed.

- Duct sealing, other insulation, and repair are most significant contributors to the increased therms savings when comparing FY2005 to FY2008.
  - Duct sealing has seen a significant increase in participation from 6 percent in FY2005 to 59 percent in FY2008. This resulted in an average per home increased savings of 19 therms.
  - Insulation repair has seen an increase in participation from 3 percent in FY2005 to 9 percent in FY2008. This increase resulted in an average per home increase in savings of 14 therms.
  - Other insulation was installed in 33 percent more homes in FY2008. Just over a third (37 percent) received the measure in FY2005 and just over half (55 percent) received the measure in FY2008. As with repair, this measure resulted in an average per home increase of 14 therms.
- Attic insulation, blower door guided infiltration reduction, and programmable thermostats also contributed additional therms savings, although the increase savings were smaller relative to the above-mentioned measures.
  - Attic insulation was installed in 81 percent of homes in FY2005 and 88 percent of homes in FY2008.

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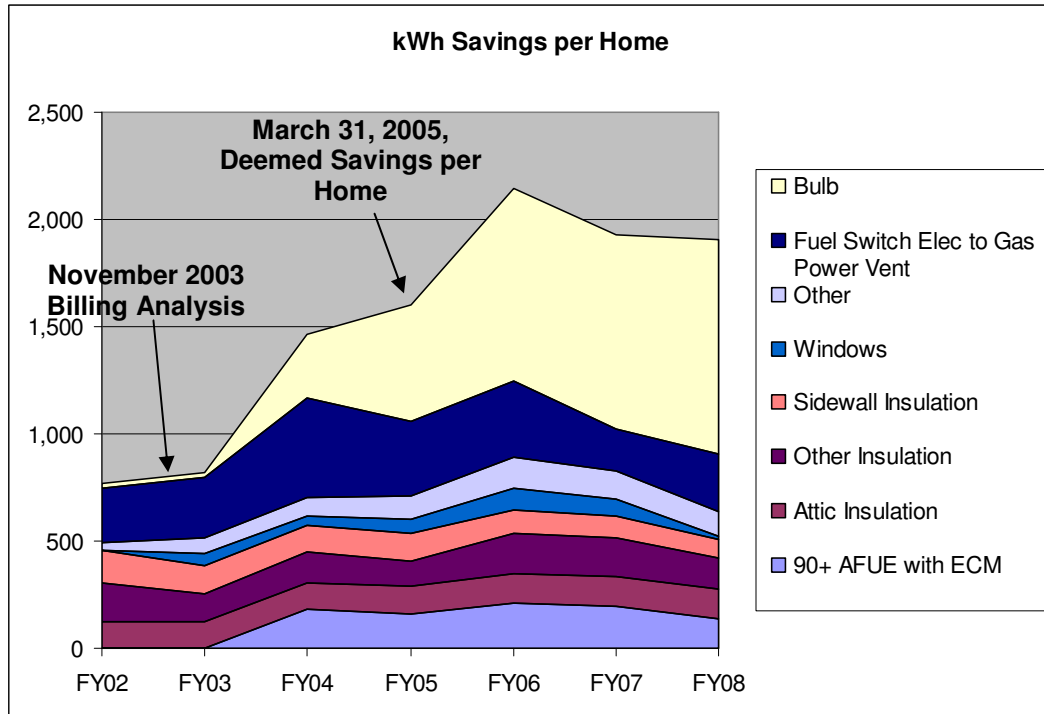
<sup>6</sup> “Other insulation” includes the following categories: band joist, crawlspace, exterior foundation, floor, interior foundation, mobile home floor, and sill box. Each of these categories has the appropriate deemed savings applied. These measures have been rolled up into one category so that the presentation is more readable.

- Blower door guided infiltration reduction was employed in 97 percent of homes in FY2008. This is a 5 percent increase from FY2005 where 92 percent received blower door guided infiltration reduction.
- The installation of programmable thermostats increased from 39 percent in FY2005 to 46 percent in FY2008.

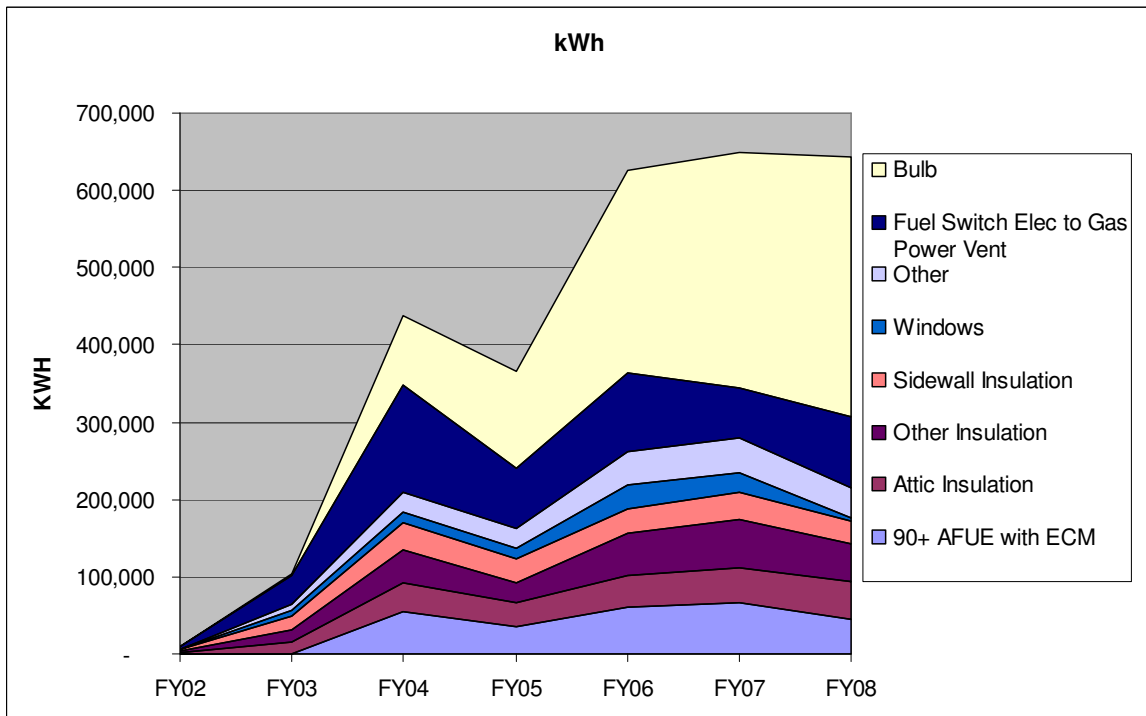
The increase in therms savings resulting from the above measures was offset by a decrease in incidence of two measures: sidewall insulation and boilers. The program also saw a decrease in the number of windows installed as a result of a policy change.

- Sidewall insulation has been steadily declining in installation rates and savings since FY2005. Forty percent of homes received sidewall insulation in FY2005 compared with 26 percent in FY2008. This resulted in a decrease of per home savings of 30 therms when comparing between the two years.
- Boilers have seen a decrease from seven percent in FY2005 to four percent in FY2008, resulting in a reduction of an average 14 therms per home.
- Fewer homes also received windows; four percent received windows in FY2005 compared to one percent in FY2008. This decrease was a result of a program policy change.

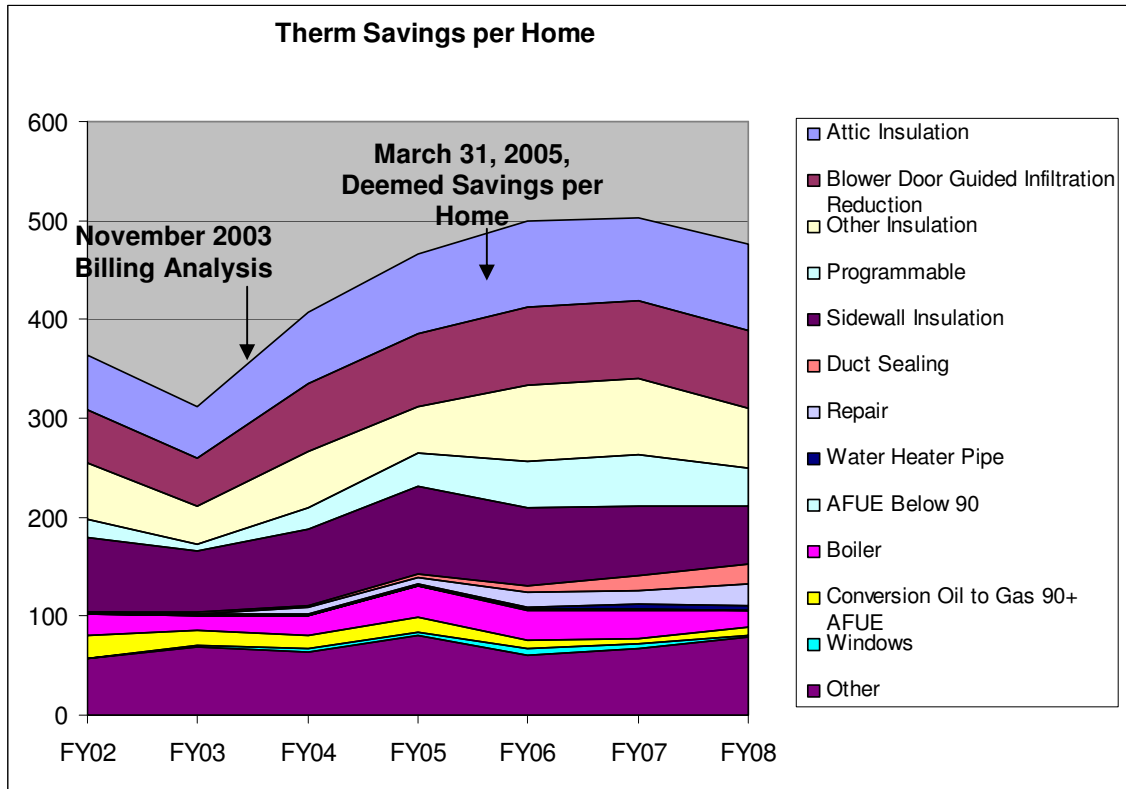
**Figure 1. Average Electric Savings per Home by Measure Using Current Deemed Values**



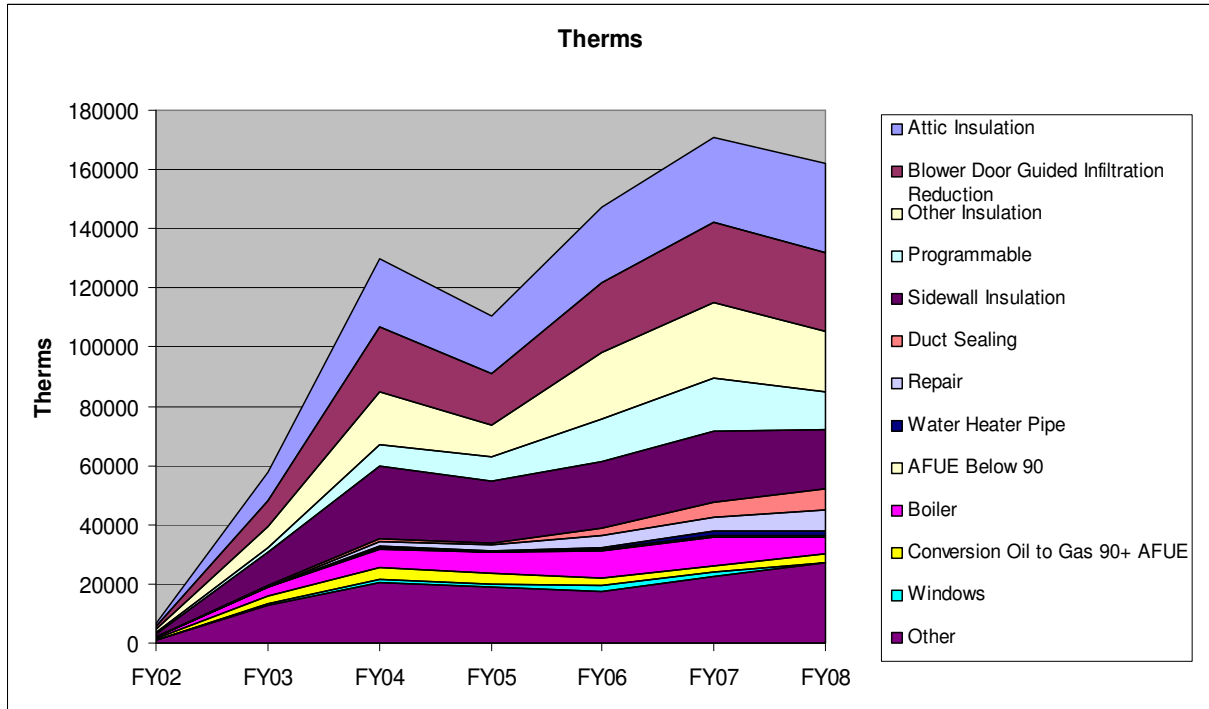
**Figure 2. Total Program Electricity Savings Allocated by Measure Using Current Deemed Values**



**Figure 3. Average Gas Savings per home by Measure Using Current Deemed Values**



**Figure 4. Total Program Gas Savings Allocated by Measure Using Current Deemed Values**



**Table 6. Proportion of Home Receiving Electricity Saving Measures FY2002–FY2008**

Number of Homes	13	127	299	228	292	337	338
Percent of kWh Homes Receiving Measure	FY02	FY03	FY04	FY05	FY06	FY07	FY08
90+ AFUE with ECM	0.0%	0%	20%	20%	24%	25%	17%
Attic Insulation	76.9%	77%	77%	84%	88%	85%	89%
Conversion Oil to Gas 90+ AFUE w/ ECM	0.0%	0%	1%	4%	5%	3%	0%
Bulb	46.2%	50%	76%	92%	93%	96%	92%
Dehumidifier	0.0%	0%	0%	0%	0%	0%	1%
Faucet Aerator	23.1%	28%	31%	30%	35%	39%	32%
Freezer	0.0%	0%	0%	0%	1%	9%	9%
Fuel Switch Electric to Gas Power Vent	7.7%	9%	14%	11%	11%	6%	8%
Other Insulation	69.2%	39%	39%	39%	57%	58%	55%
Refrigerator	0.0%	30%	27%	33%	28%	30%	34%
SEER 12	0.0%	4%	5%	2%	1%	0%	0%
SEER 13	0.0%	0%	1%	1%	4%	4%	1%
SEER 14	0.0%	0%	0%	0%	1%	1%	7%
Sidewall Insulation	46.2%	39%	37%	41%	35%	31%	26%
Water Heater Pipe	53.8%	42%	35%	45%	53%	75%	88%
Water Heater Tank	7.7%	13%	5%	10%	14%	12%	15%
Water Heater Temp Reduction	0.0%	4%	7%	10%	9%	5%	12%
Windows	0.0%	6%	4%	4%	8%	7%	1%

**Table 7. Proportion of Home Receiving Gas Saving Measures FY2002–FY2008**

Number of Homes	18	185	319	237	294	339	340
Percent of Therm Homes Receiving Measure	FY02	FY03	FY04	FY05	FY06	FY07	FY08
90+ AFUE	56%	65%	37%	32%	21%	21%	32%
90+ AFUE with ECM	0%	0%	20%	19%	24%	25%	17%
AFUE Below 90	0%	0%	35%	0%	1%	3%	1%
Attic Insulation	56%	53%	77%	81%	87%	84%	88%
Blower Door Guided Infiltration Reduction	67%	58%	5%	92%	97%	97%	97%
Boiler	6%	4%	7%	7%	8%	6%	4%
Chimney Liner	6%	3%	4%	16%	13%	17%	14%
Conversion Oil to Gas 90+ AFUE	6%	4%	0%	4%	2%	1%	2%
Conversion Oil to Gas 90+ AFUE w/ ECM	0%	0%	1%	4%	5%	3%	0%
Duct Sealing	0%	5%	76%	6%	23%	42%	59%
Faucet Aerator	17%	19%	31%	29%	35%	38%	32%
Flue Closure	33%	37%	0%	44%	41%	47%	29%
Fuel Switch Electric to Gas Power Vent	6%	6%	0%	10%	11%	6%	8%
Other Insulation	50%	27%	14%	37%	56%	57%	55%
Programmable	22%	10%	0%	39%	54%	59%	46%
Repair	0%	0%	0%	3%	6%	6%	9%
Sidewall Insulation	33%	26%	39%	40%	34%	31%	26%
Water Heater Pipe	39%	29%	27%	43%	53%	75%	88%
Water Heater Tank	6%	9%	5%	10%	14%	12%	15%
Water Heater Temp Reduction	0%	3%	1%	9%	9%	5%	12%
Windows	0%	4%	0%	4%	8%	6%	1%

**Table 8. Electric Savings Measures as a Percent of Savings FY02–FY08 Using Current Deemed Values**

Number of Homes	13		127		299		228		292		337		338	
kWh	FY02		FY03		FY04		FY05		FY06		FY07		FY08	
Measure	kWh	% kWh	kWh	% kWh	kWh	% kWh	kWh	% kWh	kWh	% kWh	kWh	% kWh	kWh	% kWh
90+ AFUE with ECM	0	0%	0	0%	54,648	12%	35,673	10%	60,720	10%	66,792	10%	45,439	7%
Attic Insulation	1,600	16%	15,680	15%	36,800	8%	30,720	8%	40,960	7%	45,600	7%	48,000	7%
Conversion Oil to Gas 90+ AFUE w/ ECM	0	0%	0	0%	3,036	1%	6,831	2%	12,903	2%	7,590	1%	0	0%
Bulb	261	3%	2,915	3%	89,610	20%	124,584	34%	263,436	42%	303,456	47%	336,777	52%
Dehumidifier	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	150	0%
Faucet Aerator	120	1%	1,680	2%	5,640	1%	4,440	1%	7,360	1%	10,200	2%	7,680	1%
Freezer	0	0%	0	0%	0	0%	42	0%	84	0%	1,260	0%	1,260	0%
Fuel Switch Ele to Gas Power Vent	3,280	33%	36,080	35%	137,760	31%	78,720	22%	101,680	16%	65,600	10%	91,840	14%
Other Insulation	2,397	24%	16,581	16%	42,897	10%	25,723	7%	53,846	9%	61,381	9%	48,951	8%
Refrigerator	0	0%	2,508	2%	5,280	1%	5,082	1%	5,544	1%	6,732	1%	7,920	1%
SEER 12	0	0%	1,250	1%	3,750	1%	1,500	0%	750	0%	250	0%	250	0%
SEER 13	0	0%	0	0%	1,384	0%	692	0%	4,498	1%	4,844	1%	1,384	0%
SEER 14	0	0%	0	0%	0	0%	0	0%	108	0%	270	0%	1,350	0%
Sidewall Insulation	1,956	20%	16,300	16%	35,860	8%	30,644	8%	32,926	5%	34,882	5%	29,014	5%
Water Heater Pipe	273	3%	2,067	2%	4,173	1%	4,017	1%	6,123	1%	10,023	2%	11,700	2%
Water Heater Tank	74	1%	1,184	1%	1,184	0%	1,702	0%	2,960	0%	3,034	0%	3,700	1%
Water Heater Temp Reduction	0	0%	410	0%	1,804	0%	1,804	0%	2,132	0%	1,476	0%	3,362	1%
Windows	0	0%	7,336	7%	13,624	3%	13,624	4%	30,392	5%	25,152	4%	4,192	1%
Totals	9,961	100%	103,991	100%	437,450	100%	365,798	100%	626,422	100%	648,542	100%	642,969	100%

**Table 9. Gas Savings Measures as a Percent of Savings FY02–FY08 Using Current Deemed Values**

Number of Homes	18		185		319		237		294		339		340	
Therms	FY02		FY03		FY04		FY05		FY06		FY07		FY08	
Measure	Therms	%	Therms	%	Therms	%	Therms	%	Therms	%	Therms	%	Therms	%
90+ AFUE with ECM	0	0%	0	0%	1,440	1%	940	1%	1,600	1%	1,760	1%	1,180	1%
90+ AFUE	980	15%	11,858	21%	13,132	10%	7,742	7%	6,076	4%	7,448	4%	11,074	7%
AFUE Below 90	0	0%	0	0%	340	0%	68	0%	204	0%	612	0%	408	0%
Attic Insulation	1,000	15%	9,800	17%	23,000	18%	19,200	17%	25,600	17%	28,500	17%	30,000	19%
Blower Door Guided Infiltration Reduction	972	15%	8,829	15%	21,870	17%	17,577	16%	23,166	16%	26,811	16%	26,649	16%
Boiler	405	6%	2,835	5%	6,480	5%	7,290	7%	9,315	6%	9,720	6%	5,670	3%
Chimney Liner	81	1%	486	1%	2,997	2%	3,240	3%	3,159	2%	4,698	3%	3,969	2%
Conversion Oil to Gas 90+ AFUE	405	6%	2,835	5%	4,050	3%	3,645	3%	2,430	2%	2,025	1%	2,835	2%
Conversion Oil to Gas 90+ AFUE w/ ECM	0	0%	0	0%	80	0%	180	0%	340	0%	200	0%	0	0%
Duct Sealing	0	0%	340	1%	680	1%	510	0%	2,278	2%	5,270	3%	7,174	4%
Faucet Aerator	9	0%	126	0%	423	0%	333	0%	552	0%	765	0%	576	0%
Flue Closure	0	0%	360	1%	4,140	3%	7,200	7%	6,480	4%	7,800	5%	10,260	6%
Fuel Switch Ele to Gas Power Vent	-55	-1%	-601	-1%	-2,293	-2%	-1,310	-1%	-1,693	-1%	-1,092	-1%	-1,529	-1%
Other Insulation	1,028	16%	7,108	12%	18,270	14%	10,957	10%	22,758	15%	25,891	15%	20,443	13%
Programmable	320	5%	1,440	2%	6,880	5%	7,920	7%	14,160	10%	17,680	10%	13,040	8%
Repair	0	0%	0	0%	1,728	1%	1,728	2%	4,104	3%	4,536	3%	7,128	4%
Sidewall Insulation	1,350	21%	11,250	19%	24,750	19%	21,150	19%	22,725	15%	24,075	14%	20,025	12%
Water Heater Pipe	35	1%	265	0%	535	0%	515	0%	785	1%	1,285	1%	1,500	1%
Water Heater Tank	17	0%	272	0%	272	0%	391	0%	680	0%	697	0%	850	1%
Water Heater Temp Reduction	0	0%	70	0%	308	0%	308	0%	364	0%	252	0%	574	0%
Windows	0	0%	476	1%	884	1%	884	1%	1,972	1%	1,632	1%	272	0%
<b>Total</b>	<b>6,547</b>	<b>100%</b>	<b>57,749</b>	<b>100%</b>	<b>129,966</b>	<b>100%</b>	<b>110,468</b>	<b>100%</b>	<b>147,055</b>	<b>100%</b>	<b>170,565</b>	<b>100%</b>	<b>162,098</b>	<b>100%</b>