



Home Energy Performance Electric Program Evaluation Program Year 3

May 2012

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Ameren Illinois

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February 2012
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1. Executive Summary

Implemented by Ameren Illinois' subcontractor, Conservation Services Group (CSG), the Home Energy Performance (HEP) program is a diagnostic and improvement program offered to Ameren Illinois' residential customers for a \$25 fee. CSG Energy Advisors conduct an "HEP Audit" of participant homes, which includes installing instant savings measures (ISMs) such as compact fluorescent light bulbs (CFLs) and domestic hot water (DHW) measures (faucet aerators, energy efficient shower heads, and water heater pipe insulation). Throughout the HEP Audit, Energy Advisors educate the homeowner on savings possible through shell measures such as air sealing, wall insulation, and attic insulation. Energy Advisors also recommend HEP Program Allies (Ameren Illinois-approved insulation contractors) that offer incentives and can install shell measures.

This report focuses on electric savings only. A follow-up memo will address similar issues on gas savings.

For the evaluation of Program Year 3 (PY3) activities, Cadmus updated impact calculations using per-unit realized savings numbers developed for the Program Year 2 (PY2) evaluation. Cadmus revisited per-unit savings estimates for DHW ISMs, which were lower than values found during secondary research conducted as part of a separate cost effectiveness analysis completed for Ameren Illinois programs. Cadmus also conducted stakeholder interviews with program staff to obtain insight into PY3 program implementation process changes.

Table ES-1 identifies sources of savings estimates used in the PY3 evaluation.

Table ES-1. Savings Estimate Sources

Savings Estimate	Sources
Faucet Aerators	Memo: Domestic Hot Water Savings Revisions, September, 12, 2011 (Appendix A)
Low-Flow Showerheads	
Hot Water Pipe Insulation	Memo: DSH Savings Analysis, February 9, 2011 (Appendix B)
Air Sealing	Energy10 Building Simulation Modeling. See PY2 Evaluation Report: Shell Measures, page 11
Attic Insulation (R-7 to R-38)	Energy10 Building Simulation Modeling. See PY2 Evaluation Report: Shell Measures, page 11
Attic Insulation (R-11 to R-38)	Energy10 Building Simulation Modeling. See PY2 Evaluation Report: Shell Measures, page 11
sR-11 Wall Insulation	Energy10 Building Simulation Modeling. See PY2 Evaluation Report: Shell Measures, page 11
Thermostat	Energy10 Building Simulation Modeling. See PY2 Evaluation Report: Thermostat, page 11
CFL Bulbs	Deemed per Final Order in ICC Docket # 07-0539
Net-to-Gross	Combination of Participant Survey in PY2 and secondary research. See PY2 Evaluation Report pages 17-19

During PY3, the Warm Neighbors Cool Friends (WNCF) pilot program offered incentives targeted to Ameren Illinois customers in the Decatur vicinity whose incomes are 200% to 300%

of the federal poverty level. The WNCF pilot combined the Ameren Illinois incentives with grants provided by the Energy Assistance Foundation, a 501(c) nonprofit based in Decatur. The program provided participants free home diagnostic audits and assistance to install energy-saving shell measures in their homes. Participants who installed shell measures were required to pay only \$500 or 10 percent of total project costs, whichever was greater. Eighty percent of participants who received free audits through the pilot program went on to install incented shell measures. In Program Year 4 (PY4), the pilot will be rolled out as an independent offering.

Impact Evaluation Findings

The impact findings are summarized below and illustrated in Figure ES-1.

- Total *ex ante* savings are 801.7 MWh (100.61 kW), derived by multiplying the number of installed measures by *ex ante* unit savings found in the Residential HEP Program PY2 Implementation Plan, August 28, 2009.
- After calculating our own realized unit savings, Cadmus derived an estimate of realized gross savings higher than estimated *ex ante* savings—1,013.6 MWh (171.5 kW)—for a gross realization rate of 126 percent.
- Using freeridership values estimated from participant surveys and secondary research, realized net savings are 841.2 MWh (153.9 kW).

Figure ES-1. PY2 HEP *Ex Ante* and Realized Gross and Net Energy Savings

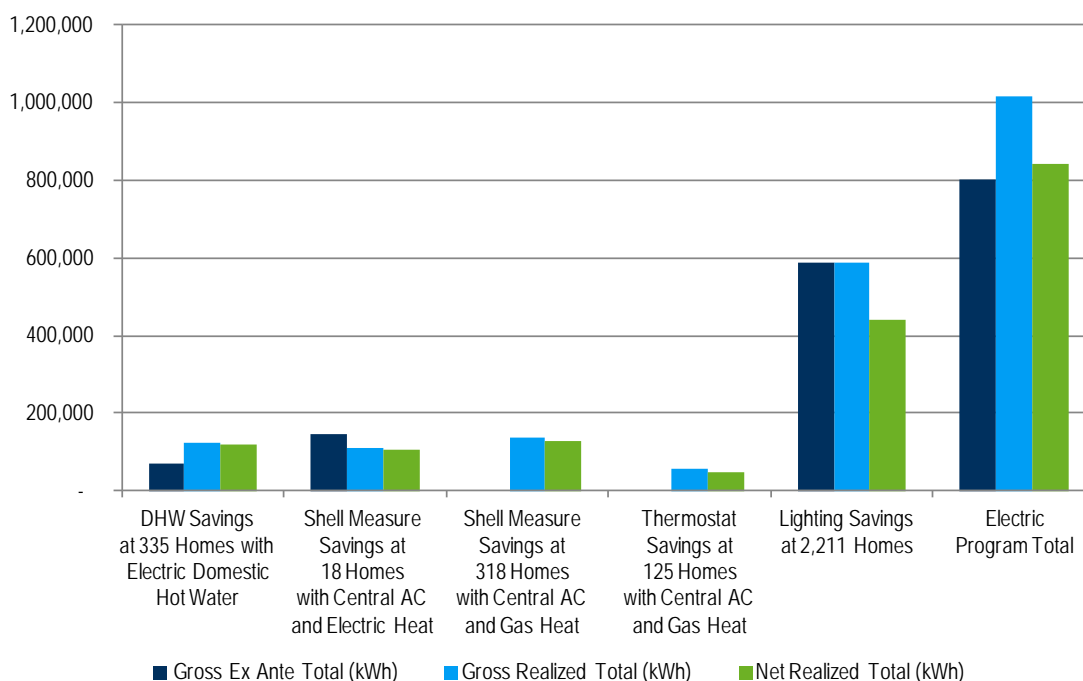


Table ES-2 below provides a summary of *ex ante* and realized gross savings and realization rates for the different measures, along with net savings.

Table ES-2. Summary of Gross Savings, Realization Rates, and Net Savings*

Measure	Ex Ante Gross Savings (kWh)	Realized Gross Savings (kWh)	Realization Rate	Net Savings (kWh)	NTG Ratio
Faucet Aerators	12,740	5,586	44%	5,556	99%
Low-Flow Shower Heads	56,525	116,603	206%	112,801	97%
Hot Water Pipe Insulation	700	204	29%	191	93%
<i>Subtotal DHW Savings at 335 Homes with Electric Domestic Hot Water</i>	<i>69,965</i>	<i>122,393</i>	<i>175%</i>	<i>118,547</i>	
Air Sealing	61,680	35,934	58%	35,754	99.5%
Ceiling Insulation (R-7 to R-38)	-	-		-	92.7%
Ceiling Insulation (R-11 to R-38)	14,686	14,294	97%	13,252	92.7%
R-11 Wall Insulation	70,130	60,883	87%	56,444	92.7%
<i>Subtotal Shell Measure Savings at 18 Homes with Central AC and Electric Heat</i>	<i>146,496</i>	<i>111,111</i>		<i>105,450</i>	
Air Sealing	N/A	16,950		16,865	99.5%
Ceiling Insulation (R-7 to R-38)	N/A	2,760		2,559	92.7%
Ceiling Insulation (R-11 to R-38)	N/A	43,920		40,718	92.7%
R-11 Wall Insulation	N/A	74,285		68,870	92.7%
<i>Subtotal Shell Measure Savings at 318 Homes with Central AC and Gas Heat</i>	<i>-</i>	<i>137,915</i>	<i>N/A</i>	<i>129,011</i>	
<i>Subtotal Thermostat Savings at 293 Homes with Central AC and Gas Heat</i>	<i>-</i>	<i>56,947</i>	<i>N/A</i>	<i>49,267</i>	<i>87%</i>
CFL 60w to 15w	355,891	355,891	100%	266,918	75%
CFL 75w to 20w	93,953	93,953	100%	70,465	75%
CFL 100w to 23w	135,416	135,416	100%	101,562	75%
<i>Subtotal Lighting Savings at 1,771 Homes</i>	<i>585,261</i>	<i>585,261</i>		<i>438,945</i>	
Electric Program Total	801,722	1,013,626	126%	841,221	83%

* Prospective and retrospective net savings are the same.

Process Evaluation Findings

The process evaluation findings are summarized below.

- Installation of shell measures increased in PY3.** The number of residences that installed air sealing, attic insulation, or wall insulation during PY3 increased to 336, including 47 WNCF projects, compared to just 68 residences during PY2. Efforts to emphasize shell-measure installations over ISMs also began to take hold in PY3. Energy savings from shell measures accounted for 28 percent of HEP energy savings, compared to just 6.5 percent during PY2.
- Shell-measure incentives increased during PY3.** Program administrators increased shell-measure incentives for air sealing, attic insulation, and wall insulation in PY3, as detailed in Table ES-3. Additionally, the administrators standardized incentives: residences with electric or natural gas heating fuel received the same incentive per square

foot (SF) or cubic foot per minute (CFM), enabling HEP Program Allies to more easily estimate rebates for prospective participants.

Table ES-3. Summary of Shell-Measure Incentives for HEP Program

Measure	Heat	PY1 and PY2		PY3	
		Per Unit	Maximum	Per Unit	Maximum
Air Sealing per CFM	Electric	\$0.27	\$430	\$0.50	\$900
	Gas	\$0.23	\$370		
Attic Insulation per SF	Electric	\$0.24	\$580	\$0.35	\$700
	Gas	\$0.24	\$580		
Wall Insulation per SF	Electric	\$0.55	\$1,570	\$0.60	\$1,200
	Gas	\$0.23	\$660		
Duct Sealing per CFM	Electric	-	-	-	-
	Gas	\$0.25	\$150		

- Adding HEP Allies helped promote the HEP program.** More HEP Allies are needed to meet the higher demand that comes from the higher incentives. At the end of PY3, 29 additional HEP Allies had been recruited into the program, compared to the 11 recruited during PY1 and PY2. The increase enabled program administrators to expand the HEP Program marketing for the entire Ameren Illinois service territory. The program will need additional HEP Allies to meet demand as it expands in PY4.
- Some contractors undercut the HEP program to avoid BPI training.** Contractors must obtain BPI certification to become HEP Allies, assuring the quality and safety of HEP installations. To avoid the cost of BPI training, some contractors reduce their costs to customers to compete with the HEP discounts.
- HEP Allies began providing Energy Audits.** Beginning in PY3, two Allies provided comprehensive Energy Audits (including blower door testing) comparable to CSG's HEP Audits. After the audits, the Allies referred potential candidates for additional insulation measures to the HEP program.
- Fewer residences were audited during PY3.** Just 2,211 residences were audited during PY3—776 fewer than were audited during PY2. Fewer audits lead to a decline in HEP program savings from 1,120 MWh in PY2 to 841 in PY3, since fewer ISMs were installed.
- More than 41% of participants who installed insulation did so without an audit.** In PY3, 336 participants installed shell measures through HEP Program Allies. Of these, 142 resulted from PY3, 52 from PY2, four from Program Year 1 (PY1) HEP Audits, and 138 were installed without an HEP Audit. (Ameren Illinois customers can hire an HEP Program Ally directly without first having an HEP Audit.)
- CSG implemented new home energy-performance software, EnergyMeasure™, to track program efforts.** The software provides additional capacity to program administrators and auditors by tracking optional energy-efficiency measures and scenarios, and by offering additional fields for data capture.

- **Leave-behind HEP Audit reports were improved.** Audit reports were updated with additional capabilities from EnergyMeasure. Recommended energy-efficiency measures included estimated measure costs, available incentives, annual savings, and payback periods with and without the incentives.

Recommendations for future actions include:

- **Expand the WNCF program.** The Decatur-area pilot program was extremely successful, resulting in 80 percent of participants installing additional shell measures. Expanding the program will contribute to meeting savings targets and increasing HEP Ally recruitment. It will also increase program visibility.
- **Increase the benefit for prospective contractors to become HEP Program Allies.** Through a combination of increasing available incentives and decreasing the costs of BPI certification, program managers can promote participation in the HEP program and ensure contractors meet the standards for quality and safety established by the Building Performance Institute.
- **Recruit additional HEP Program Allies.** BPI certification continues to slow development of the HEP Allies network. Ameren Illinois should consider additional means to provide financing for training and to reduce the time commitment for certification.
 - **Assess feasibility of online BPI certification training.** Review ways to reduce the time commitment necessary to achieve BPI certification. One suggestion would be to provide online materials for prospective allies seeking training prior to the BPI envelope courses. Offering a variety of BPI courses formats, including week-long intensives and night and weekend courses, may increase recruitment.
 - **Continue to work with HEP Program Allies to improve invoicing.** As new HEP Program Allies are recruited, provide training on filing rebate paperwork and correctly itemizing incentive measures to ensure that Ameren Illinois and CSG capture needed information.
- **Encourage HEP Program Allies to provide audits.** If additional Program Allies provide comprehensive audits, program administration costs can be reduced by shifting the costs of audits from CSG to Program Allies, while increasing participation.
- **Increase audits and track audits performed by HEP Allies.** Expand marketing efforts to ensure that HEP Auditors remain at high capacity. As additional HEP allies are recruited to perform HEP Audits, develop tracking methods for energy savings potential at those sites.
- **Integrate and standardize the new database platform.** Data capture in EnergyMeasure is not standardized, resulting in inconsistent measure details complicating site-level tracking of installed and recommended measures and quantities. The database transitioned from CSG's HomeCheck platform to the EnergyMeasure platform in September, 2010.

2. Introduction

The Home Energy Performance program (HEP) is a home diagnostic and improvement program available to Ameren Illinois' residential customers. The program, implemented by CSG, conducted its first HEP Audit in January 2009, six months into PY1. The HEP program was active for all of PY2 and PY3. The program provides incentives for shell measures (air sealing, attic insulation, and wall insulation) installed by HEP Program Allies. Additionally, energy advisors perform an energy audit, which includes installing ISMs and providing participants with a list of potential shell and HVAC savings measures for a \$25 fee.

Cadmus conducted the following activities in the PY3 evaluation:

- Provided insight into the changes from PY2 to PY3 by conducting interviews (n=2) with CSG and Ameren Illinois program staff.
- Updated impact calculations using unit savings numbers developed in PY2. The only exception is DHW unit measure savings, which were revised.

Program Description

The HEP program was implemented as follows during PY3:

- CSG sent targeted mailers to residences in Ameren Illinois' service territory. CSG targeted customers based on census block data, focusing on moderately affluent residences built during the 1970s and 1980s. This allowed them to identify residents who need insulation and can probably afford the required investment.
 - Beginning in PY3, CSG directed mailers to communities with high numbers of residences with electric resistance heat.
 - CSG program administrators placed HEP program advertisements in publications and regional media, and continued to market the program through home shows and contractor networks.
- Program participants called CSG's Peoria office and scheduled an HEP Audit with one of four CSG Energy Advisors. Two are located in Peoria, one is in East St. Louis, and one is in the Champaign metropolitan area.
 - During PY3, one CSG Energy Advisor was dedicated to providing HEP Audits to participants in the WNCF pilot. The Energy Advisors provided audits, free of charge, to Ameren Illinois customers with incomes at 200 to 300 percent of the federal poverty level.
- During the HEP Audit, the Energy Advisor conducted a 10-minute interview with the program participant; installed domestic hot water (DHW) and lighting ISMs in eligible locations; and estimated the potential savings of shell measures and HVAC replacement using CSG's home auditing energy savings tool, EnergyMeasure. The EnergyMeasure tool estimates savings from assumed savings estimates associated with the quantity of ISMs to be installed

- HEP Audit participants received a customized report with recommendations for additional shell and HVAC measures, as well as a list of approved contractors—HEP Program Allies a reference to the ActOnEnergy Website for HVAC Allies—whom they could contact to perform the work.
 - In PY3, CSG updated the audit report to include details captured in upgraded program software. The updated reports included a comprehensive list of energy-efficiency recommendations such as estimated measure costs, incentives, annual savings, and payback periods with and without incentives. CSG expanded energy use records to include natural gas consumption.
- CSG made audit participants aware that Ameren Illinois gas customers who did not already have one, were eligible for a \$25 rebate on an ENERGY STAR[®] programmable thermostat.
- CSG made follow-up calls to HEP Audit participants identified as potential candidates (based on payback periods) for additional shell measures. Follow-up calls focused on encouraging participants to contact an HEP Program Ally.
- A CSG account manager provides support to HEP Program Allies and CSG's Energy Advisors.
- HEP participants contacted HEP Program Allies to install additional shell measures. Participants that did not first have an HEP Audit performed directly contacted the HEP Program Allies for measure installation. Eligible participants received shell-measure incentives as line item discounts in invoices from HEP Program Allies.
 - Beginning in PY3, two HEP Program Allies (independent contractors) provided comprehensive home energy audits, including blower door tests. This higher-level home energy audit is necessary to qualify for air sealing, insulation, and duct sealing in residences where combustion appliances are installed. After completing the audit, these HEP Program Allies referred participants interested in installation of additional shell measures to the HEP program and Program Allies.
- To receive the shell-measure incentive, the HEP Program Allies submitted their invoices to CSG, signed by both the homeowner and the Ally, for the work performed, and with the discount clearly indicated. The HEP Program Ally received the rebate check within 30-45 days of invoice submittal, paid twice per month.
- A CSG account manager conducted informal quality assurance to ensure rebated insulation was installed, including on-site observation during post-installation blower door testing, and reviewing final test number submissions.

3. Evaluation Methods

Data Sources

The following data sources informed the impact and process evaluation:

- Final PY3 program databases
- Data were combined by CSG from two database platforms in use during PY3, HomeCheck and EnergyMeasure, and provided to Cadmus.
- Information gathered through program manager interviews
- Marketing and informational materials (provided by Ameren Illinois and CSG)
- PY1 and PY2 Reports and analysis
- Summary of DHW secondary research and analysis (Attachment A)

Process Interviews with Program Manager

Cadmus interviewed Ameren Illinois and CSG program managers. Cadmus asked about suggested target attainment, implementation, and procedures, and changes to program implementation made during PY3. We also asked about which portions of the program work well and where opportunities for improvement might exist.

Impact Calculations

Cadmus reviewed realized energy savings estimates and assumptions for DHW ISMs, including energy efficient shower heads and faucet aerators. The result of this review is discussed in Section 4, Program Results.

DHW Measures

For the review of aerator and shower head unit savings estimates, Cadmus examined ten other aerator and shower head savings estimates. This analysis led to the following revised savings estimates:

- Aerators: 57 kWh
- Shower heads: 361 kWh

The revised estimates departed from throttling equations used by CSG, resulting in a higher flow number for both energy efficient and standard DHW measures. (See Appendix A: *Domestic Hot Water Savings Revisions* for the memo describing revised calculations.)

All other impact savings estimates use the realized unit savings as determined and described in the PY2 evaluation report.

4. Program Results

Impact Findings

A summary of the gross impact evaluation findings is presented in Table 1. The table shows the number of measures installed, *ex ante* and realized unit savings, and *ex ante* and realized total gross savings. Gas measures are covered in a separate report.

Table 1. Program Year 3 Gross Savings for HEP Electric Program

Measure	Number Installed	Annual Gross Savings					
		<i>Ex Ante</i> Per Unit (kWh)	Realized Per Unit (kWh)	<i>Ex Ante</i> Total (kWh)	<i>Ex Ante</i> Total (kW)	Realized Total (kWh)	Realized Total (kW)
Faucet Aerators	98	130	57	12,740	1.59	5,586	0.70
Low-Flow Shower Heads	323	175	361	56,525	7.04	116,603	14.53
Hot Water Pipe Insulation	4	175	51	700	0.09	204	0.03
<i>DHW Savings at 335 Home with Electric Domestic Hot Water</i>	425			69,965	8.72	122,393	15.25
Air Sealing	16	3,855	2,246	61,680	24.89	35,934	14.50
Ceiling Insulation (R-7 to R-38)	0	1,585	1,640	-	-	-	-
Ceiling Insulation (R-11 to R-38)	14	1,049	1,021	14,686	5.93	14,294	5.77
R-11 Wall Insulation	10	7,013	6,088	70,130	28.30	60,883	24.57
<i>Shell Measure Savings at 18 Homes with Central AC and Electric Heat</i>	40			146,496	59.12	111,111	44.84
Air Sealing	311	N/A	55	N/A	N/A	16,950	6.84
Ceiling Insulation (R-7 to R-38)	10	N/A	276	N/A	N/A	2,760	1.11
Ceiling Insulation (R-11 to R-38)	240	N/A	183	N/A	N/A	43,920	17.73
R-11 Wall Insulation	179	N/A	415	N/A	N/A	74,285	29.98
<i>Shell Measure Savings at 318 Homes with Central AC and Gas Heat</i>	740			-	-	137,915	55.66
<i>Thermostat Savings at 293 Homes with Central AC and Gas Heat</i>	293	N/A	194	-	-	56,947	22.98
CFL 60w to 15w	9,268	38.4	38.4	355,891	19.93	355,891	19.93
CFL 75w to 20w	1,999	47.0	47.0	93,953	5.26	93,953	5.26
CFL 100w to 23w	2,058	65.8	65.8	135,416	7.59	135,416	7.59
<i>Lighting Savings at 1,771 Homes</i>	13,325			585,261	32.77	585,261	32.77
Electric Program Total	14,823			801,722	100.61	1,013,626	171.5

A summary of the net impact evaluation findings, including the NTG ratio and realized total net savings, is presented in Table 2.

Table 2. Program Year 3 Net Savings for HEP Electric Program

Measure	Annual Net Savings		
	NTG Ratio	Realized Total (kWh)	Realized Total (kW)
Faucet Aerators	99%	5,556	0.69
Low-Flow Shower Heads	97%	112,801	14.05
Hot Water Pipe Insulation	93%	191	0.02
<i>DHW Savings at 335 Home with Electric Domestic Hot Water</i>		118,547	14.77
Air Sealing	99.5%	35,754	14.43
Ceiling Insulation (R-7 to R-38)	92.7%	-	-
Ceiling Insulation (R-11 to R-38)	92.7%	13,252	5.35
R-11 Wall Insulation	92.7%	56,444	22.78
<i>Shell Measure Savings at 18 Homes with Central AC and Electric Heat</i>		105,450	42.56
Air Sealing	99.5%	16,865	6.81
Ceiling Insulation (R-7 to R-38)	92.7%	2,559	1.03
Ceiling Insulation (R-11 to R-38)	92.7%	40,718	16.43
R-11 Wall Insulation	92.7%	68,870	27.80
<i>Shell Measure Savings at 318 Homes with Central AC and Gas Heat</i>		129,011	52.07
<i>Thermostat Savings at 293 Homes with Central AC and Gas Heat</i>	87%	49,267	19.88
CFL 60w to 15w	75%	266,918	14.95
CFL 75w to 20w	75%	70,465	3.95
CFL 100w to 23w	75%	101,562	5.69
<i>Lighting Savings at 1,771 Homes</i>		438,945	24.58
Electric Program Total		841,221	153.9

Summary of Program Participation

Table 3, which summarizes HEP program participation from PY1 to PY3, shows the following:

- HEP conducted 2,211 audits in PY3, compared to 2,987 in PY2 and 769 in PY1. After the HEP Audits, 198 of those homes (188 with gas heat and 10 with electric heat) installed incented insulation measures. Another 138 homes (130 with gas heat and eight with electric heat) installed incented insulation measures without the home energy audit.
- In PY3, 425 DHW measures—faucet aerators, energy efficient-flow shower heads, and hot water pipe insulation—were installed in 335 homes with electric heat. In PY2 and PY1, 866 and 283 DHW measures were installed, respectively. Part of the reason for the decline between PY3 and PY2 was that hot water pipe insulation accounted for only four installations and was discontinued as an ISM during PY3. In PY2 there were 226 hot water pipe insulation installations.

- In PY3, 40 shell measures—air sealing, ceiling insulation, and wall insulation—were installed in 18 homes with electric heat, compared to 11 measures in six homes in PY2. These homes with electric heat had electric savings from insulation during both the heating and cooling seasons.
- In PY3, 740 shell measures were installed in 318 homes with gas heat, compared to 134 measures installed in 62 homes in PY2. These homes with gas heat had electric savings from insulation during the cooling season only.
- In PY3, 293 programmable thermostats were installed compared to 125 in PY2.
- In PY3, 13,325 CFLs were installed, compared to 21,543 in PY2, marking the transition in program focus from ISMs to those measures that save more energy.

Table 3. Participation in PY3, PY2, and PY1

	PY3 Participation	PY2 Participation	PY1 Participation
Home Energy Audits in Total	2,211	2,987	769
DHW Measures Installed in Homes with Electric Water Heaters	425	866	283
Shell Measures Installed in Homes with Electric Heat	40	11	0
Shell Measures Installed in Homes with Gas Heat	740	134	0
Programmable Thermostats	293	125	1
CFLs in Total	13,325	21,543	4,100

Determination of Gross Savings

The original *ex ante* unit savings, found in the PY2 HEP Implementation Plan, and the realized unit savings are shown in Table 4 below. As described in Section 3, Evaluation Methods, Cadmus revised PY2 realized energy savings per unit for two DHW ISMs—shower heads and aerators – for the PY3 evaluation. Because of the revision to per unit savings for DHW measures, the updated faucets realization rate was 44 percent in the PY3 evaluation, compared to 23 percent in the PY2 evaluation. The energy efficient shower head realization rate was 240 percent, compared to 206 percent in PY2.¹

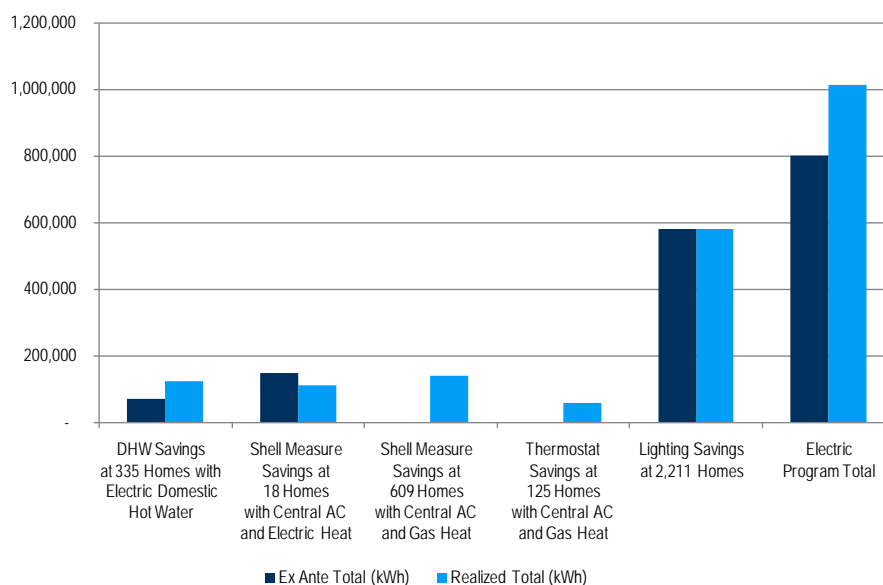
¹ Annual per unit realized energy savings used in the PY2 evaluation for shower heads and aerators was 240 kWh and 30 kWh, respectively. Appendix A: *Domestic Hot Water Savings Revisions* describes the revised calculations.

Table 4. Comparison of *Ex Ante* and Realized Unit Savings

Measure	Annual Gross Savings		
	<i>Ex Ante</i> Per Unit (kWh) *	Realized Per Unit (kWh)	Unit Savings Realization Rate
Faucet Aerators	130	57	44%
Shower Heads	175	361	206%
Hot Water Pipe Insulation	175	51	29%
Air Sealing	3,855	2,246	58%
Ceiling Insulation (R-7 to R-38)	1,585	1,640	103%
Ceiling Insulation (R-11 to R-38)	1,049	1,021	97%
R-11 Wall Insulation	7,013	6,088	87%
Programmable Thermostat	N/A	194	194%
CFL 60w to 15w	38	38	100%
CFL 75w to 20w	47	47	100%
CFL 100w to 23w	66	66	100%

* Note: The per-project values in the PY2 Implementation Plan were estimates based on expected average quantities of work performed. Actual incentives and savings are based on per-CFM or per-SF values and are proportional to the actual quantities in each individual project, except when the maximum incentive is reached. This applies to both air sealing and insulation measures.

Figure 1 summarizes gross energy savings results for the different DHW, insulation, and CFL measures. Total gross electric program *ex ante* savings are 801.7 MWh and 100.6 kW demand and were derived by multiplying the number of installed measures by *ex ante* unit savings. After reviewing and calculating our own realized unit savings, Cadmus derived a higher estimate of realized gross savings—1,013.6 MWh and 171.5 kW demand—for a realization rate of 126 percent.

Figure 1. PY2 HEP Program *Ex Ante* and Realized Gross Energy Savings

Cadmus calculated demand savings by multiplying energy reduction estimates by the appropriate end-use coincidence factor listed in Table 5. We calculated the coincidence factors directly from hourly end-use load shapes developed for the PY2 evaluation using engineering models for the Midwestern region of the United States, which were then calibrated to long-term weather conditions in Ameren Illinois' service area.

Table 5. Coincidence Factors

Unit	Coincidence Factor*
DHW Measures	0.000124577
Shell Measures	0.000403589
Lighting Measures	0.000056

Source: The Cadmus Group, Inc. *Ameren Illinois Portfolio Cost-Effectiveness Evaluation*. December 30, 2009.

Determination of Net Savings

For the PY3 Evaluation, Cadmus used net-to-gross (NTG) ratios calculated for the PY2 evaluation. The NTG ratio accounts for the effect of participants that would have purchased the measures even without the benefit of the program.

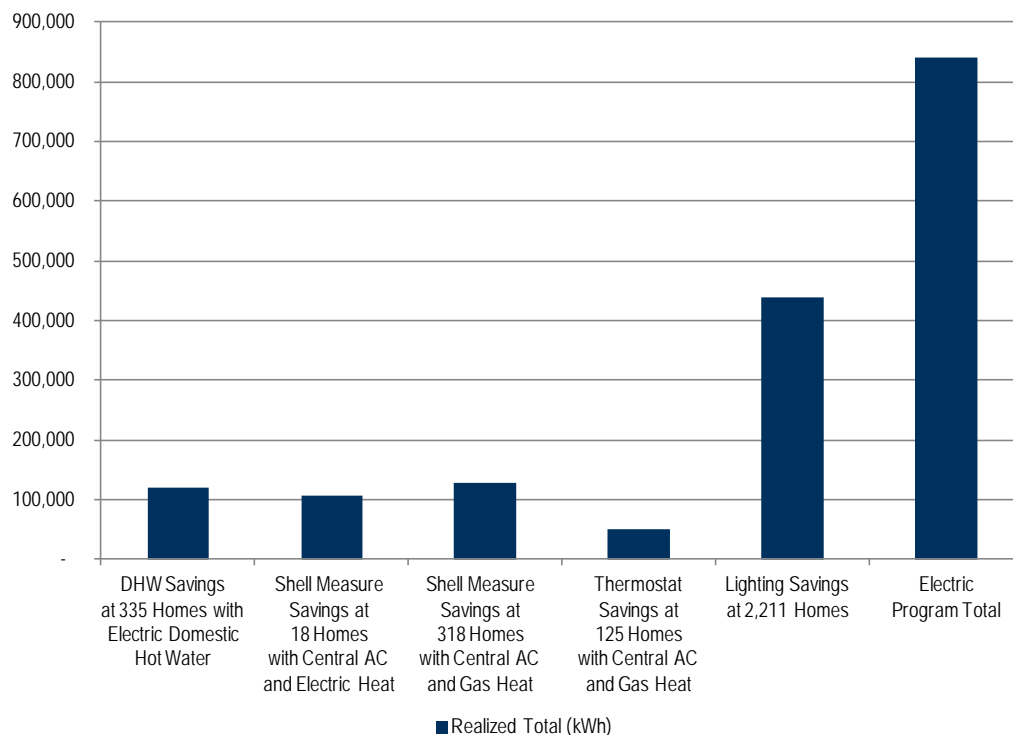
Cadmus estimated freeridership and spillover ratios for ISMs based on survey responses from program participants in PY2.

During the PY3 evaluation, Cadmus reviewed the secondary data sources used to establish NTG ratios in the PY2 evaluation. We made three changes to the PY2 estimate for PY3. First, we averaged the three California studies before averaging them with the remaining studies. Since California has a different climate as well as longer running programs, we determined that it would be more appropriate to average the California studies rather than having California weighted more heavily. Second, we added a new and recent study from Commonwealth Edison into the average. The result is a slightly higher NTG ratio for insulation measures and a slightly lower NTG for air sealing measures. Table 6 lists the studies and results we used a secondary research. Third, we used estimated spillover ratios determined in the secondary data sources to establish a spillover ratio for insulation and air sealing measures in the PY3 evaluation.

Table 6. Net to Gross Estimated from Other Insulation Program Evaluations

Net of Freeridership Ceiling and Wall Insulation	Spillover for Ceiling and Wall Insulation	Source
74%	41%	NYSERDA Report: New York's System Benefits Charge Programs , Evaluation and Status Report, Final Report, March 2010, Table 4-10.
90%	7%	Energy Efficiency/ Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011), Evaluation Report: Single Family Programs, DRAFT Presented to Commonwealth Edison Company, November 9, 2011, Table 6-14
84%	NA	EnergyWise 2008 Program Evaluation, May 24, 2010, p. 43.
70%	10%	Overview of DEER NTFR Update Process for 2006-2007 Programs, Table 3-2.
53%	NA	2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation, CPUC-ID#:1115-04, Table 9-35.
27%	NA	Residential Retrofit High Impact Measure Evaluation Report, Prepared For The California Public Utilities Commission Energy Division February 8, 2010 Table 85
50%	10%	Average of CA Studies
69%	NA	WI Focus on Energy Evaluation Home Performance with ENERGY STAR: Insulation Supply-side Study Results and Integration with Participant Findings April 16, 2010,
73.4%	19.3%	Average for Ceiling and Wall Insulation
Net of Freeridership for Air Sealing	Spillover for Air Sealing	Source
100%	0%	WI Focus on Energy Evaluation Home Performance with ENERGY STAR: Insulation Supply-side Study Results and Integration with Participant Findings
92%	7%	Energy Efficiency/ Demand Response Plan: Plan Year 3 (6/1/2010-5/31/2011), Evaluation Report: Single Family Programs, DRAFT Presented to Commonwealth Edison Company, November 9, 2011, Table 6-14
96%	3.5%	Average for Air Sealing

As shown in Figure 2, total realized net savings are 841.2 MWh (153.9 kW).

Figure 2. PY2 HEP Program Realized Net Energy Savings

Process Findings

Program Manager Interview Findings

Cadmus interviewed Ameren Illinois and CSG program administrators for the PY3 evaluation. During the interviews, Cadmus asked about changes to program staff and implementation that occurred between PY2 and PY3, including changes to incented measures and eligibility. Cadmus also reviewed suggested recommendations from the PY2 Report, and discussed new challenges and changes anticipated in PY4.

Areas of Potential Improvement in the HEP Program

- **Few HEP Audit participants go on to install shell measures.** Despite an increase in the total number of shell-measure incentives installed in PY3 (780) compared to PY2 (145), only six percent of HEP Audit participants went on to install air sealing, attic insulation, or wall insulation through the HEP program.
 - The program relies on participants to call the HEP Program Allies. A limited amount of follow-up is completed by CSG, during which they answer questions regarding the shell measures and audit reports, and encourage participants to contact local HEP Program Allies. Discussions regarding giving leads directly to HEP Program Allies have occurred; however, questions about distributing leads in a fair manner have complicated the process.

- Program participants who can afford upgrades tend to live in newer, well insulated homes that do not qualify for attic and wall insulation incentives, which require existing insulation levels be less than R11.
- **Fewer HEP Audits resulted in a decline in program savings.** In PY3, the total number of audits completed fell by 776 compared to PY2 – a 25 percent reduction. ISMs installed during audits, which account for a large portion of HEP program savings, declined further.
- **Additional Allies are needed to promote and continue the HEP program expansion.** To meet anticipated demand, the program needs to recruit more HEP allies. At the end of PY3, 44 Allies were active in the program – enough to market the program to all of Ameren Illinois’s service territory but insufficient to meet expanded demand.
- **Building critical mass for BPI training continues to be an issue.** Scheduling BPI trainings continued to delay HEP Ally recruitment during PY3. To offer the training, twelve or more recruits needed to enroll. Ten trainings were organized during PY3; however frequently recruits had to wait lengthy periods for the training – reducing their opportunity to participate in the program.
- **Non-Allied home energy performance contractors undercut incentives.** Despite the increase in incentives, some home energy performance contractors chose to discount installation costs to customers in lieu of becoming an HEP Program Ally. This behavior may indicate that the costs associated with BPI training (required for Program Allies) are still too high compared to program benefits.
- **Upgraded software made it harder to track program savings.** The new database platform, EnergyMeasure, does not always capture the quantity of an installed ISM. Additionally, inconsistent tracking of measure type installed (i.e., not specifying the GPM of an aerator, or wattage of a CFL) made it harder to track savings.

Positive Outcomes from the HEP Program PY3

- **PY3 saw a large increase in shell-measure installations.** A large increase in the number of shell-measure installations occurred between PY2 and PY3, from 145 measures installed at 68 residences in PY2 to 780 measures installed at 336 residences during PY3. This increase was likely the combined result of increased incentives and more having more HEP trade allies.
- **The WNCF pilot program had a high success rate.** Eighty percent of pilot participants who received an audit through the HEP program went on to install shell measures. The program provided extra relief to Ameren customers in need of, but unable to afford, high-ticket shell measures.
- **Leave-behind HEP Audit reports were improved.** In PY3, CSG updated the audit report provided to HEP program participants with additional capabilities from EnergyMeasure database software. Participants received comprehensive lists of recommended energy-efficiency measures, including HEP and HVAC measures. The list detailed estimated measure costs, incentives, annual savings, and payback periods with

and without the incentives. Additionally, CSG expanded the energy use records included in the report to include natural gas at applicable sites.

- **The number of HEP Program Allies recruited increased.** By October 2010, sufficient numbers of HEP Program Allies had been recruited to cover the entire Ameren Illinois service territory, allowing HEP Program managers to expand marketing for the program both through Ameren Illinois-led efforts and by leveraging HEP Program Allies' marketing efforts. By the end of PY3, an additional 29 HEP Program Allies had been recruited, bringing the total number to 44
- **Comprehensive energy audits are offered by HEP Allies.** Two HEP Program Allies began to provide comprehensive energy audits, including blower door testing, to prospective HEP program participants during PY3. Recruited outside the established program structure, participants eligible for additional insulation measures were referred to HEP Allied Contractors. HEP Program managers hope to increase the number of HEP Program Allies providing audits during PY4. Doing so could contribute to an increase in program participation, while reducing program administration costs by shifting audit costs to HEP Allies.

Appendix A: Domestic Hot Water Savings Revisions

Date: November 22, 2011
To: Karen Kansfield, Ameren Illinois
From: Jane Colby and Dave Korn, The Cadmus Group Inc.
Re: Domestic Hot Water Savings Revisions

At Ameren Illinois' request, Cadmus reviewed our previous² engineering estimate of unit savings for two domestic hot water (DHW) measures for the Home Energy Performance and Multifamily programs--faucet aerators and showerheads. **The purpose of this memo is to describe how these revised results, shown in Table 1, were calculated.**

Table 1. Domestic Hot Water Unit Revisions Savings Summary

DHW Default Savings Estimates								
Type of Water Heater	Faucet Aerator				Low-Flow Showerheads			
	Single Family		Multifamily		Single Family		Multifamily	
	Savings	Per	Savings	Per	Savings	Per	Savings	Per
Electric (in kWh)	57	aerator	71.1	aerator	361	shower-head	398.4	shower-head
Gas (in therms)	2.6	aerator	3.2	aerator	16	shower-head	17.7	shower-head

Aerators

We calculated energy savings by assuming a decrease in flow rate through the aerators in kitchen and bathroom faucets. This decrease in flow led to energy savings calculated for electric and gas water heaters, shown in Equations 1 and 2 below, respectively:

Equation 1:

Annual Electric DHW Savings (in kWh) per Person for bathroom and kitchen aerators = $(8.33 * 1 * \text{TIME} * (\text{FR}_b - \text{FR}_e) * (\text{T}_{in} - \text{T}_{out}) * \text{DAY}_h / 3,413) / \text{EFF}_{elec}$

Equation 2:

Annual Gas DHW Savings (in therms) per Person for bathroom and kitchen aerators = $(8.35 * 1 * \text{FR}_b * \text{TIME} * (\text{FR}_b - \text{FR}_e) / \text{FR}_b * (\text{T}_{in} - \text{T}_{out}) * \text{DAY}_h / 100,000) / \text{EFF}_{gas}$

Where the labeled variables are listed in Table 2 and the constants in the equations are:

- 8.35 lbs per gallon
- 1 BTU/lb-degree F = amount of energy to raise 1 lb of water 1 degree F
- 3,413 BTUs per kWh

² Memo from Jane Colby and Robert Huang to Karen Kansfield, dated February 9, 2011.

- 100,000 BTUs per therm
- FR: Flow Rate, denoted with *b* (before) or *e* (efficient) unit
- T: Temperature, denoted with *in* (in-let, cold) or *out* (out-let, hot)

The inputs into Equations 1 and 2, as well as the results of the savings calculation, are shown in the Table 2. Cadmus reviewed DWH savings from other program estimates³ and determined our previous estimate of aerator savings was significantly lower than the average. Upon review, Cadmus determined that the assumption of using throttled flow (faucet not running full out) was not an appropriate assumption until more data on the issue could be collected. We previously assumed a baseline throttled flow rate of 1.85 gpm and an aerator flow rate of 1.48 gpm. The new baseline flow rates, as shown in Table 2, are flow rates measured at HEP audit sites during PY1 that have not been throttled. We then weighted the annual DHW savings per person by the ratio of kitchen to bathroom aerator PY1 installs. We multiplied the annual weighted DHW savings per person by the number of people living in the home and divided by the number of sinks per home to derive an annual per aerator savings for either single or multifamily homes in the Ameren Illinois service territory.

Table 2. Assumptions Used in Aerator Calculation

Estimate of Default Saving for Aerators				
Type of Water Heater	Electric		Gas	
Measure Name	Kitchen Aerator	Bathroom Aerator	Kitchen Aerator	Bathroom Aerator
Number Installed at Ameren Illinois ^[a]	5	38	59	680
Efficient Aerator Flow Rate (FR _e) ^[b]	2.2	1.5	2.2	1.5
Baseline Aerator Flow Rate (FR _b) ^[c]	2.75	2.25	2.75	2.25
Water Heater Recovery Efficiency (EFF) ^[d]	100%	100%	77%	77%
T _{in} (in °F) ^[e]	53.9	53.9	53.9	53.9
T _{out} (in °F) ^[f]	80	80	80	80
Length of Use (in min) per day per person (TIME) ^[g]	5	5	5	5
Days per Year at Home (DAYh) ^[h]	352.25	352.25	352.25	352.25
Annual DHW Savings per Person	61.9	84.4	2.7	3.7
Annual DHW Savings per Person Weighted	81.8	kWH	3.7	therms
People per SF Home ^[i]	2.67	people	2.67	people

³ The other estimates included the following sources: Ohio TRM 2010, PA TRM 2010, Michigan Measure database, as prepared by Morgan Marketing Partners, 2011, "Energy Cost Calculator for Faucets and Showerheads." 1.9 GPM aerator, 2.0 GPM showerhead, all other input values as defaults.http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calc.html#output , ComEd All Electric Single Family HEP Tune-Up Program Evaluation Report Draft-October 5, 2010, Efficiency Vermont, TRM User Manual No. 2009-54, pgs 340-344, Dec 30, 2008, NEEP Mid-Atlantic Technical Reference Manual Version 1.1, Oct 2010, prepared by VEIC.

Estimate of Default Saving for Aerators				
Type of Water Heater	Electric		Gas	
Measure Name	Kitchen Aerator	Bathroom Aerator	Kitchen Aerator	Bathroom Aerator
Sinks per SF Home ^[l]	3.83	sinks	3.83	sinks
<i>Annual Savings per Aerator in SF Home</i>	<i>57.0</i>	<i>kWH</i>	<i>2.6</i>	<i>therms</i>
People per MF Home ^[k]	2.14	people	2.14	people
Sinks per MF Home ^[l]	2.46	sinks	2.46	sinks
<i>Annual Savings per Aerator in MF Home</i>	<i>71.1</i>	<i>kWH</i>	<i>3.2</i>	<i>therms</i>

[a] Ameren Illinois HEP data PY1 compiled by Cadmus on 12/15/09

[b] Rated gpm for efficient aerators.

[c] Average measured flow rates from HEP PY1 participants as measured prior to installation of aerators.

[d] <http://energyexperts.org/EnergySolutionsDatabase/ResourceDetail.aspx?id=594>

[e] For Chicago, IL: From Appendix D: Cold Water Inlet Temperatures, http://www1.eere.energy.gov/femp/pdfs/FTA_res_heat_pump.pdf

[f] Default Temperature of faucets in the Vermont TRM 2009 p. 280

[g] http://www.focusonenergy.com/files/Document_Management_System/Evaluation/renewableenergystandardcalculationrecommendationsrevised_evaluationreport.pdf

[h] Cadmus derived based on two weeks of vacation per year.

[i] DOE Residential Energy Consumption Survey (RECS) Table HC2.3: Household Characteristics by Type of Housing Unit (Millions of Households)

[j] From 12/21/09 Cadmus Group analysis of ComEd data from residential survey of 140 sites. (see sheet BH sinks.xls)

[k] DOE Residential Energy Consumption Survey (RECS) Table HC2.3: Household Characteristics by Type of Housing Unit (Millions of Households)

[l] From 12/21/09 Cadmus Group analysis of ComEd data from residential survey of 140 sites. (see sheet BH sinks.xls)

Showerheads

We calculated energy savings by assuming a decrease in flow rate through low-flow showerheads. This decrease in flow led to energy savings calculated for electric and gas water heaters, shown in Equations 3 and 4 below, respectively:

Equation 3:

Annual Electric DHW Savings (in kWh) per Person for showerheads = $(8.35 * 1 * \text{TIME} * (\text{FR}_b - \text{FR}_e) * (T_{in} - T_{out}) * \text{DAY}_h / 3,413) / \text{EFF}_{elec}$

Equation 4:

Annual Gas DHW Savings (in therms) per Person for showerheads = $(8.35 * 1 * \text{TIME} * (\text{FR}_b - \text{FR}_e) * (T_{in} - T_{out}) * \text{DAY}_h / 100,000) / \text{EFF}_{gas}$

Where the labeled variables are listed in Table 3 and the constants in the equations are:

- 8.35 lbs per gallon
- 1 BTU/lb-degree F = amount of energy to raise 1 lb of water 1 degree F
- 3,413 BTUs per kWh

- 100,000 BTUs per therm
- FR: Flow Rate, denoted with *b* (before) or *e* (efficient) unit
- T: Temperature, denoted with *in* (in-let, cold) or *out* (out-let, hot)

The inputs into Equations 3 and 4, as well as the results of the savings calculation, are shown in Table 3. Cadmus reviewed DWH savings from other program estimates⁴ and determined our previous estimate of shower savings was significantly lower than the average. Since our previous evaluations in PY1 and PY2 we updated the flow rates from a baseline of 2.26 and efficient flow of 1.82, which were based upon an assumption of throttled flow, to the estimates provided in Table 3, below. Cadmus believes that throttled flow (where the shower flow is not turned up all the way) is not appropriate because some shower fixtures do not allow you to change the flow rate of the shower. For those with fixtures where you can adjust flow, Cadmus believed that, in general, people do not use a lower flow rate on their shower. We then multiplied annual savings per person by the number of people living in the home and divided by the number of sinks per home to derive an annual per aerator savings for either single or multifamily homes.

Table 3. Assumptions Used in Low-Flow Showerhead Calculation

Estimate of Default Saving for Low-Flow Showerheads		
Type of Water Heater	Electric	Gas
Efficient Showerhead Flow Rate (FRe) ^[a]	2	2
Baseline Showerhead Flow Rate (FRb) ^[b]	2.67	2.67
Water Heater Recovery Efficiency (EFF) ^[c]	100%	77%
T _{in} (in °F) ^[d]	53.9	53.9
T _{out} (in °F) ^[e]	105	105
Length of Shower (in min) per day per person (TIME) ^[f]	8.2	8.2
Days per Year at Home (DAYh) ^[g]	352.25	352.25
Annual Savings per Person (kWh,therms)	242.0	10.7
People per SF Home ^[h]	2.67	2.67
Showers per SF Home ^[i]	1.79	1.79
Annual Savings per Showerhead in SF Home (kWh,therms)	361.0	16.0
People per MF Home ^[j]	2.14	2.14
Showers per MF Home ^[k]	1.3	1.3
Annual Savings per Showerhead in MF Home (kWh,therms)	398.4	17.7

⁴ The other estimates included the following sources: Ohio TRM 2010, PA TRM 2010, Michigan Measure database, as prepared by Morgan Marketing Partners, 2011, "Energy Cost Calculator for Faucets and Showerheads." 1.9 GPM aerator, 2.0 GPM showerhead, all other input values as defaults.http://www1.eere.energy.gov/femp/technologies/eep_faucets_showerheads_calc.html#output , ComEd All Electric Single Family HEP Tune-Up Program Evaluation Report Draft-October 5, 2010, Efficiency Vermont, TRM User Manual No. 2009-54, pgs 340-344, Dec 30, 2008, NEEP Mid-Atlantic Technical Reference Manual Version 1.1, Oct 2010, prepared by VEIC

Estimate of Default Saving for Low-Flow Showerheads		
Type of Water Heater	Electric	Gas
[a] Rated gpm for efficient showerheads.		
[b] Average measured flow rates from HEP PY1 participants as measured prior to installation of efficient showerheads.		
[c] http://energyexperts.org/EnergySolutionsDatabase/ResourceDetail.aspx?id=594		
[d] For Chicago, IL: From Appendix D: Cold Water Inlet Temperatures, http://www1.eere.energy.gov/femp/pdfs/FTA_res_heat_pump.pdf		
[e] A BPA study measured average shower temperatures 104 - 106. http://www.focusonenergy.com/files/Document_Management_System/Evaluation/renewableenergystandardcalculationrecommendationsrevised_evaluationreport.pdf And 105 is the Default Temperature of Showers in the Vermont TRM 2009 p. 278		
[f] Report claims average shower length is 8.2 minutes: Mayer, P. W., De Oreo, W. B., Nelson, J. O., Opitz, E., and Allen, R. (1997) North American Residential End Use Study Progress Report . American Water Works Association Research Foundation, Denver, CO.		
[g] Cadmus derived based on 2 weeks of vacation per year.		
[h] DOE Residential Energy Consumption Survey (RECS) Table HC2.3: Household Characteristics by Type of Housing Unit		
[i] From 12/21/09 Cadmus Group analysis of ComEd data from residential survey of 140 sites.		
[j] DOE Residential Energy Consumption Survey (RECS) Table HC2.3: Household Characteristics by Type of Housing Unit (Millions of Households)		
[k] From 12/21/09 Cadmus Group analysis of ComEd data from residential survey of 140 sites. (see sheet BH sinks.xls)		