APPENDIX D

Energy Impact Evaluation in Kentucky

Final Report

Prepared for
Duke Energy

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Quick Summary

Duke is evaluating the impacts of a few of their energy efficiency programs in Kentucky. Several different methods of analysis were used to evaluate the impacts. A mail survey was sent to customers who participated in the Kentucky ENERGY STAR lighting program. Customers were asked about their satisfaction with the CFL's or torchiere that they purchased as well as the number of bulbs they installed. There was an online survey that was conducted of customers that visited the energy efficiency section of the Duke Energy website. These customers were asked about the effectiveness of the energy efficiency tools that were on the website as well as if they installed the items they received in the energy efficiency kit sent to them. Finally, a billing analysis of the Personalized Energy Report (PER) of customers that received an energy efficiency kit was completed.

The ENERGY STAR lighting program evaluation revealed a net impacts savings per customer of 755kWh per year. Over half of participants (61%) purchased 7 or more CFLs at the promotional price. Participants purchased on average a little over 9 CFLs at the special price. Slightly over half (53.6%) of participants purchased only 1 or 2 torchiere lamps at the promotional price. The majority of participants (69%) were very satisfied with the CFLs they purchased. Most participants, (60.2%) did not have a CFL in their house before they purchased bulbs through the ENERGY STAR lighting program.

The evaluation of the energy efficiency web tools on the Duke Energy website showed 613.92 kilowatt hours and 17.23 therms saved per customer. This savings is from taking the recommendations found on the website. The most frequently taken actions were replacing furnace filters, switching from hot to cold water to do laundry and managing the drapes. The majority of respondents (83%) thought the website was useful in providing them information about energy use in their home. The energy efficiency calculators found on the Duke Energy website seemed to be the most useful feature as well as most visited area of the site. The lighting calculator found on the site encouraged customers to purchase CFL's. After using the lighting calculator 62.3% of respondents purchased and installed additional CFLs. Overall, half (50.7%) of respondents thought that the website alone caused them to take energy conserving actions.

The billing analysis of the Personalized Energy Report (PER) program for customers within Duke Energy Kentucky apply only to electric customers which have received the energy efficiency kit. The estimated model used for the billing analysis shows that the PER kits results in a savings of 16.22 kWh/month, or 195 kWh a year. The parameter coefficient estimates suggest that there is some interaction between the month variables and the temperature and degree day variables, but this is expected due to the use of a single weather station for the entire service territory. Applying unique weather data more closely aligned to the customer's location would improve modeling accuracy, but would not likely change the overall average impact estimate overall.

ENERGY STAR Lighting Program Evaluation - Kentucky

This evaluation is based on surveys conducted with customers who participated in the Kentucky ENERGY STAR lighting program. These customers purchased either compact fluorescent bulbs or torchiere floor lamp and filled out an instant rebate form at the store from where they purchased the lighting.

The survey was mailed out to 4,717 participants. There were 409 responses received for an 8.7% response rate.

Impacts From the Program

Based on the responses to this survey, the following impacts were developed shown in the table below. The net impact savings per customer was 755kWh per year. There was an average reduction in consumption of 56 watts per bulb. The survey did not address the actual time-of-use, so we are unable to determine the daily load shape. Based upon our previous work on evaluating similar residential CFL programs in other areas, we believe that a conservative estimate of coincident diversity is 10%.

ENERGY STAR Lighting Program Impacts

	Value
Average Installed Bulb/Torchiere	6.5
Average Hours of Use	6.4
Average Watts reduced per bulb	56
Gross Impacts, per customer	897 kWh/year
Free Ridership	16%
Net Impacts, per customer	755 kWh/year

The remainder of this report presents the statistics of each of the questions of the survey. The actual survey instrument can be found in appendix 1.

Promotions

Just over a third (37.9%) of participants found the store advertising and displays and signs in the store very useful. As did slightly over a third (38.1%) of participants think the sales associates in the store were very useful in providing information about the ENERGY STAR program.

How useful was the following in providing you information about energy use in your home?

	Very Useful (3)	Somewhat Useful (2)	Not at all Useful (1)	Total	Mean
Store Advertising	135	149	72	356	2.2
	37.9%	41.9%	20.2%		
Displays and signs in the store	131	145	70	346	2.2
	37.9%	41.9%	20.2%		
Sales Associate at the store	126	101	104	331	2.1
	38.1%	30.5%	31.4%		

Slightly more than a third (31.3%) of participants thought the store advertising was very influential in their decision to purchase the CFLs or torchiere lamp. Participants also thought that the displays and signs in the store had an influence on their purchase decision, with 28.4% very influential. The sales associates were not found to be quite as influential, 41.6% stated they had no influence at all on their decision to purchase.

How influential was the following in your decision to purchase the CFLs or torchiere lamp?

	Very Influential (3)	Somewhat Influential (2)	Not at all Influential (1)	Total	Mean
Store Advertising	105	125	105	335	2.0
	31.3%	37.3%	31.3%		
Displays and signs in the store	96	137	105	338	2.0
	28.4%	40.5%	31.1%		
Sales Associate at the store	94	87	146	327	1.8
	28.7%	26.6%	44.6%		

Performance Ratings

Over half of participants (61%) purchased 7 or more CFLs at the promotional price. Participants purchased on average a little over 9 CFLs at the special price. The average number of CFLs that would have been purchased goes down to 3 when asked how many bulbs the customer would purchase without a rebate or incentive. Slightly over half (53.6%) of participants purchased only 1 or 2 torchiere lamps at the promotional price. There was an average of around 4 torchiere lamps purchased by participants.

We would like to understand how you have used the CFLs and torchiere lamps you have purchased

	1-2	3	4	5	6	7-11	12+	Total	Mean
How many CFLs did you purchase for the special price?	30	7	35	9	71	75	168	395	9
	7.6%	1.8%	8.9%	2.3%	18.0%	19.0%	42.5%		
How many torchiere lamps did you purchase for the special price?	98	14	11	2	16	13	29	183	4
	53.6%	7.7%	6.0%	1.1%	8.7%	7.1%	15.8%		
How many bulbs would you have bought without the rebate or incentive?	202	29	40	7	25	5	14	322	3
	62.7%	9.0%	12.4%	2.2%	7.8%	1.6%	4.3%		

Price of CFL Bulbs

Participants were asked how many CFL bulbs they would purchase at the same price as a standard bulb, if they were $1.00 more, $2.00 more, $3.00 more or free with a rebate. As expected, participants would purchase the most CFLs if the bulbs are free with a rebate, with an average number of 9 bulbs. Participants would almost purchase as many if the CFLs cost the same as a standard bulb, with an average number of 8. The average number of bulbs decreases as the price goes up. The average number of bulbs at $1.00 more is 5, $2.00 more is 3, and $3.00 more is 2.

How many CFL bulbs would you purchase if...

	1-2	3	4	5	6	7-11	12+	Total	Mean
They were the same price as a standard bulb	40	13	29	14	51	43	163	353	8
	11.3%	3.7%	8.2%	4.0%	14.4%	12.2%	46.2%		
They were $1.00 more than a standard bulb	84	25	34	25	50	23	39	280	5
	30.0%	8.9%	12.1%	8.9%	17.9%	8.2%	13.9%		
They were $2.00 more than a standard bulb	115	33	34	9	18	4	11	224	3
	51.3%	14.7%	15.2%	4.0%	8.0%	1.8%	4.9%		
They were $3.00 more than a standard bulb	147	24	15	3	9	1	7	206	2
	71.4%	11.7%	7.3%	1.5%	4.4%	0.5%	3.4%		
They were free but you had to mail in a rebate form to get your money back	39	13	21	10	40	30	164	317	9
	12.3%	4.1%	6.6%	3.2%	12.6%	9.5%	51.7%		

Bulb Installation

Over half of participants (60.2%) installed 6 or more CFL bulb that they purchased. The average number of bulbs participants installed was 7. The typical wattage (47.2%) that the CFL bulb replaced was 45-70 watts. The bulb that the CFL replaced was used and average of 6.9 hours.

Of the bulbs you bought…

	1-2	3	4	5	6	7-11	12+	Total	Mean
How many did you install?	45	32	58	22	76	77	84	394	7
	11.4%	8.1%	14.7%	5.6%	19.3%	19.5%	21.3%		

For each of those bulbs that you installed, what was the typical wattage of the bulb that was replaced?

Wattage of the bulb that was replaced	<44	45-70	71-99	>=100	Total
	5	167	79	103	354
	1.4%	47.2%	22.3%	29.1%	

About how many hours do you use this bulb?

Number of hours bulb is used	<1	1-2	3-4	5-9	10-12	13-24	Total	Mean
	9	29	118	133	57	33	379	6.9
	2.4%	7.7%	31.1%	35.1%	15.0%	8.7%		

The majority of participants (80.8%) did not remove any of the CFLs that they installed. Of the participants that did on average they removed 2 bulbs. Slightly more than one fourth of the participants (26.1%) that removed a CFL did so because the bulb was not bright enough.

Did you remove any of the CFLs you installed?

	Yes	No	Total
Did you remove any of the CFLs you installed?	77	323	400
	19.3%	80.8%	

If yes, how many did you remove?

	1-2	3	4	5	6	7-11	12+	Total	Mean
How many bulbs were removed	47	12	6	0	5	0	0	70	2.0
	67.1%	17.1%	8.6%	0.0%	7.1%	0.0%	0.0%		

Why did you remove them?

	Not bright enough	Did not like the light	Too slow to start	Other	Total
Why the bulb was removed	18	6	5	40	69
	26.1%	8.7%	7.2%	58.0%	

Future CFL Purchases

Participants purchased CFL to install now and for future use. Participants are storing an average of 4 CFLs for later use. The majority of participants (77.8%) have not purchased additional CFL for the standard retail price. Of those participants that have purchased additional bulbs they purchased on average 5 CFLs.

How many CFLs that you purchased did you store for a later time?

	1-2	3	4	5	6	7-11	12+	Total	Mean
CFLs stored for a later time	106	35	48	20	66	31	19	325	4
	32.6%	10.8%	14.8%	6.2%	20.3%	9.5%	5.8%		

	Yes	No	Total
Have you bought any CFLs for retail price after buying these CFLs through the Duke program?	86	301	387
	22.2%	77.8%	

	1-2	3	4	5	6	7-11	12+	Total	Mean
If yes, how many did you purchase?	22	12	18	6	14	4	7	83	5
	26.5%	14.5%	21.7%	7.2%	16.9%	4.8%	8.4%		

Well over half (69%) are very satisfied with the CFLs they purchased. The majority, (60.2%) did not have a CFL in their house before they purchased bulbs through the ENERGY STAR lighting program. Those participants that already had CFLs in there home had on average 4 in their home.

	Very Satisfied (3)	Somewhat Satisfied (2)	Not at all Satisfied (1)	Total	Mean
Overall, how satisfied are you with the CFLs	271	109	13	393	2.7
	69.0%	27.7%	3.3%		

	Yes	No	Total
Did you have any CFLs in your house before you bought these discounted CFLs?	160	242	402
	39.8%	60.2%	

	1-2	3	4	5	6	7-11	12+	Total	Mean
If yes, how many?	71	24	28	4	14	8	7	156	4
	45.5%	15.4%	17.9%	2.6%	9.0%	5.1%	4.5%		

Awareness of CFLs

Almost all of the participants (83.2%) were aware of CFLs before they saw the store promotion. Under half (44.9%) were definitely planning on buying CFLs before they saw the promotion in the store. A large number (85.6%) of the participants felt the in store promotion lead them to purchase more CFLs than they were originally planning to when the walked in the store. The in store promotion lead them to purchase an additional 7 CFLs on average.

	Yes	No	Total
Were you aware of CFLs before you saw the promotion at the store?	328	66	394
	83.2%	16.8%	

	Yes	No	Total
Were you planning on definitely buying CFLs before you saw the promotion?	172	211	383
	44.9%	55.1%	

	Yes	No	Total
Did the promotion lead you to buy more CFLs then you were - planning?	297	50	347
	85.6%	14.4%	

	1-2	3	4	5	6	7-11	12+	Total	Mean
If yes, how many did you purchase?	32	21	31	13	65	51	67	280	7
	11.4%	7.5%	11.1%	4.6%	23.2%	18%	23.9%		

Energy Star Awareness

Most of the participants (68.2%) have not added any electrical appliances to their home in the past year. The majority of customers (63.9%) were aware of the ENERGY STAR label. Slightly over half look for the ENERGY STAR label when they are purchasing a new appliance.

	Yes	No	Total
Have you added any electrical appliances to your home in the past year?	128	275	403
	31.8%	68.2%	

	Yes	No	Total
Are you aware of ENERGY STAR?	253	143	396
	63.9%	36.1%	

	Yes	No	Total
Do you look for the ENERGY STAR label when purchasing an appliance?	219	155	374
	58.6%	41.4%	

Most of the customers (82.2%) that participated in the ENERGY STAR lighting program have never used the Duke Energy website.

	Often (3)	Sometimes (2)	Never (1)	Total	Mean
Do you use the Duke Energy Website?	16	55	327	398	1.2
	4.0%	13.8%	82.2%		

General Information About Your Home

The majority of customers (83.1%) participating in the ENERGY STAR lighting program live in a single family detached dwelling. Over half (58.4%) of the participants homes were built after 1959. More than half (59%) live in a home that has 1,900 or less heated area square footage. Over one fourth (26.5%) of participants were not sure of the square footage of their home. A large percentage (71.9%) of the participants has 1 to 2 people living in their home. Almost all (95.0%) of the participants own their home.

	Detached Single Family	Townhouse	Condo	Apartment	Manufactured Home	Total
Type of home in which you live?	329	7	31	18	11	396
	83.1%	1.8%	7.8%	4.5%	2.8%	

	After 1959	1960-1979	1980-1989	1990-1997	1998-2000	>=2001	Total
What year was your home built?	167	103	47	42	18	24	401
	41.6%	25.7%	11.7%	10.5%	4.5%	6.0%	

	<1200	1201-1600	1601-1900	1901-2400	2401-3000	>=3001	Don't know	Total
Approximate square footage (heated area) of your home?	53	83	47	57	51	19	82	310
	17.1%	26.8%	15.2%	18.4%	16.5%	6.1%	26.5%	

	1	2	3	4	5	6	7	Total
How many people live in your home?	78	209	55	34	17	6	1	399
	19.5%	52.4%	13.8%	8.5%	4.3%	1.5%	.3%	

	Own	Rent	Total
Do you own or rent your home?	380	20	400
	95.0%	5.0%	

Energy Efficiency Web tool

This evaluation is based on an on-line survey conducted with customers who visited the Duke Energy website and used the energy efficiency calculator. These customers were mailed an energy efficiency kit which contained a showerhead, faucet aerators, compact fluorescent light bulbs, and other items to help them save energy. Customers received $20 for filling out the survey.

The survey mailed out to 159 participants. There were 71 responses received for a 44.6% response rate. For the energy efficiency kit, the impacts are assumed to be the same as the impacts from the kits associated with the Kentucky Personalized Energy Report (PER) impact analysis, as the kits were identical. For the energy efficiency recommendations, the PER and website are sufficiently different in their approach (though the measures are identical) that the energy savings from the website are expected to be different from the savings associated with PER.

Therefore, to determine the savings associated with the Energy Efficiency Web tool, the results of the customer behavior from this survey where combined with the engineering based measure savings from the PER analysis to give an estimate of the savings associated with the website recommendations. A summary of the savings are:

Measure	Percent Installed	Website Useful >=4	Average kWh Savings	Total kWh Savings	Average kW Savings	Total kW Savings	Average Therm Savings	Total Therm Savings
Furnace	0.042	0.330	0.00	**0.00**	0.000	**0.000**	16.63	**0.23**
Heat Pump	0.028	1.000	3373.91	**94.47**	1.750	**0.049**	0.00	**0.00**
AC	0.042	1.000	1339.19	**56.25**	1.194	**0.050**	0.00	**0.00**
Window Kits	0.155	0.727	85.22	**9.61**	0.056	**0.006**	1.54	**0.17**
Sidewall	0.085	0.500	796.35	**33.84**	0.706	**0.030**	32.38	**1.38**
Attic	0.113	0.750	350.21	**29.68**	0.188	**0.016**	6.66	**0.56**
Duct Repair	0.099	0.571	542.15	**30.67**	0.159	**0.009**	12.29	**0.70**
Rplace Filter	0.803	0.596	-36.06	**-17.27**	-0.018	**-0.009**	-0.12	**-0.06**
Stop heating room	0.652	0.644	308.74	**129.73**	0.214	**0.090**	3.85	**1.62**
Cleaned Baseboards	0.739	0.647	23.00	**11.00**	0.000	**0.000**	0.00	**0.00**
Drapes	0.812	0.677	75.63	**41.56**	0.000	**0.000**	0.00	**0.00**
Insul. Water Heater	0.217	0.677	175.53	**25.77**	0.020	**0.003**	18.31	**2.69**
Cold water wash	0.812	0.677	202.55	**111.29**	0.023	**0.013**	14.00	**7.69**
Lower water temp	0.812	0.677	101.28	**55.65**	0.000	**0.000**	4.00	**2.20**
Closed Fireplace	0.145	0.677	17.16	**1.68**	0.005	**0.000**	0.36	**0.05**
Total per Cust. Savings		**32%**		**613.92**		**0.258**		**17.23**

Note that the column denoting the percentage of responses with the "website usefulness >4" shows the percentage of respondents undertaking the action who stated that the website was more than "somewhat useful" in affecting the decision to affect the action. Thus, one minus this amount is assumed to be the level of freeridership, which is shown to be 32% overall.

The remainder of this report reviews the individual results for each measure.

Energy Efficiency Recommendations from the Website

The Duke Energy website has an energy efficiency section that provides suggestions for customers on how to make their home more energy efficient. The tables below provide the results of what measures respondents installed after visiting the website.

Installed New Furnace

Most of the respondents (95.8%) did not install a new natural gas furnace after visiting the website. Of the respondents that did more than half of them installed a furnace that the exhaust goes up a chimney similar to a standard efficiency unit.

Frequency of Recommendation Taken: Installed Natural gas furnace

	Count	Col %
Installed a new natural gas furnace		
Yes	3	4.2%
No	68	95.8%
Total	71	100.0%
Type of high efficiency furnace		
the exhausts exit out a plastic pipe coming through the side of the home	1	33.3%
the exhausts go up a chimney similar to a standard efficiency unit	2	66.7%
Total	3	100.0%

Installed New Heat Pump

A very small number of respondents installed a new heat pump after visiting the website. Of those that did, all of them installed a high efficiency unit.

Frequency of Recommendation Taken: Installed Heat Pump

	Count	Col %
Installed a new heat pump		
Yes	2	2.8%
No	69	97.2%
Total	71	100.0%
Efficiency of heat pump		
High Efficiency Unit	2	100.0%
Standard Unit	0	0%
Total	2	100.0%
SEER number for heat pump		
<=11	0	0%
12	0	0%
13	0	0%
>= 14	1	50.0%
Don't Know	1	50.0%
Total	2	100.0%

Install New Air Conditioner

Almost all of the respondents (95.8%) that visited the website did not install a new air conditioning unit. The respondents that did install a new unit installed a high efficiency unit. All the respondents that installed a new unit were unsure of the SEER number for the unit.

Frequency of Recommendation Taken: Installed New Air Conditioning Unit

	Count	Col %
Installed new air conditioner		
Yes	3	4.2%
No	68	95.8%
Total	71	100.0%
Efficiency of air conditioner	0	0%
High Efficiency Unit	3	100.0%
Standard	0	0%
Total	3	100.0%
SEER number for air conditioner		
<=11	0	0%
12	0	0%
13	0	0%
>= 14	0	0%
Don't Know	3	100.0%
Total	3	100.0%

Plastic Wrap-Type Window Kits

A small percentage of respondents (15.5%) purchased and installed additional window kits after visiting the website. Most of the respondents that did install additional kits covered 1-3 windows, that were averaged sized windows.

Frequency of Recommendation Taken: Plastic Wrap-Type Window Kits

	Count	Col %
Purchased and installed window kits		
Yes	11	15.5%
No	60	84.5%
Total	71	100.0%
Number of windows covered		
1-3	8	72.7%
4-7	0	0%
8-10	3	27.3%
11+	0	0%
Total	11	100.0%
Size of window		
Small window	0	0%
Average sized window	7	63.6%
Large window	4	36.4%
Total	11	100.0%

Sidewall Insulation

A few customers (8.5%) installed sidewall insulation as a result of visiting the website. The respondents that did insulate their sidewalls did so on an average of 2 walls.

Frequency of Recommendation Taken: Insulated sidewalls

	Count	Col %
Sidewalls Insulated		
Yes	6	8.5%
No	65	91.5%
Total	71	100.0%
Number of sidewalls insulated		
1	1	20.0%
2	2	40.0%
3	1	20.0%
4+	1	20.0%
Total	5	100.0%

Attic Insulation

Not very many respondents (11.3%) took the recommendation to insulate their attic. Half of those that did take the suggestion insulated part of their attic and the other half insulated their whole attic. Most of those that insulated their attic used 4-6 inch thick insulation.

Frequency of Recommendation Taken: Attic Insulation

	Count	Col %
Attic Insulated		
Yes	8	11.3%
No	63	88.7%
Total	71	100.0%
All or part of ceiling insulated		
Insulated part of the attic	4	50.0%
Insulated the entire attic	4	50.0%
Total	8	100.0%
Inches of thickness added		
1-3	1	14.3%
4-6	5	71.4%
13+	1	14.3%
Total	7	100.0%

Duct Insulation/Repair

Respondents were more likely to repair the ducts (19.7%) than to insulate them (9.9%).

Frequency of Recommendation Taken: Duct Insulation or Repair

	Count	Col %
Insulated ducts		
Yes	7	9.9%
No	64	90.1%
Total	71	100.0%
Repaired or fixed holes in ducts		
Yes	14	19.7%
No	57	80.3%
Total	71	100.0%

Replacing Furnace Filters

The majority of respondents (80.3%) replaced their furnace filters after visiting the website. Most of the customers changed their furnace filter monthly before visiting the website. After visiting the website most respondents started changing their furnace filter on a quarterly basis, which is not as frequently as before visiting the website.

Frequency of Recommendation Taken: Furnace Filter Replacement

	Count	Col %
Replaced furnace filter		
Yes	57	80.3%
No	14	19.7%
Total	71	100.0%
Frequency of filter changes before visiting website		
Monthly	32	56.1%
Quarterly	20	35.1%
Yearly	2	3.5%
*Other	3	5.3%
Total	57	100.0%
Other Responses		
Every 2-3 months		
Every 2 months		
Monthly in the winter months		
Frequency of filter changes since visiting website		
Monthly	14	24.6%
Quarterly	32	56.1%
Yearly	6	10.5%
*Other	5	8.8%
Total	57	100.0%
Other Responses		
6 months		
Every 3-4 months		
Just moved		
Quarterly in winter months		
Whenever I thought it needed it		

Stopped Heating Unused Rooms

Over half of customers (65.2%) that visited the website stopped heating rooms in their home that they were not using after visiting the website. On average respondents would stop heating 2 unused rooms in their home.

Frequency of Recommendation Taken: Turn Off Heat in Unused Rooms

	Count	Col %
Stopped heating unused rooms		
Yes	45	65.2%
No	24	34.8%
Total	69	100.0%
Number of rooms no longer being heated		
1	16	36.4%
2	22	50.0%
3	5	11.4%
5	1	2.3%
Total	44	100.0%

Cleaned Electric Baseboards

This measure only applies to those respondents that have both electric heat and baseboards. Many of those that said they took the action did not have electric heat, so most of the cases were removed from the impact estimation calculation. These responses indicate that many respondents do not know what baseboard unit are, and most likely cleaned the warm air registers from their central heating unit.

Frequency of Recommendation Taken: Clean Baseboards of Dust

	Count	Col %
Cleaned electric baseboards		
Yes	51	73.9%
No	18	26.1%
Total	69	100.0%
Number of electric baseboards cleaned		
1-3	3	6.0%
4-7	12	24.0%
8-12	23	46.0%
13+	12	24.0%
Total	50	100.0%

Install Dual Heating System

Almost none of the respondents (97.1%) installed a dual heating system after visiting the website. Of the few that did, half manages the system to only heat the rooms needed.

Frequency of Recommendation Taken: Install Dual Heating System

	Count	Col %
Installed dual heating system		
Yes	2	2.9%
No	67	97.1%
Total	69	100.0%
Manage this system to only heat the rooms needed		
Yes	1	50.0%
No	1	50.0%
Total	2	100.0%

Manage Draperies

This recommendation has one of the highest response rates, with a little over 80% of respondents indicating that they are now managing their drapes at night and letting the sun shine in during the day. Respondents are managing on average 6 windows after visiting the website.

Frequency of Recommendation Taken: Keep draperies open on sunny days and closed at night

	Count	Col %
Manages draperies		
Yes	56	81.2%
No	13	18.8%
Total	69	100.0%
Number of window coverings managed		
1-3	10	20.8%
4-7	20	41.7%
8-12	13	27.1%
13+	5	10.4%
Total	48	100.0%

Insulated Water Heater

A little under a quarter (21.7%) of respondents insulated their water heater after visiting the website. Most of those respondents had a 50 gallon water heater. The majority of the water heaters (80%) were heated by gas.

Frequency of Recommendation Taken: Insulated water heater

	Count	Col %
Insulated hot water heater tank		
Yes	15	21.7%
No	54	78.3%
Total	69	100.0%
Capacity of water heater, in gallons		
1 -30	3	20.0%
50	7	46.7%
60	2	13.3%
75		
80+	3	20.0%
Total	15	100.0%
How water tank is heated		
Electricity	3	20.0%
Gas	12	80.0%
Total	15	100.0%

Using Cold Water for Laundry

A large percentage of respondents (81.2%) switched from hot to cold water to do their laundry after visiting the website. The respondents do on average 6 loads of laundry per week.

Frequency of Recommendation Taken: Wash laundry in cold water

	Count	Col %
Switched from hot to cold water for laundry		
Yes	56	81.2%
No	9	13.0%
Does Not Apply	4	5.8%
Total	69	100.0%
Number of loads per week		
1-2	6	10.7%
3-4	12	21.4%
5-6	17	30.4%
7-8	12	21.4%
9-10	4	7.1%
11-12	2	3.6%
13+	3	5.4%
Total	56	100.0%

Lowering the Temperature in the Winter

The majority of respondent (81.2%) lowered the temperature of their home in the winter as a result of visiting the website. Over half of the customers (62.5%) that lowered the temperature did so both at night and during the day.

Frequency of Recommendation Taken: Lower Thermostat Temperature in Winter

	Count	Col %
Lowered the temperature in the winter		
Yes	56	81.2%
No	6	8.7%
Does Not Apply	7	10.1%
Total	69	100.0%
Time of day lowered temperature		
At night	16	28.6%
During the day	5	8.9%
Both at night and during the day	35	62.5%
Total	56	100.0%

Closed Off Fireplace

A small percentage of customers (14.5%) stopped using their fireplace unless it is one that uses outside air after visiting the website. Around the same percentage (15.9%) closed off their fireplace as suggested. It appears there are a large number of respondents that do not have a fireplace, which would prevent them from taken the recommended actions.

Frequency of Recommendation Taken: Closed Off Fireplace

	Count	Col %
Stopped using fireplace unless it is one that uses outside air		
Yes	10	14.5%
No	5	7.2%
Does Not Apply	54	78.3%
Total	69	100.0%
Closed off fireplace		
Yes	11	15.9%
No	14	20.3%
Does Not Apply	44	63.8%
Total	69	100.0%

Purchased and Installed CFLs after reviewing the lighting calculator

On the Duke Energy website there is a lighting calculator that calculates your energy savings if you switch from a standard bulb to a CFL based on wattage of bulb, number of bulbs and hours on per day. After using the lighting calculator 62.3% of respondents purchased and installed additional CFLs. Customers on average purchased and installed an additional 7 CFLs after reviewing the lighting calculator. Most of the customers installing a CFL were replacing a bulb that was between 45-70 watts. The bulbs are used on average 7 hours a day.

Purchase and Install Compact Florescent Light (CFLs)

	Count	Col %
Purchased and installed CFLs after reviewing the lighting calculator		
Yes	43	62.3%
No	26	37.7%
Total	69	100.0%
Number of CFLs purchased and installed since visiting the website		
1-2	9	21.4%
3-5	9	21.4%
6-9	6	14.3%
10+	18	42.9%
Total	42	100.0%
Average wattage of bulb removed		
<=44	3	7.0%
45 - 70	29	67.4%
71 - 99	9	20.9%
>=100	2	4.7%
Total	43	100.0%
Average hours bulbs are used per day		
1-2	3	7.0%
3-4	7	16.3%
5-9	25	58.1%
10-12	5	11.6%
13-24	3	7.0%
Total	43	100.0%

Usefulness of Website

The majority of respondents (83%) thought the website was useful in providing them information about energy use in their home. The calculators seemed to be the most useful feature on the website as well as most visited area of the site. Most of the respondents 67.6% found the Home energy calculator useful, 66.2 found the lighting calculator useful and 59.2% found the Appliance calculator useful.

How useful was the website in providing you information about energy use in your home?

	Not at all Useful 1	2	Somewhat Useful 3	4	Very Useful 5	Total	Mean
Count	1	1	10	37	22	71	4.1
Row %	1.4%	1.4%	14.1%	52.1%	31.0%	100.0%	

Which components in the website did you review and how useful were they?

		Not at all Useful 1	2	Somewhat Useful 3	4	Very Useful 5	Did Not Visit	Total	Mean
Home Energy Calculator	Count	0	1	18	24	24	4	71	4.1
	Row %	0%	1.4%	25.4%	33.8%	33.8%	5.6%	100.0%	
Appliance calculator	Count	1	2	14	22	20	12	71	4.0
	Row %	1.4%	2.8%	19.7%	31.0%	28.2%	16.9%	100.0%	
Lighting calculator	Count	2	2	10	25	22	10	71	4.0
	Row %	2.8%	2.8%	14.1%	35.2%	31.0%	14.1%	100.0%	
Interactive home	Count	3	4	15	19	8	22	71	3.5
	Row %	4.2%	5.6%	21.1%	26.8%	11.3%	31.0%	100.0%	
Energy library home energy system	Count	1	6	13	20	10	21	71	3.6
	Row %	1.4%	8.5%	18.3%	28.2%	14.1%	29.6%	100.0%	
Energy library fundamental of electricity	Count	2	5	14	23	6	21	71	3.5
	Row %	2.8%	7.0%	19.7%	32.4%	8.5%	29.6%	100.0%	
For kids		12	3	10	9	3	34	71	2.7
		16.9%	4.2%	14.1%	12.7%	4.2%	47.9%	100.0%	

Almost all (95.8%) respondents thought the website was easy to navigate through. The following suggestions were made to make the site better:

- Full site map needed
- I like it the way it is.
- I wonder if the calculator also takes into account location of the home? i.e. in an open flat area or hilltop, or in a valley all play into air cooling.
- Include info on even bigger things to do - like education on alternative sources of energy (particularly in Covington and especially for heating.
- Large buttons and clear text. Clear colors are a must.
- Put everything on one page rather than clicking links to get to other "hidden" links.

Was the site easy to navigate to get to the information you wanted?

	Yes	No	Total
Count	68	3	71
Row %	95.8%	4.2%	100.0%

Most of the respondents (88.7%) did look at the details in the home energy calculator report and the majority of them (85.7%) though that the results reasonably reflected their usage. Over half (57.2%) of the respondents that looked at the home energy calculator found it to be useful.

Did you look at the Home Energy calculator report details?

	Yes	No	Total
Count	63	8	71
Row %	88.7%	11.3%	100.0%

Did you feel that the estimate reasonably reflected your usage?

	Yes	No	Total
Count	54	9	63
Row %	85.7%	14.3%	100.0%

Was the report very useful?

	Not at all Useful 1	2	Somewhat Useful 3	4	Very Useful 5	Total	Mean
Count	0	0	27	26	10	63	3.7
Row %	0%	0%	42.9%	41.3%	15.9%	100.0%	

The most popular actions that respondents took based on tips from the website were replacing the furnace filter, cleaning baseboards of dust and turning off the heat in unused rooms. Of the respondents that completed those actions 59.8% found the tip to replace the furnace filters helpful, 64.7% found the tip on cleaning the baseboard helpful and 64.4 thought the tip to turn off heat in unused rooms useful.

How useful was the website in determining whether to take any of the following actions

		Not at all Useful 1	2	Somewhat Useful 3	4	Very Useful 5	Total	Mean
Natural gas furnace	Count	0	0	2	1	0	3	3.3
	Row %	0%	0%	66.7%	33.3%	0%	100.0%	
Heat pump	Count	0	0	0	1	1	2	4.5
	Row %	0%	0%	0%	50%	50%	100.0%	
Central air conditioning	Count	0	0	0	1	2	3	3.7
	Row %	0%	0%	0%	33.3%	66.7%	100.0%	
Plastic wrap-type window kits	Count	0	0	3	3	5	11	4.2
	Row %	0%	0%	27.3%	27.3%	45.5%	100.0%	
Insulated sidewalls	Count	0	0	3	1	2	6	3.8
	Row %	0%	0%	50.0%	16.7%	33.3%	100.0%	
Attic insulation	Count	0	1	1	5	1	8	3.8
	Row %	0%	12.5%	12.5%	62.5%	12.5%	100.0%	
Heating or cooling duct insulations	Count	0	2	1	4	0	7	3.3
	Row %	0%	28.6%	14.3%	57.1%	0%	100.0%	
Repair duct	Count	0	2	3	6	3	14	3.7
	Row %	0%	14.3%	21.4%	42.9%	21.4%	100.0%	
Furnace filter replacement	Count	1	5	17	22	12	57	3.7
	Row %	1.8%	8.8%	29.8%	38.6%	21.1%	100.0%	
Turn off heat in unused rooms	Count	2	2	12	20	9	45	3.7
	Row %	4.4%	4.4%	26.7%	44.4%	20.0%	100.0%	
Clean baseboards of dust	Count	2	2	14	23	10	51	3.7
	Row %	3.9%	3.9%	27.5%	45.1%	19.6%	100.0%	

Overall Effect of the Website

Overall, half (50.7%) of respondents thought that the website alone caused them to take energy conserving actions. The website did a good job of reassuring customers about what energy conserving actions to take. The majority of customers 76.8% stated that website was effective in confirming the energy conserving actions they did before visiting the website. A large percentage of respondents (82.4%) felt that the website inspired them to take the energy conserving actions sooner. Receiving the energy efficiency kit caused 66.7% of respondents to take energy conserving actions that they did not think of before visiting the website.

Overall, how much did the website alone cause you to take energy conserving actions that you had not thought of prior to visiting the site?

	Not at All	2	Somewhat	4	Very Much	Total	Mean
Count	1	3	30	22	13	69	3.6
Row %	1.4%	4.3%	43.5%	31.9%	18.8%	100.0%	

If you had energy conserving actions that you did before visiting the website, how effective was the website in confirming that these actions were the correct thing to do?

	Not at all Effective	2	Somewhat	4	Very Effective	N/A	Total	Mean
Count	1	0	14	20	33	1	69	4.2
Row %	1.4%	0%	20.3%	29.0%	47.8%	1.4%	100.0%	

Did the website inspire you to take these actions sooner?

	Yes	No	Total
Count	56	12	68
Row %	82.4%	17.6%	100.0%

How much did the addition of the kit cause you to take energy conserving actions that you had not thought of prior to visiting the site?

	Not at All	2	Somewhat	4	Very Much	Total	Mean
Count	2	2	19	24	22	69	3.9
Row %	2.9%	2.9%	27.5%	34.8%	31.9%	100.0%	

General Information about your home

	Count	Col %
Type of home in which you live		
Detached single-family	59	85.5%
Manufactured/Modular home	2	2.9%
Condominium	2	2.9%
Duplex/2-family	2	2.9%
Multi-family (3 or more units)	4	5.8%
Total	69	100.0%
Year home was built		
Before 1959	28	40.6%
1960 - 1979	15	21.7%
1980 - 1989	4	5.8%
1990 - 1997	4	5.8%
1998 - 2000	5	7.2%
After 2000	13	18.8%
Total	69	100.0%
Approximate square footage (heated area) of your home		
< 1,200	18	26.1%
1,201-1,600	17	24.6%
1,601-1,900	8	11.6%
1,901-2,400	6	8.7%
2,401-3,000	7	10.1%
>3,000	7	10.1%
Don't Know	6	8.7%
Total	69	100.0%
Number of rooms in home (excluding bathrooms but including finished basements)		
1-3	5	7.2%
4	8	11.6%
5	8	11.6%
6	12	17.4%
7	10	14.5%
8	11	15.9%
9	6	8.7%
greater than 9	9	13.0%
Total	69	100.0%
Number of people that live in the home		
1	9	13.0%
2	26	37.7%
3	19	27.5%
4	8	11.6%
5	6	8.7%
7	1	1.4%
Total	69	100.0%

Own or rent home		
Own	60	87.0%
Rent	9	13.0%
Total	69	100.0%

Information about your heating and cooling system

	Count	Col %
Primary type of fuel used to heat the home		
Electricity	15	22.1%
Natural Gas	47	69.1%
Propane	1	1.5%
Oil	3	4.4%
Other/Don't Know	2	2.9%
Total	68	100.0%
Type of heating system in home		
Central furnace fueled by natural gas, propane,or oil with a duct system	52	76.5%
Central furnace with an electric heat pump and a duct system	7	10.3%
Central electric furnace with a duct system	6	8.8%
Other/Don't know	3	4.4%
Total	68	100.0%
If have central furnace system, number of years old		
0-4	22	32.4%
5-9	20	29.4%
10-14	17	25.0%
greater than 14	9	13.2%
Total	68	100.0%
Type of cooling system in home		
Central air conditioner	56	82.4%
Room/window unit air conditioner	8	11.8%
Heat pump	4	5.9%
Total	68	100.0%
Number of room/window unit air conditioners		
2	4	5.6%
3	1	1.4%
4	2	2.8%
5	1	1.4%
Total	8	100.0%
If have a cooling system, number of years old		
0-4	28	41.2%
5-9	19	27.9%
10-14	13	19.1%
greater than 14	8	11.8%

Total	68	100.0%

Information about your water heating, kitchen and laundry systems

	Count	Col %
Primary fuel used by water heater		
Electricity	21	30.9%
Natural gas	46	67.6%
Propane	1	1.5%
Total	68	100.0%
Age of water heater (in years)		
0-4	28	41.2%
5-9	30	44.1%
10-14	8	11.8%
greater than 14	2	2.9%
Total	68	100.0%
Fuel used for indoor cooking		
Electricity	53	77.9%
Natural gas	15	22.1%
Total	68	100.0%
Primary fuel used by clothes dryer		
Electricity	61	89.7%
Natural gas	7	10.3%
Total	68	100.0%

PER Billing Analysis

This analysis presents some of the results of the billing analysis of the Personalized Energy Report (PER) program for customers within Duke Energy Kentucky. These results apply only to electric customers which have received the kit.

For this analysis, data are available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of data, known as "panel" data, it becomes possible to control, simultaneously, for differences across households as well as differences across periods in time through the use of a "fixed-effects" panel model specification. The fixed-effect refers to the model specification aspect that differences across homes that do not vary over the estimation period (such as square footage, heating system, etc.) can be explained, in large part, by customer-specific intercept terms that capture the net change in consumption due to the program, controlling for other factors that do change with time (e.g., the weather).

Because the consumption data in the panel model includes months before and after the installation of measures through the program, the period of program participation (or the participation window) may be defined specifically for each customer. This feature of the panel model allows for the pre-installation months of consumption to effectively act as controls for post-participation months. In addition, this model specification, unlike annual pre/post-participation models such as annual change models, does not require a full year of post-participation data. Effectively, the participant becomes their own control group, thus eliminating the need for a non-participant group. We know the exact month of participation in the program for each participant, and are able to construct customer specific models that measure the change in usage consumption immediately before and after the date of program participation, controlling for weather and customer characteristics.

The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household.

Algebraically, the fixed-effect panel data model is described as follows:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it},$$

where:

y_{it} = energy consumption for home i during month t
α_I = constant term for site i
β = vector of coefficients
x = vector of variables that represent factors causing changes in energy consumption for home i during month t (i.e., weather and participation)
ε = error term for home i during month t.

With this specification, the only information necessary for estimation is those factors that vary month to month for each customer, and that will affect energy use, which effectively are weather conditions and program participation. Other non-measurable factors can be captured through the use of monthly indicator variables (e.g., to capture the effect of potentially seasonal energy loads). The effect of the program, in the case the

Personal Energy Report kit, is done by including a variable which is equal to one for all months after the customer received the kit.[1] The estimated electric model is presented in Table 1.

Table 1: Estimated Model – dependent variable is monthly kWh usage, January 2005 through April 2007.

Independent Variable	Coefficient	t-value
Customer received kit	-16.22	-14.0
Humidity	0.02	0.1
Temperature	-0.08	-4.9
Cooling Degree Days	-0.03	-17.0
Heating Degree Days	8.76	5.4
Indicator for February	-10.09	-5.6
Indicator for March	-29.24	-13.5
Indicator for April	-71.92	-35.5
Indicator for May	-42.14	-9.8
Indicator for June	-14.94	-2.3
Indicator for July	-8.47	-1.3
Indicator for August	-40.93	-14.0
Indicator for September	-61.38	-33.3
Indicator for October	-47.10	-24.4
Indicator for November	-3.02	-1.7
Sample Size	9,688 obs (346 homes)	
R-Squared		
With fixed effect terms	64.9%	
W/O terms	38.8%	

This estimated model shows that the PER kits results in a savings of 16.22 kWh/month, or 195 kWh a year. This estimate is precisely estimated, with the 90% confidence interval extending from savings of 14.3 kWh/month to 18.1 kWh/month. In general, the model performs well, with very high R-squared values and high t-values. The parameter coefficient estimates suggest that there is some interaction between the month variables and the temperature and degree day variables, but this is expected due to the use of a single weather station for the entire service territory. Applying unique weather data more closely aligned to the customer's location would improve modeling accuracy, but would not likely change the overall average impact estimate overall.

[1] The model was estimated in this case only for electrical customers who received the kit. Other models were estimated that included all customers irrespective of whether or not they received a kit, and the pre vs. post effect comparisons were negligibly small, as expected (~3 kWh/month decrease) relative to estimated change per month.

Appendix 1

Dear Customer,

Duke Energy is continuously trying to improve our services for you. To help us improve the ENERGY STAR lighting program, we would like your input. Please let us know what you think about the compact fluorescent bulbs or torchiere floor lamp you purchased through our Energy Star program.

Monica Redman
Research Manager

PLEASE ANSWER THE QUESTIONS BELOW RELATED TO THE CFLs OR TORCHIERE LAMPS YOU PURCHASED.
FILL IN THE CIRCLES COMPLETELY USING BLUE OR BLACK INK.

Promotions

How useful was the following in providing you information about energy use in your home?

	Very Useful	Somewhat Useful	Not at all Useful
Store Advertising	○	○	○
Displays and signs in the store	○ ○	○	
Sales Associate at the store	○	○	○

How influential was the following in your decision to purchase the CFL or torchiere lamp?

	Very Influential	Somewhat Influential	Not at all Influential
Store Advertising	○	○	○
Displays and signs in the store	○ ○	○	
Sales Associate at the store	○	○	○

Performance Ratings

In this section of the survey, we would like to understand how you have used the CFLs and torchiere lamps you have purchased

	1-2	3	4	5	6	7-11	12+
How many CFLs did you purchase for the special price?	○	○	○	○	○	○	○
How many torchiere lamps did you purchase for the special price?	○	○	○	○	○	○	○
How many bulbs would you have bought without the rebate or incentive?	○	○	○	○	○	○	○

How many CFL bulbs would you purchase if...

	1-2	3	4	5	6	7-11	12+
They were the same price as a standard bulb?	○	○	○	○	○	○	○
They were $1.00 more than standard bulbs?	○	○	○	○	○	○	○
They were $2.00 more than standard bulbs?	○	○	○	○	○	○	○
They were $3.00 more than standard bulbs?	○	○	○	○	○	○	○

They were free but you had to mail in a rebate form to get your money back? ☐

Bulb installation

Of the bulbs you bought...

	1-2	3	4	5	6	7-11	12+
How many did you install?	☐	☐	☐	☐	☐	☐	☐

For each of those bulbs that you installed, what was the typical wattage of the bulb that was replaced?

☐ <44 ☐ 45-70 ☐ 71-99 ☐ >=100

	<1	1-2	3-4	5-9	10-12	13-24
About how many hours do you use this bulb?	☐	☐	☐	☐	☐	☐

Did you remove any of the CFLs you installed? ☐ Yes ☐ No

	1-2	3	4	5	6	7-11	12+
If yes, how many did you remove?	☐	☐	☐	☐	☐	☐	☐

Why did you remove them?

☐ Not bright enough ☐ Did not like the light ☐ Too slow to start ☐ Other

More on Back ☞

	1-2	3	4	5	6	7-11	12+
How many CFLs that you purchased did you store for a later time?	☐	☐	☐	☐	☐	☐	☐

Have you bought any CFLs for retail price after buying these CFLs through the Duke program?

☐ Yes ☐ No

	1-2	3	4	5	6	7-11	12+
If yes, how many did you purchase?	☐	☐	☐	☐	☐	☐	☐

	Very Satisfied	Somewhat Satisfied	Not at all Satisfied
Overall, how satisfied are you with the CFLs?	☐	☐	☐

Did you have any CFLs in your house before you bought these discounted CFLs?

☐ Yes ☐ No

	1-2	3	4	5	6	7-11	12+
If yes, how many?	☐	☐	☐	☐	☐	☐	☐

Were you aware of CFLs before you saw the promotion at the store?

☐ Yes ☐ No

If yes...

Were you planning on definitely buying CFLs before you saw the promotion?

☐ Yes ☐ No

If yes…

Did the promotion lead you to buy more CFLs then you were planning?

☐ Yes ☐ No

	1-2	3	4	5	6	7-11	12+
If yes, how many more did you purchase?	☐	☐	☐	☐	☐	☐	☐

ENERGY STAR Awareness

Have you added any electrical appliances to your home in the past year? ☐ Yes ☐ No

Are you aware of ENERGY STAR? ☐ Yes ☐ No

Do you look for ENERGY STAR label when purchasing an appliance? ☐ Yes ☐ No

	Often	Sometimes	Never
Do you use the Duke Energy Website?	☐	☐	☐

General Information About Your Home

To be able to group your responses, please respond to the following categories.

How would you best describe the type of home in which you live?

☐ Detached single-family ☐ Townhouse ☐ Condominium

☐ Apartment ☐ Manufactured home

In what year was your home built?

☐ Before 1959 ☐ 1960 - 1979 ☐ 1980 - 1989

☐ 1990 - 1997 ☐ 1998 – 2000 ☐ >=2001

What is the approximate square footage (heated area) of your home?

☐ <1,200 ☐ 1,201 – 1,600 ☐ 1,601 – 1,900

☐ 1,901 – 2,400 ☐ 2,401 – 3,000 ☐ >=3,001

☐ Don't know

How many people live in your home?

☐ 1 ☐ 2 ☐ 3 ☐ 4

☐ 5 ☐ 6 ☐ 7 ☐ >=8

Do you own or rent your home?

☐ Own ☐ Rent

THANK YOU FOR YOUR RESPONSES

APPENDIX E

Energy Impact Evaluation of the Personalized Energy Report Program in Kentucky

Final Report

Prepared for
Duke Energy

139 East Fourth Street
Cincinnati, OH 45201

July 27, 2007

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Summary of Findings

The measures provided in the Energy Efficiency Starter Kits are installed and used by program participants in a way that provides significant energy savings to the participants and to Duke Energy. For the Kentucky participants, the installation of the measures provided in the kit provides an annual energy savings of 4,443 therms, 157,414 kWh and reduced peak load by 16.492 kilowatts.

	Total Savings	Mean Savings
Kentucky Kits (n = 741)		
kW	16.492	0.022
kWh	157,414	212.4
Therms	4,443	6.0

The Personalized Energy Report also included recommendations for the customers to reduce their energy consumption. These recommendations were provided to those that received the Energy Efficiency Starter Kits, and to those that did not. The annual first year savings estimated as a result of these actions are summarized in the table below:

	Total Savings	Mean Savings
Kentucky Kits (n = 741)		
kW	180.600	0.244
kWh	485,709	656
Therms	10,925	14.7
Kentucky No Kits (n = 1,879)		
kW	185.923	0.099
kWh	1,062,698	566
Therms	29,042	15.5

These savings can be expected over the effective useful life of the installed measures.

The impact estimates are based on survey responses of what actions were taken and the use conditions associated with these actions for the weather zone in which the participants reside. The energy savings estimates are based on DOE-2 simulations of measure impact in residential buildings. This type of modeling and assessment approach is an industry standard and can be expected to provide accurate estimates of program impact that are consistent with the accuracy of the survey information provided by the program participants. It should also be noted that the energy savings estimates included in this report include substantial discounts for self-selection bias and false response bias. At this time the impacts of these two response biases are largely un-quantified within the energy program evaluation industry and substantial research is needed to accurately predict the impacts of these biases on the analysis results. These biases and the resulting discount factors are discussed in the main body of the report.

Introduction

This document presents the evaluation report for Duke Energy's Personalized Energy Report Program as it was administered in Kentucky. An impact analysis was performed for each of the measures in the Personalized Energy Report Kit. The impacts are based on the responses to two customer surveys, attached to this report as Appendices A and B.

This report is structured to provide energy savings impact estimations per measure and per recommendation adopted by participants. The impact tables reporting total savings are based on the number of respondents indicating that they have taken actions as a result of their participation in the program. The number of customers installing the different measure varies widely, however the average savings per customer for each measure and/or recommendation can be calculated from the information in the tables. After each of the measures are discussed individually, the report presents the estimated energy savings achieved per distributed PER with or without the Energy Efficiency Starter Kit.

This evaluation is based on surveys conducted with customers who participated in the PER program and who may have received the kits mailed by the program. The study did not use on-site verification efforts to confirm if the survey information provided by the customer is accurate or if the measures taken were correctly installed, or used in a way that provides the projected savings. However, we have no reason to believe that the kit-related information provided by the participants is inaccurate or that the measures reported to be installed by the participants were not installed, nor do we believe these measures once installed, were ineffectively used to acquire energy savings. In the opinion of the authors of this report, the biases associated with the kit-provided measures are not significant. As a result, the evaluation contractors consider the kit associated analysis of the study a reasonable estimate of kit-induced savings. However, because of the greater uncertainty around the two key biases associated with the installation of program-recommended measures (self-selection bias and false response bias) we do not consider the savings estimates based solely on the participant's responses to be a reliable indicator of actions taken. As a result, the authors have substantially reduced the estimated savings resulting from the participant's responses regarding the recommendations that were reported as being taken by the participants.

The evaluation was conducted by TecMarket Works and Architectural Energy Corporation (AEC) with assistance from Integral Analytics. The survey instruments were developed by TecMarket Works and AEC. The survey was administered by Integral Analytics via an automated response reading system. The survey was designed to be easily completed by participants by shading a box that best represents their response to the questions. Integral Analytics finalized the survey and formatted the instrument for electronic reading of survey results. The questions were designed to support energy savings calculations for actions that were taken as a result of the program.

Methodology

This section presents the approach for conducting this assessment.

Development of the Customer Surveys

TecMarket Works and Integral Analytics developed a customer survey for delivery to the Personalized Energy Report (PER) Program participants after they have had time to implement the actions and recommendations included in the kit and PER that was distributed to participants. The survey asks participants about the changes that they have made to their home as a result of their receipt of the kit and the recommendations contained in the PER distributed by the Program. The survey asked the customer for information specific to each of the measures included in the Energy Efficiency Starter Kit and each of the recommendations in the PER. For each measure that was installed and for each recommendation taken, the participant completed a short battery of questions to determine the degree to which that measure was effectively placed and used. The survey was sent to two different types of customers. One of these was a group who received the kit and the PER. The second group of customers were residential program participants who only received the PER.

The customer surveys were electronic-scoring surveys. During the survey development process it was necessary to restrict questions so that they would fit on a set of double page paper that could be electronically scanned on each side of the page. This approach helped reduce the evaluation cost, but also reduced the number of questions that could be asked in order to calculate energy savings. However, this procedure did not result in overly restrictive questions and were structured to collect the data necessary to calculate savings. These two surveys can be found in Appendices A and B.

Survey Response

The surveys were sent to 5,401 participants – 3,562 customers that did not receive the kit, and 1,839 customers that did receive the Energy Efficiency Starter Kit. The data collection efforts resulted in 1,879 responses from PER participants that only received the PER (response rate = 52.8%), and 741 responses (response rate = 40.3%) from Kentucky PER participants that received the Energy Efficiency Kit.

Obtained and Cleaned Customer Information

The evaluation required participant data from Duke Energy, including the results of the survey data provided by each of the participants enrolled in the program. Once the data was delivered, TecMarket Works reviewed the data for accuracy and completeness, and coded the data to ready it for analysis in SPSS[1].

Program Impact Estimation

Using the measure-specific data collected from the customer surveys, we were able to extrapolate energy savings to the PER Program as a whole, and for each of the kit's eight measures individually. The per unit energy savings for each of the measures was

[1] Statistical Package for the Social Sciences. SPSS.com.

determined through a method in which TecMarket Works and AEC assigned the estimates of energy savings for each of the measures included in the PER Energy Efficiency Starter Kit and for each of the recommended measures. The estimates were formed via engineering estimates of savings based on survey information and on modeling results in which the calculations for the actions taken follow DOE-II residential software modeling algorithms for the expected weather in which the actions are taken. Historical weather average daily conditions were used as the predictive weather. This approach allows for reliable energy savings estimates consistent with accepted modeling approaches based on customer-provided installation and use conditions. Because the survey asks for customers to provide information on actions that were taken in part or in whole as a result of the program, the savings reported can be considered net savings with the understanding that typically actions are taken as a result of a combination of reasons and conditions. However, because the measures were obtained via the Duke-provided kit, and because the survey instrument asked for respondents to indicate only the actions taken as a result of their participation in the program the findings in this study can be considered reflective of the net program-induced savings.

The items distributed in the kit include the following measures.

1. 15-watt CFL
2. 20-watt CFL
3. Weather stripping
4. Outlet gaskets
5. Window shrink kit
6. Showerhead
7. Bathroom aerator
8. Kitchen aerator

The recommendations in the PER include the following actions:

1. Clean baseboards
2. Close off fireplace
3. Install a new central air unit
4. Install a new furnace
5. Install a new heat pump
6. Install attic insulation
7. Install sidewall insulation
8. Install window shrink kits
9. Insulate ducts
10. Insulate water heater
11. Lower the temperature in winter
12. Manage draperies
13. Purchase and install CFLs
14. Repair ducts
15. Replace furnace filter
16. Stop heating unused rooms
17. Switch to cold water for laundry

The algorithms used to calculate the impact estimates can be found in Appendix C.

Findings

Use of the Kit's Measures and Their Impacts

CFLs

The CFLs included in the PER kit were installed by more recipients than any other measure in the Energy Efficiency Starter Kit. Almost 90% of the recipients installed the 15-watt CFL, and close to 85% of them installed the 20-watt CFL. Table 1 below shows a summary of the responses to the questions about the 15-watt CFL. Most of the Kit recipients replaced a 45-70-watt bulb with the 15-watt CFL, and the replacement was done on lights that were used 3-4 hours per day on average. The same information can be found in Table 2 for the 20-watt CFL.

Table 1. Frequency of Installation: 15-watt CFL

Action	Kentucky Kits (n)	Kentucky Kits (%)
Installed 15w bulb		
Yes	654	89.3%
No	72	9.8%
Don't Know	6	0.8%
Wattage of bulb removed		
Less than 44w	52	8.1%
45-70w	459	71.5%
71-99w	69	10.7%
Greater than 100w	62	9.7%
Hours of use per day		
<1	63	10.2%
1-2	144	23.3%
3-4	237	38.3%
5-10	143	23.1%
11-12	16	2.6%
13-24	16	2.6%

Table 2. Frequency of Installation: 20-watt CFL

Action	Kentucky Kits (n)	Kentucky Kits (%)
Installed 20w bulb		
Yes	590	83.7%
No	106	15.0%
Don't Know	9	1.3%
Wattage of bulb removed		
Less than 44w	27	4.7%
45-70w	333	58.0%
71-99w	125	21.8%
Greater than 100w	89	15.5%
Hours of use per day		
<1	49	8.9%
1-2	138	25.2%
3-4	219	40.0%

5-10	118	21.5%
11-12	12	2.2%
13-24	12	2.2%

Using the information above and the algorithm for lighting impacts (which can be found in Appendix C), the estimate of savings for these customers totals 8.01 kw and 104,690 kilowatt hours per year. However, the reduction in heat output from switching the incandescent to the CFL results in an increase in therm consumption of 158.9 therms per year total. Savings can be found in Table 3.

The savings per customer for either of the CFLs can also be found Table 3 below. For instance, each customer that installed the 15-watt CFL will save 84.5 kwhs per year (55,269 / 654 = 84.5). This is the average per customer savings. The real savings will of course depend on the other factors involved (the wattage of the bulb removed and hours of use).

Table 3. Impact Estimates from the Installation of the CFL Bulbs

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
15-watt CFL	654	4.148	55,269	-158.9
20-watt CFL	590	3.862	49,421	
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
15-watt CFL	654	0.00634	84.51	-0.13
20-watt CFL	590	0.00655	83.76	

Weather Stripping

Just over a third of the kit recipients (36%) installed the weather stripping, but most of those that did used 11-17 feet of the product. Given the low number of installations, the savings for this measure are modest, Table 5 below shows the energy savings from these 259 installations, with only 1,791 kilowatt hours and 41 therms saved per year.

Table 4. Frequency of Installation: Weather Stripping

Action	Kentucky Kits (n)	Kentucky Kits (%)
Installed weather stripping		
Yes	259	35.8%
No	453	62.9%
Don't Know	9	1.3%
Feet installed		
1-5	36	14.2%
6-10	95	37.5%
11-17	122	48.2%

Table 5. Impact Estimates from the Installation of the Weather Stripping

	Number	Total kW	Total kWh	Total Therm

	Installed	Savings	Savings	Savings
Weather stripping	259	.549	1,791	41.3
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
		0.00212	6.9	0.16

Outlet Gaskets

About half of the recipients installed the outlet gaskets, and most of them installed 3-5 gaskets (they were provided with 8). Despite this, the kilowatt hour savings from this measure are 5,259 kWh annually.

Table 6. Frequency of Installation: Outlet Gaskets

Action	Kentucky Kits (n)	Kentucky Kits (%)
Installed the gaskets on outlets		
Yes	366	50.6%
No	354	48.6%
Don't Know	4	0.6%
Number installed		
1-2	73	19.4%
3-5	180	47.7%
6-8	124	32.9%

Table 7. Impact Estimates from the Installation of the Outlet Gaskets

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Outlet gaskets	366	1.534	5,259	105.5
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
		0.00419	14.37	0.29

Window Shrink Kit

Most of the kit recipients did not install the window film shrink kit. Only 14% of the population installed this measure.

Table 8. Frequency of Installation: Window Film Shrink Kit

Installed window shrink kit	Kentucky Kits (n)	Kentucky Kits (%)
Yes	101	14.0%
No	611	85.0%
Don't Know	7	1.0%
Size of window		
Small	16	16.3%
Average	69	70.4%
Large	13	13.3%
Type of window		
Single Pane	37	38.1%
Single with storm	23	23.7%

Double Pane	37	38.1%

With the low numbers of installations combined with the fact that 38% of the kits were installed on double-pane windows, the savings for this measure are also quite low.

Table 9. Impact Estimates from the Installation of the Window Film Shrink Kit

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Window shrink kit	101	2.286	3,957	44.9
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
		0.02263	39.18	4.41

Low-Flow Showerhead

A high percentage (64%) of the kit recipients installed the low-flow showerhead. Most of the recipients reported that there are 5-10 showers taken at the residence per week. However, the high savings comes from the larger families that indicated that they take over 21 showers per week with the new showerhead.

Table 10. Frequency of Installation: Low-Flow Showerhead

Action	Kentucky Kits (n)	Kentucky Kits (%)
Installed the showerhead		
Yes	467	63.9%
No	261	35.7%
Don't Know	3	0.4%
Number of showers per week		
0-4	77	16.7%
5-10	226	49.0%
11-15	107	23.2%
16-20	28	6.1%
21+	23	5.0%
Estimate of water flow		
Less than the old unit	251	56.5%
About the same as the old unit	176	39.6%
More than the old unit	17	3.8%

The numbers of installations vary as a result of the estimate of water flow provided. If the customer indicated that the water flow was "about the same as the old unit", their information was removed from the energy impact calculations. If they indicated that the water flow was "more than the old unit", they were included in the impact calculations but a 1.0gpm showerhead was assumed to have been replaced with the 1.5gpm showerhead included in the kit. This resulted in those 17 customers having negative savings. However, the savings from this measure are still very strong, with over 35,000 kilowatt hours and almost 4,000 therms saved annually as a result of these customers installing this measure.

Table 11. Impact Estimates from the Installation of the Low-Flow Showerhead

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Showerhead	291	4.053	36,983	3,725
Per Install →		Mean kW Savings	Mean kWh Savings	Mean Therm Savings
		0.01393	127.09	12.80

Faucet Aerators

The customers were also likely to install the faucet aerators included in the Energy Efficiency Starter Kit. More than half of the kit recipients installed both of the aerators. The wording of the survey questions for this measure resulted in an interesting finding: many of the customers indicated that they did not install the aerator included in the kit, but still marked that there was already an aerator in place, indicating that this energy efficient action had already been undertaken without the prompting of the Energy Efficiency Starter Kit and the Personalized Energy Report. Those that fall into this category are included in the frequency tables below (Table 12 and Table 13), but not in the energy impact estimates.

Table 12. Frequency of Installation: Bathroom Faucet Aerator

Action	Kentucky Kits (n)	Kentucky Kits (%)
Installed the bathroom aerator		
Yes	397	54.8%
No	320	44.2%
Don't Know	7	1.0%
Aerator already installed		
Yes	245[2]	55.8%
No	177	40.3%
Don't Know	17	3.9%
Estimate of water flow		
Less than the old unit	188	54.5%
About the same as the old unit	145	42.0%
More than the old unit	12	3.5%

Table 13. Frequency of Installation: Kitchen Faucet Aerator

Action	Kentucky Kits (n)	Kentucky Kits (%)
Installed the kitchen aerator		
Yes	366	50.6%
No	354	48.6%
Don't Know	4	0.6%
Aerator already installed		
Yes	236[3]	58.7%
No	153	38.1%
Don't Know	13	3.2%
Estimate of water flow		

[2] Includes 14 respondents that did not install the PER kit's aerator.
[3] Includes 22 respondents that did not install the PER kit's aerator.

Less than the old unit	175	57.4%
About the same as the old unit	114	37.4%
More than the old unit	16	5.2%

The energy impacts for this measure are in the table below, and indicate overall savings of over 4,000 kilowatt hours per year and 285 therms per year.

Table 14. Impact Estimates from the Installation of the Bathroom and Kitchen Faucet Aerators

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Bathroom aerator	397	.035	2,651	150
Kitchen aerator	366	.025	2,083	135
Per Install →		Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Bathroom aerator		.00009	6.68	0.38
Kitchen aerator		.00007	5.69	0.37

All Kit Measures

The Energy Efficiency Starter Kit is a kit of 8 energy efficient measures. The tables below show the relative "popularity" of each of the items for the recipients of the kits and the total savings for each of the measures based on those customers that indicated they installed the measure.

The CFLs are the most likely measure to be installed, with the showerhead coming in second. Given the responses by the customers indicating the details of the installation (number of showers, wattage of bulb replaced, etc.), the showerhead provides a greater amount of savings than the CFLs.

Table 15. Summary of Total Savings for All Measures

Kentucky Kits	Installed	Percent Installed	Total kW savings	Total kWh savings	Therm savings
15-watt CFL	654	88.3%	4.148	55,269	
20-watt CFL	590	79.6%	3.862	49,421	-159
Weather stripping	259	35.0%	.549	1,791	41
Outlet gaskets	366	49.4%	1.534	5,259	106
Window shrink kit	101	13.6%	2.286	3,957	445
Showerhead	291	39.3%	4.053	36,983	3,725
Bathroom aerator	397	53.6%	.035	2,651	150
Kitchen aerator	366	49.4%	.025	2,083	135
Total Savings			**16.492**	**157,414**	**4,443**

The total savings from those that received the kits and responded to the survey is estimated to be 157,414 kilowatt-hours and 4,443 therms annually. The kilowatt impacts of the kits is estimated to be 16.492.

Table 16 below shows the mean savings per measure installed. To obtain these values, the total savings for each group and measure was divided by the total installations, resulting in a "per install" savings value. If a customer were to install each of the measures in the kit, the "Mean Total" amount at the bottom of each table would be the average energy savings based on the responses of that group.

The "Mean Total Savings per Kit" at the bottom of the table shows the average savings realized by the respondents using the mean of percent installed from Table 15 above.

Table 16. Summary of Mean Savings for All Measures

Kentucky Kits	Mean kW per install	Mean kWh per install	Mean Therms per install
15-watt CFL	0.00634	84.51	-0.13
20-watt CFL	0.00655	83.76	
Weather stripping	0.00212	6.9	0.16
Outlet gaskets	0.00419	14.37	0.29
Window shrink kit	0.02263	39.18	4.41
Showerhead	0.01393	127.09	12.80
Bathroom aerator	0.00009	6.68	0.38
Kitchen aerator	.00007	5.69	0.37
Mean Total Savings, if all measures installed	**0.05592**	**368.18**	**18.28**
Mean Total Savings per Kit Sent	**0.02226**	**212.4**	**6.00**

PER Recommendations Impacts

The Personalized Energy Report had a list of energy-saving recommendations for each participant. The survey (which can be found in Appendix B) was sent out to those that received the Energy Efficiency Starter Kit and customers who did not receive the Kit, (only the PER). The results of this mail survey are presented below, with the associated energy impact estimations for each of the recommendations. Responses were received from 741 customers that received the Kit, and 1,879 customers that only received the PER.

The surveys allowed respondents to state they took the recommendation, or that they plan to take the recommendation. Those that indicated that they "plan to do this" are reported separately and should be interpreted as future potential savings rather than achieved savings.

Lowering the Temperature in Winter

The PER stated that lowering the thermostat temperature to the lowest temperature comfortable for the family could save 3% of energy costs for each degree. The response to this recommendation was strong, with 83% of those that received the kits and 84% of

those that did not get the kit indicating on the survey that they did lower the temperature in the winter as a result of reading the report. Most of the customers lowered the temperature by 1-3 or 4-6 degrees, but there were some that lowered the temperature by 11 degrees or more, saving the household a significant amount of energy.

Table 17. Frequency of Recommendation Taken: Lowering the Temperature in Winter

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Lowered the temperature at night				
Yes	608	83.4%	1,559	84.0%
No	99	13.6%	243	13.1%
No, but plan to do this	19	2.6%	36	1.9%
Don't Know	3	0.4%	17	0.9%
Number of degrees lowered during the day				
1-3	286	48.8%	689	45.6%
4-6	222	37.9%	596	39.6%
7-10	65	11.1%	176	11.7%
11+	13	2.2%	43	2.9%
Number of degrees lowered at night				
1-3	316	60.3%	778	58.1%
4-6	141	26.9%	409	30.5%
7-10	54	10.3%	123	9.2%
11+	13	2.5%	29	2.2%

The 2,167 respondents to the survey that indicated that they have turned down the temperature are realizing a savings of 178,466 kilowatt hours per year and 3,807 therms per year, an average of almost 300 kwhs and 6 therms annually per response.

Table 18. Total Impact Estimates from Lowering the Temperature in Winter

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes, lowered the temperature in winter	608			
Daytime savings		-	121,733	2,727
Nighttime savings		-	56,733	1,080
No, but plan to lower the temperature	19			
Daytime savings		-	2,727	39
Nighttime savings		-	1,361	18
Kentucky No Kits	1879			
Yes, lowered the temperature in winter	1559			

Daytime savings		-	464,354	7,255
Nighttime savings		-	96,373	2,778
No, but plan to lower the temperature	36			
Daytime savings		-	9,878	82
Nighttime savings		-	5,529	31

Table 19. Mean Impact Estimates from Participants Lowering the Temperature in Winter

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, lowered the temperature in winter	608			
Daytime savings		-	200.2	4.5
Nighttime savings		-	93.3	1.8
Kentucky No Kits	1879			
Yes, lowered the temperature in winter	1559			
Daytime savings		-	297.7	4.7
Nighttime savings		-	138.1	1.8

CFLs

The PER included the following statement: "Energy-saving compact fluorescent light bulbs use up to 75% less energy than standard bulbs and last up to 10 times longer." From this simple statement, about 50% of the recipients said that they purchased and installed more CFLs that was at least in part induced by their report. Those that received the two CFLs with the kit were slightly more likely to take this action (55% versus 50%). However, 32% that did not receive the kit indicate that they plan on purchasing and installing CFLs.

Table 20. Frequency of Recommendation Taken: Purchase and Install CFLs

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Purchased and installed CFLs				
Yes	393	55.4%	899	49.4%
No	144	20.3%	588	32.0%
No, but plan to do this	170	24.0%	319	17.3%
Don't Know	2	0.3%	25	1.4%
Number of CFLs purchased and installed				
1-2	99	24.3%	299	31.9%

3-5	143	35.1%	330	35.2%
6-9	94	23.1%	188	20.1%
10+	71	17.4%	120	12.8%
Average wattage of bulb removed				
=<44	12	2.9%	28	3.2%
45-70	267	65.4%	521	59.0%
71-99	78	19.1%	191	21.6%
=>100	51	12.5%	143	16.2%
Average hours bulbs are used per day				
=<1	4	1.0%	25	2.7%
1-2	43	11.0%	120	13.1%
3-4	142	36.2%	305	33.3%
5-9	141	36.0%	357	38.9%
10-12	41	10.5%	79	8.6%
13-24	21	5.4%	31	3.4%

The savings from installing the CFLs are shown in Table 21 below. The estimates for those that indicated that they planned on purchasing CFLs are based on the mean responses of those that provided the details of what wattage bulb was replaced and the hours of use for that bulb. Using only the savings estimates based on those that said that they took the action, those that received the kits reduced their kWh consumption by 151,396kWhs, or about 385 kwhs per person, per year. Those that did not receive kits reduced their consumption by 45,864 kWhs per year, or 51 kWhs per person, per year. These may seem like high estimates, but when you consider the responses to the questions summarized in Table 20 above, many of them made these replacements in lamps that the customer reports using 5-9 hours per day. That is, they report that they have installed the lamps in their high-use fixtures and checked the number of hours that they use the lamps per day.

Table 21. Total Impact Estimates from Installing CFLs

	Population	Total Bulbs	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741				
Yes, purchased and installed CFLs	393	2107	25.255	151,396	-67.2
No, but plan to purchase and install CFLs	170		.187	3,477	-6.8
Kentucky No Kits	1879				
Yes, purchased and installed CFLs	899	4269	5.503	45,864	-136
No, but plan to purchase and install CFLs	319		.580	7,461	-12.7

Table 22. Mean Estimates from Participants Installing CFLs

	Population	Mean kW	Mean kWh	Mean

		Savings	Savings	Therm Savings
Kentucky Kits	741			
Yes, purchased and installed CFLs	393	0.06426	385.2	-0.2
Kentucky No Kits	1879			
Yes, purchased and installed CFLs	899	0.00612	51	-0.2

Using Cold Water for Laundry

Over half of the respondents indicated that they switched from hot to cold water to do their laundry at least in part because of the PER. The total savings from this recommendation are presented in Table 24 and indicate significant savings. The mean savings are presented in Table 25.

Table 23. Frequency of Recommendation Taken: Switching to Cold Water for Laundry

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Switched from hot to cold water for laundry				
Yes	390	55.5%	993	55.5%
No	242	34.4%	643	35.9%
No, but plan to do this	53	7.5%	118	6.6%
Don't Know	18	2.6%	35	2.0%
Number of loads per week				
1-2	61	15.6%	195	19.3%
3-4	128	32.7%	356	35.2%
5-6	105	26.9%	265	26.2%
7-8	48	12.3%	116	11.5%
9-10	28	7.2%	56	5.5%
11-12	10	2.6%	8	0.8%
13+	11	2.8%	16	1.6%

Table 24. Total Impact Estimates for Switching to Cold Water

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes, switched to cold water	386	5.582	27,404	3,875.6
Plan to switch	53	.234	2,059	450
Kentucky No Kits	1879			
Yes, switched to cold water	987	7.159	62,702	10,210.6
Plan to switch	118	0.753	6,601	1,130

Table 25. Mean Impact Estimates for Participants Switching to Cold Water

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, switched to cold water	386	0.01446	71	10.0
Kentucky No Kits	1879			
Yes, switched to cold water	987	.00725	63.5	10.3

Replacing Furnace Filter

This recommendation is the only one that resulted in overall negative savings. Many of those that indicated that they changed their furnace filters reported that they change their filters *less* frequently now compared to before they received the PER recommendations. This resulted in an overall increase in energy consumption. As a result we separated the results for this measure to show the savings for those that increased the frequency of filter changes and those that decreased the frequency of filter changes.

Table 26. Frequency of Recommendation Taken: Replacing Furnace Filter

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Replaced furnace filter				
Yes	613	86.5%	1,574	87.8%
No	66	9.3%	136	7.6%
No, but plan to do this	26	3.7%	75	4.2%
Don't Know	4	0.6%	8	0.5%
Frequency of filter changes before PER				
Less than once a year	18	3.1%	47	3.2%
Once a year	51	8.7%	134	9.2%
Twice a year	128	21.9%	342	23.5%
More than twice a year	380	65.1%	897	61.6%
Don't Know	7	1.2%	35	2.4%
Frequency of filter changes since PER				
Less than once a year	8	1.3%	22	1.5%
Once a year	39	6.6%	111	7.5%
Twice a year	125	21.0%	307	20.7%
More than twice a year	420	70.7%	1,035	69.7%
Don't Know	2	0.3%	10	0.7%

Table 27. Total Impact Estimates for Changing Furnace Filter

	Population	Number Changing Filters	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741	143			
Increasing Frequency		68	8.800	11,943	122
Decreasing Frequency		75	-11.040	-15,877	-143

Total Savings			-2.240	-3934	-21
Kentucky No Kits	1879	458			
Increasing Frequency		241	32.240	43,359	433
Decreasing Frequency		217	-33.120	-47,976	-392
Total Savings			-.880	-4617	41

Table 28. Mean Impact Estimates for Participants Changing Furnace Filter

	Population	Number Changing Filters	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741	143			
Increasing Frequency		68	0.12941	175.63	1.79
Decreasing Frequency		75	-0.14720	-211.69	-1.91
Total Savings			-0.01779	-36.06	-0.12
Kentucky No Kits	1879	458			
Increasing Frequency		241	0.13378	179.91	1.80
Decreasing Frequency		217	-0.15263	-221.09	-1.81
Total Savings			-0.01885	-41.18	-0.01

Closed Off Fireplace

The survey asked if the respondent stopped using the fireplace, and then asked if they closed off the fireplace. Those that indicated that they stopped using the fireplace were removed, as there are no savings from this action, but if they also indicated that they closed up or sealed up the fireplace, then the savings were estimated.

Table 29. Frequency of Recommendation Taken: Closing Off Fireplace

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Stopped using fireplace				
Yes	211	38.7%	559	42.5%
No	305	56.0%	708	53.8%
No, but plan to do this	19	3.5%	26	2.0%
Don't Know	10	1.8%	23	1.8%
Closed off fireplace				
Yes	191	39.0%	509	46.2%
No	265	54.1%	531	48.2%
No, but plan to do this	24	4.9%	36	3.3%
Don't Know	10	2.0%	25	2.3%

Table 30. Total Impact Estimates for Closing Off Fireplace

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kits	191	0.642	1,103	20.7
No Kits	509	0.340	1,201	22.5

Table 31. Mean Impact Estimates for Participants Closing Off Fireplace

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kits	191	0.00336	5.8	0.1
No Kits	509	0.00067	2.40	0.0

Stopped Heating Unused Rooms

More than half said that they stopped heating unused rooms in their homes, and significant savings were realized from this action. Most of them indicated that they stopped heating one or two rooms in the house, 15% of those that did not get kits said they stopped heating three unused rooms.

Table 32. Frequency of Recommendation Taken: Stop Heating Unused Rooms

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Stopped heating unused rooms				
Yes	405	56.6%	1,032	56.2%
No	282	39.4%	735	40.0%
No, but plan to do this	27	3.8%	63	3.4%
Don't Know	1	0.1%	7	0.4%
Number of rooms no longer being heated				
1	138	36.6%	320	31.6%
2	159	42.2%	419	41.3%
3	41	10.9%	152	15.0%
4	15	4.0%	59	5.8%
5	13	3.4%	33	3.3%
6+	11	2.9%	31	3.1%

The savings from this recommendation are shown in

Table 33 below.

Table 33. Total Impact Estimates for Not Heating Unused Rooms

	Population	Number Closing Off Rooms	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741				
Yes		405	86.488	35,061	437
No, but plan to		27	1.523	2,120	33.1
Kentucky No Kits	1879				
Yes		1032	81.334	123,535	1,270.4
No, but plan to		63	5.992	9,529	74.9

Table 34. Mean Impact Estimates for Participants Not Heating Unused Rooms

	Population	Number Closing Off Rooms	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741				
Yes		405	0.21345	86.6	1.1
Kentucky No Kits	1879				
Yes		1032	0.07881	119.7	1.2

Window Shrink Kits

Only 14% of those receiving the Energy Efficiency Starter Kit installed the shrink kit that was included. Here, less than 10% state that they purchased and installed additional kits per the PER recommendations, and another 3-4% indicated that they plan to purchase and install window kits. Obviously, this is not a popular measure.

Table 35. Frequency of Recommendation Taken: Installed Window Kits

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Purchased and installed window kits				
Yes	68	9.4%	166	9.1%
No	614	85.3%	1,600	87.9%
No, but plan to do this	32	4.4%	50	2.7%
Don't Know	6	0.8%	5	0.3%
Number of windows				

covered				
1-3	38	57.6%	72	49.7%
4-7	18	27.3%	44	30.3%
8-10	7	10.6%	12	8.3%
11+	3	4.5%	17	11.7%
Size of window				
Small	4	5.9%	13	9.4%
Average	47	69.1%	80	57.6%
Large	17	25.0%	46	33.1%
Type of window				
Single pane	25	35.7%	54	34.9%
Single with storm	19	27.1%	31	22.6%
Double pane	26	37.1%	52	38.0%

The savings from this measure are relatively low, with the exception of therm savings of those that did not get the kits. This group was able to reduce their therm consumption by 49 therms annually, however these savings amounts to 0.3 therms per household, per year.

Table 36. Total Impact Estimates for Installing Window Shrink Kits

Window shrink kit	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Kits				
Yes, installed	68	2.127	1,018	18.9
Plan to install	32	0.637	1,179	12.8
No Kits				
Yes, installed	166	2.147	3,516	48.9
Plan to install	50	0.564	1,060	8.7

Table 37. Mean Impact Estimates for *Participants Installing Window Shrink Kits*

Window shrink kit	Number Installed	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kits				
Yes, installed	68	0.03128	15.0	0.3
No Kits				
Yes, installed	166	0.01293	21.1	0.3

Insulated Water Heater

The second most common response to the recommendation to insulate the hot water heater was "No, but I plan to", with about 11-17% of both groups providing this response. Only about 14-15% of the respondents report that they have taken the action as a result of the PER.

Table 38. Frequency of Recommendation Taken: Insulated Water Heater

Action	Kentucky Kits	Kentucky Kits	Kentucky No	Kentucky No

	(n)	(%)	Kits (n)	Kits (%)
Insulated hot water heater tank				
Yes	103	14.4%	267	14.8%
No	488	68.4%	1,304	72.2%
No, but plan to do this	119	16.7%	201	11.1%
Don't Know	3	0.4%	35	1.9%
Capacity of water heater, in gallons				
30	15	12.8%	75	26.0%
50	58	49.6%	117	40.5%
60	21	17.9%	31	10.7%
75	7	6.0%	9	3.1%
80+	7	6.0%	19	6.6%
Don't Know	9	7.7%	38	13.1%

Table 39. Total Impact Estimates for Insulating Water Heater

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes	102	1.134	3,282	354.1
No, but plan to	119	0.474	4,153	460.8
Kentucky No Kits	1879			
Yes	265	1.288	11,278	901.4
No, but plan to	201	0.698	6,111	915.3

Table 40. Mean Impact Estimates for Participants Insulating Water Heater

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes	102	0.01112	32.2	3.5
Kentucky No Kits	1879			
Yes	265	0.00486	42.6	3.4

Manage Draperies

This recommendation has one of the highest response rates, with about 80% of both groups indicating that they are now managing their drapes in the winter to let the sun shine in during the day. Again, the survey asked respondents to record what they were doing that was at least in part caused by the information presented on their PER report.

Table 41. Frequency of Recommendation Taken: Managing Draperies

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)

Manages draperies				
Yes	589	80.7%	1,446	78.6%
No	124	17.0%	342	18.6%
No, but plan to do this	11	1.5%	43	2.3%
Don't Know	6	0.8%	8	0.4%
Number of window coverings managed				
1-3	152	30.0%	410	32.5%
4-7	250	49.3%	601	47.7%
8-12	84	16.6%	198	15.7%
13+	21	4.1%	52	4.1%

Table 42. Total Impact Estimates for Managing Draperies

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes	589	0	36,371	1.641
No, but plan to	11	0	176	32.1
Kentucky No Kits	1,879			
Yes	1,446	0	96,373	4,371.6
No, but plan to	43	0	338	84.8

Table 43. Mean Impact Estimates for Participants Managing Draperies

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes	589	0.00000	61.8	2.8
Kentucky No Kits	1,879			
Yes	1,446	0.00000	66.6	3.0

Cleaned Electric Baseboards

As this measure only applies to those that have both electric heat and baseboards, and the impacts of the action are small - little savings are realized from this recommendation. Many of those that said they took the action did not have electric heat, so most of the cases were removed from the impact estimation calculations. This response indicates that many participants do not know what baseboard units are, and most likely cleaned the warm air registers leading from the central heating unit. An action that provides no savings.

Table 44. Frequency of Recommendation Taken: Cleaning Baseboards

Action	Kentucky Kits	Kentucky Kits	Kentucky No	Kentucky No

	(n)	(%)	Kits (n)	Kits (%)
Cleaned electric baseboards				
Yes	112	39.6%	231	37.7%
No	143	50.5%	317	51.7%
No, but plan to do this	18	6.4%	43	7.0%
Don't Know	10	3.5%	22	3.6%
Number of electric baseboards cleaned				
1-3	21	22.6%	52	27.8%
4-7	42	45.2%	62	33.2%
8-12	22	23.7%	55	29.4%
13+	8	8.6%	18	9.6%

Table 45. Total Impact Estimates for Cleaning Baseboards

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes	5	-	40	-
No, but plan to	1	-	8	-
Kentucky No Kits	1879			
Yes	7	-	51	-
No, but plan to	1	-	8	-

Table 46. Mean Impact Estimates for Participants Cleaning Baseboards

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes	5	-	8.0	-
Kentucky No Kits	1879			
Yes	7	-	7.2	-

Attic Insulation

The recommendation to insulate the attic was taken by over 45% of the respondents. Another 6-10% plan to take this action. Most respondents report that they have or will insulate the entire attic with fiberglass insulation, adding 2-6 inches.

Table 47. Frequency of Recommendation Taken: Attic Insulation

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Attic insulated				
Yes	303	45.4%	833	48.9%
No	286	42.9%	707	41.5%
No, but plan to do this	64	9.6%	107	6.3%

Don't Know	14	2.1%	56	3.3%
All or part of ceiling insulated				
Part of ceiling	39	12.7%	82	11.2%
All of ceiling	267	87.3%	649	88.8%
Type of insulation				
Fiberglass	191	68.5%	505	71.8%
Cellulose	58	20.8%	126	17.9%
Foam	15	5.4%	38	5.4%
Other	15	5.4%	34	4.8%
Inches of thickness added				
1-2	21	8.2%	81	12.8%
2-4	84	32.7%	223	35.1%
5-6	81	31.5%	163	25.7%
7-8	36	14.0%	77	12.1%
9-10	21	8.2%	49	7.7%
11+	14	5.4%	42	6.6%
Inches of thickness already there				
1-2	75	34.7%	207	41.5%
2-4	66	30.6%	174	34.9%
5-6	38	17.6%	61	12.2%
7-8	18	8.3%	30	6.0%
9-10	7	3.2%	9	1.8%
11+	12	5.6%	18	3.6%

The myriad of responses in the survey regarding this recommendation (and the following recommendation of insulation of sidewalls) require a more complex table than the other measures. Those that responded are broken down into six groups:

1. Yes, installed attic insulation. These respondents provided full details by answering all of the four follow-up questions.
2. Yes, installed attic insulation, but only partial detail. These respondents answered only 2 or 3 of the follow-up questions.
3. Yes, installed attic insulation, but little or no detail. These respondents answered 0 or 1 of the follow-up questions.
4. No, but plan to install attic insulation. These respondents provided full details by answering all of the four follow-up questions.
5. No, but plan to install attic insulation, but only partial detail. These respondents answered only 2 or 3 of the follow-up questions.
6. No, but plan to install attic insulation but little or no detail. These respondents answered 0 or 1 of the follow-up questions.

The impacts for groups 2, 3, 5 and 6 are estimated using the mean value of the responses of those that provided the needed details. The impacts are presented in Table 48 below.

Table 48. Total Impact Estimates for Attic Insulation

	Population	Total kW	Total kWh	Total Therm

		Savings	Savings	Savings
Kentucky Kits	741			
Yes, installed attic insulation	247	25.107	15,843	267.5
Yes, installed, but only partial detail	38	1.644	3,119	57.1
Yes, installed, but little or no detail	18	0.894	1,494	27.0
No, but plan to, with full detail	5	0.098	97	3.6
No, but plan to, but only partial detail	2	0.052	51	2.8
No, but plan to, but little or no detail	57	4.465	9,367	85.1
Kentucky No Kits	1879			
Yes, installed attic insulation	628	31.440	56,639	875.4
Yes, installed, but only partial detail	81	5.578	10,798	136.1
Yes, installed, but little or no detail	124	8.589	17,726	211.1
No, but plan to, with full detail	9	0.299	593	3.9
No, but plan to, but only partial detail	1	0.028	27	1.4
No, but plan to, but little or no detail	97	6.801	13,031	149.8

Table 49. Mean Impact Estimates for Participants Installing Attic Insulation

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, installed attic insulation	247	0.10165	64.1	1.1
Yes, installed, but only partial detail	38	0.04326	82.1	1.5
Yes, installed, but little or no detail	18	0.04967	83.0	1.5
Kentucky No Kits	1879			
Yes, installed attic insulation	628	0.05006	90.2	1.4
Yes, installed, but only partial detail	81	0.06886	133.31	1.7
Yes, installed, but little or no detail	124	0.06927	142.95	1.7

Sidewall Insulation

Less than 10% have taken this action as a result of the PER recommendation, with another 3-5% planning on doing this. The energy savings are higher for this measure than for attic insulation, since the base assumption is that the wall is uninsulated.

Table 50. Frequency of Recommendation Taken: Sidewall Insulation

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Sidewalls insulated				
Yes	34	5.0%	133	7.7%
No	606	88.5%	1,486	86.3%
No, but plan to do this	32	4.7%	57	3.3%
Don't Know	13	1.9%	45	2.6%
Number of sidewalls insulated				
1	4	14.3%	5	5.1%
2	1	3.6%	8	8.2%
3	6	21.4%	15	15.3%
4+	17	60.7%	70	71.4%
Type of insulation				
Fiberglass	12	42.9%	59	60.2%
Cellulose	3	10.7%	14	14.3%
Foam	9	32.1%	13	13.3%
Other	4	14.3%	12	12.2%
Inches of thickness added				
1-3	14	53.8%	46	50.9%
4-6	11	42.3%	34	39.3%
7-12	1	3.8%	6	8.0%
13+	0	0.0%	2	1.8%

Table 51. Total Impact Estimates for Sidewall Insulation

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes, installed sidewall insulation	20	6.948	2,656	61.9
Yes, installed, but only partial detail	8	1.273	752	31.0
Yes, installed, but little or no detail	62	4.509	9,232	238.1
No, but plan to, with full detail	1	.447	499	31
No, but plan to, but only partial detail	0	0	0	0
No, but plan to, but little or no detail	31	2.415	7,003	101.9
Kentucky No Kits	1879			

Yes, installed sidewall insulation	76	5.746	13,714	276.3
Yes, installed, but only partial detail	16	1.284	3,503	54.6
Yes, installed, but little or no detail	199	15.919	41,563	700.9
No, but plan to, with full detail	4	0.329	1,104	3.5
No, but plan to, but only partial detail	2	0.134	500	3.9
No, but plan to, but little or no detail	51	4.084	10,591	173.3

Table 52. Mean Impact Estimates for Participants Installing Sidewall Insulation

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, installed sidewall insulation	20	0.34738	132.8	3.1
Yes, installed, but only partial detail	8	0.15913	94	3.9
Yes, installed, but little or no detail	62	0.07273	149	3.8
Kentucky No Kits	1879			
Yes, installed sidewall insulation	76	0.07561	180.4	3.6
Yes, installed, but only partial detail	16	0.08025	218.9	3.4
Yes, installed, but little or no detail	199	0.07999	208.9	3.5

Duct Insulation/Repair

Respondents were more likely to repair the ducts than to insulate them, but many report that they plan on taking both actions. Unfortunately, over 60% of the ducts are located in heated areas of the home in which insulation or repair will not provide savings.

Table 53. Frequency of Recommendation Taken: Duct Insulation or Repair

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Insulated ducts				
Yes	75	10.7%	202	11.7%
No	558	79.8%	1,403	81.6%
No, but plan to do this	48	6.9%	64	3.7%
Don't Know	18	2.6%	51	3.0%

Repaired holes in ducts				
Yes	77	23.2%	173	19.9%
No	230	69.3%	599	68.9%
No, but plan to do this	8	2.4%	24	2.8%
Don't Know	17	5.1%	73	8.4%
Location of ducts insulated				
Unheated area	74	26.2%	193	25.9%
Heated area	183	64.9%	462	62.0%
Don't Know	25	8.9%	90	12.1%

The tables below present the savings for the duct work, and the breakdown of how many of them repaired or insulated ducts in heated areas.

Table 54. Total Impact Estimates for Duct Insulation

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes, insulated ducts	41	4.071	3,896	88.1
Yes, insulated ducts, but they were in a heated area	32	0	0	0
No, but plan to	48	1.213	2,808	45.6
Kentucky No Kits	1879			
Yes, insulated ducts	104	6.688	16,648	210.1
Yes, insulated ducts, but they were in a heated area	96	0	0	0
No, but plan to	64	3.173	6,692	65.7

Table 55. Mean Impact Estimates for Participants Installing Duct Insulation

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, insulated ducts	41	0.09928	95.0	2.1
Kentucky No Kits	1879			
Yes, insulated ducts	104	0.06431	160.1	2.0

Table 56. Total Impact Estimates for Duct Repair

	Population	Total kW	Total kWh	Total Therm

		Savings	Savings	Savings
Kentucky Kits	741			
Yes, repaired ducts	37	7.495	4,408	58.1
Yes, repaired ducts, but they were in a heated area	36	0	0	0
No, but plan to	8	..155	362	9.9
Kentucky No Kits	1879			
Yes, repaired ducts	92	7.754	16,255	94.1
Yes, repaired ducts, but they were in a heated area	79	0	0	0
No, but plan to	24	1.155	2,486	23.9

Table 57. Mean Impact Estimates for Participants Performing Duct Repair

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, repaired ducts	37	0.20257	119.1	1.6
Kentucky No Kits	1879			
Yes, repaired ducts	92	0.08429	176.7	1.0

Installed a New Central Air Unit

Just over 20% of the respondents indicated that they have installed a new central air unit at least in part because of the PER program. Over half of the participants report that their new units are high efficiency units. Most of the respondents did not know the SEER number for their new unit, and many of the responses had to be adjusted in this analysis as a result. For example, some respondents said that they installed a high efficiency unit and also reported that it had an SEER of 12. When this occurred, we assumed the SEER number was correct and changed the efficiency to "standard". We also distributed the SEER values of the people who could report them across the values for the individuals that could not report them. This provided a way to adjust the SEER ratings for the people who reported buying a high efficiency unit, but did not know the SEER rating to account for the fraction of the participants who actually purchased a more standard SEER unit.

Close to 3% of the respondents indicated that they planned on installing a new central air unit.

Table 58. Frequency of Recommendation Taken: New Central Air Unit

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Installed a new central air unit				
Yes	154	22.1%	386	22.3%
No	519	74.6%	1,291	74.8%
No, but plan to do this	18	2.6%	43	2.5%
Don't Know	5	0.7%	6	0.4%
Efficiency of unit				
High efficiency	139	52.1%	325	49.2%
Standard	65	24.3%	135	20.4%
Don't Know	63	23.6%	201	30.4%
SEER number for unit				
=<11	14	6.0%	16	2.8%
12	12	5.2%	26	4.5%
13	21	9.1%	53	9.2%
14+	20	8.6%	33	5.7%
Don't Know	165	71.1%	451	77.9%

Only 58 respondents who also received the kits provided any details on the new central air unit they installed. The other 96 cases provided partial or no details, so we used the mean responses from the 58 cases that provided purchase details to determine impact estimates. We used this same method for the 269 cases in the "no kits" group who also were unable to provide full details about the efficiency of their units. We only calculated estimated savings for those that plan to install a new central air unit if they provided the details on the efficiency level that they planned to purchase.

Table 59. Total Impact Estimates for New Central Air Units

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes, installed a new central air unit	58	12.865	17,411	0
Yes, installed, but little or no detail	96	19.463	22,531	0
No, but plan to, with full detail	1	0.129	118	0
No, but plan to, but little or no detail	17	2.439	3,597	0
Kentucky No Kits	1879			
Yes, installed a new central air unit	117	26.778	34,523	0
Yes, installed, but little or no detail	269	58.680	68,558	0
No, but plan to, with full detail	7	1.545	2,244	0
No, but plan to, but little or no detail	36	4.988	4,939	0

Table 60. Mean Impact Estimates for Participants Installing New Central Air Units

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, installed a new central air unit	58	0.79103	300.2	0
Yes, installed, but little or no detail	96	0.20274	234.7	0
Kentucky No Kits	1879			
Yes, installed a new central air unit	117	0.22887	295.1	0
Yes, installed, but little or no detail	269	0.21814	254.9	0

Installed a New Heat Pump

About 7% of the respondents indicated that they installed a new heat pump, but most of them do not know the SEER of their new units. However, they indicated that more than half of them were high efficiency. Here again, we used the efficiency distributions from the participants who did report their SEER, at the same ratio for those who did not know the SEER.

Table 61. Frequency of Recommendation Taken: Installed a New Heat Pump

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Installed a new heat pump				
Yes	48	7.3%	110	6.8%
No	549	83.6%	1,363	84.6%
No, but plan to do this	54	8.2%	119	7.4%
Don't Know	6	0.9%	19	1.2%
Efficiency of heat pump				
High efficiency	34	54.8%	74	50.7%
Standard	9	14.5%	20	13.7%
Don't Know	19	30.7%	52	35.6%
SEER number for heat pump				
=<11	4	7.4%	8	6.6%
12	1	1.9%	6	5.0%
13	6	11.1%	18	14.9%
14+	9	16.7%	15	12.4%
Don't Know	34	63.0%	74	61.2%

Table 62. Total Impact Estimates for New Heat Pumps

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings

Kentucky Kits	741			
Yes, installed a new heat pump	16	5.126	11,288	0
Yes, installed, but little or no detail	32	9.831	18,921	0
No, but plan to, with full detail	0			
No, but plan to, but little or no detail	54	13.410	18,474	0
Kentucky No Kits	1879			
Yes, installed a new heat pump	33	10.626	24,289	0
Yes, installed, but little or no detail	77	25.318	48,152	0
No, but plan to, with full detail	5	1.184	1,910	0
No, but plan to, but little or no detail	114	30.079	36,313	0

Table 63. Mean Impact Estimates for Participants Installing New Heat Pumps

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, installed a new heat pump	16	0.32038	705.5	0
Yes, installed, but little or no detail	32	0.30722	591.3	0
Kentucky No Kits	1879			
Yes, installed a new heat pump	33	0.32199	736.0	0
Yes, installed, but little or no detail	77	0.32881	625.4	0

Installed a New Furnace

About 20% of the respondents indicated that they installed a new furnace at least in part because of the PER report, and about 2-3% indicated that they plan on taking this action.

Table 64. Frequency of Recommendation Taken: New Furnace

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)
Installed a new furnace				
Yes	131	19.3%	278	16.9%
No	526	77.4%	1,323	80.6%
No, but plan to do this	18	2.6%	30	1.8%

Don't Know	5	0.7%	11	0.7%
Exhaust/efficiency				
Plastic pipe	133	78.7%	245	62.0%
Chimney or flue	27	16.0%	94	23.8%
Don't Know	9	5.3%	56	14.2%

Most of the respondents that plan to install a new furnace did not provide details on the efficiency of the units, so only a small number of participants have impact estimates applied. The 409 respondents that did install a new furnace and who could provide information on energy efficiency are saving an estimated 61 therms annually.

Table 65. Total Impact Estimates for New Furnaces

	Population	Total kW Savings	Total kWh Savings	Total Therm Savings
Kentucky Kits	741			
Yes, installed a new furnace	131	-	-	381.9
No, but plan to	18	-	-	94.9
Kentucky No Kits	741			
Yes, installed a new furnace	131	-	-	841.3
No, but plan to	18	-	-	104.7

Table 66. Mean Impact Estimates for Participants Installing New Furnaces

	Population	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Kentucky Kits	741			
Yes, installed a new furnace	131	0.00000	0.00	2.9
Kentucky No Kits	1,879			
Yes, installed a new furnace	278	0.00000	0.00	3.0

Visited the Duke Energy Web Site

Most of the respondents have not visited the Duke Energy web site. Only about 20-30% said that they have or that they plan to visit the site. Of those that have visited the site, over half of them said that they found the web site helpful.

Action	Kentucky Kits (n)	Kentucky Kits (%)	Kentucky No Kits (n)	Kentucky No Kits (%)

Visited Duke web site				
Yes	96	13.6%	155	8.6%
No	498	70.6%	1,427	79.6%
No, but plan to do this	107	15.2%	191	10.7%
Don't Know	4	0.6%	19	1.1%
Web site was helpful				
Yes	53	55.2%	70	53.8%
Somewhat	40	41.7%	54	41.5%
Don't Know	3	3.1%	6	4.6%

All Recommendations

The following tables summarize the number of recommendations taken and the savings estimates based on those recommendations. These tables do not include the savings estimates of those that plan to take the recommendation.

Those customers who received the kits followed about 21.7% of the recommendations overall, and were able to save 406 kW, over 2 million kilowatt hours, and almost 47,000 therms. If the information they provided on their survey is accurate. The following table summarizes the savings achieved.

Table 67. Summary of Total Savings for All Recommendations Taken by Those Receiving Kits

	Population	Percent Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Lowered the temperature in winter	608	82.1%			
Daytime savings			-	121,733	2,727
Nighttime savings			-	56,733	1,080
Purchased and installed CFLs	393	53.0%	25.255	151,396	-67
Switched to cold water	386	52.1%	5.582	27,404	3,876
Replaced furnace filter	143	19.3%	-2.24	-3,934	-21
Closed off fireplace	191	25.8%	0.642	1,103	21
Stopped heating unused rooms	405	54.7%	86.488	35,061	437
Window Shrink	68	9.2%	2.127	1,018	19
Insulated water heater	102	13.8%	1.134	3,282	354
Manages draperies	589	79.5%	-	36,371	1,641
Cleaned baseboards	5	0.7%	-	40	-
Installed attic insulation	247	33.3%	25.107	15,843	268
Installed, but only partial detail	*38*	*5.1%*	*1.644*	*3,119*	*57*
Installed, but little or no detail	*18*	*2.4%*	*0.894*	*1,494*	*27*
Installed sidewall insulation	20	2.7%	6.948	2,656	62
Installed, but only partial detail	*8*	*1.1%*	*1.273*	*752*	*31*
Installed, but little or no detail	*62*	*8.4%*	*4.509*	*9,232*	*238*
Insulated ducts	41	5.5%	4.071	3,896	88
Repaired ducts	37	5.0%	7.495	4,408	58
Installed a new central air unit	58	7.8%	12.865	17,411	-
Installed a central air unit, but little or no detail	*96*	*13.0%*	*19.463*	*22,531*	-
Installed a new furnace	131	17.7%	-	-	382
Installed a new heat pump	16	2.2%	5.126	11,288	-

Installed heat pump, but little or no detail	*32*	*4.3%*	*9.831*	*18,921*	-
Total			**180.6**	**485,709**	**10,925**

Those that did not receive the kits also followed 21.7% of the recommendations, but had much higher total savings due to the number of participants providing the survey.

Table 68. Summary of Total Savings for All Recommendations Taken by Those Not Receiving Kits

	Population	Percent Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Lowered the temperature in winter	1559	83.0%			
Daytime savings			-	464,354	7,255
Nighttime savings			-	96,373	2,778
Purchased and installed CFLs	899	47.8%	5.503	45,864	-136
Switched to cold water	987	52.5%	7.159	62,702	10,211
Replaced furnace filter	458	24.4%	-0.880	-4617	41
Closed off fireplace	509	27.1%	0.340	1,201	23
Stopped heating unused rooms	1032	54.9%	81.334	123,535	1,270
Window Shrink	166	8.8%	2.147	3,516	49
Insulated water heater	265	14.1%	1.288	11,278	901
Manages draperies	1,446	77.0%	-	96,373	4,372
Cleaned baseboards	7	0.4%	-	51	-
Installed attic insulation	628	33.4%	31.440	56,639	857
Installed, but only partial detail	*81*	*4.3%*	*5.578*	*10,798*	*136*
Installed, but little or no detail	*124*	*6.6%*	*8.589*	*17,726*	*211*
Installed sidewall insulation	76	4.0%	5.746	13,714	276
Installed, but only partial detail	*16*	*0.9%*	*1.284*	*3,503*	*55*
Installed, but little or no detail	*199*	*10.6%*	*15.919*	*41,563*	*701*
Insulated ducts	104	5.5%	6.688	16,648	210
Repaired ducts	92	4.9%	7.754	16,255	94
Installed a new central air unit	117	6.2%	26.778	34,523	-
Installed a central air unit, but little or no detail	*269*	*14.3%*	*56.590*	*68,558*	-
Installed a new furnace	278	14.8%	-	-	841
Installed a new heat pump	33	1.8%	10.626	24,289	-
Installed heat pump, but little or no detail	*77*	*4.1%*	*25.318*	*48,152*	-
Total			**185.923**	**1,062,698**	**29,042**

The following two tables show the mean savings for the recommendation based on the total savings and the number of respondents following the recommendation.

Table 69. Summary of Mean Savings for All Recommendations Taken by Those Receiving Kits

	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Lowered the temperature in winter			
Daytime savings	-	200.2	4.5
Nighttime savings	-	93.3	1.8

Purchased and installed CFLs	0.06426	385.2	-0.2
Switched to cold water	0.01446	71.0	10.0
Replaced furnace filter	-0.01779	-36.06	-0.12
Closed off fireplace	0.00336	5.8	0.1
Stopped heating unused rooms	0.21345	86.6	1.1
Window Shrink	0.03128	15.0	0.3
Insulated water heater	0.01112	32.2	3.5
Manages draperies	-	61.8	2.8
Cleaned baseboards	-	8.0	-
Installed attic insulation	0.10165	64.1	1.1
Installed, but only partial detail	*0.04326*	*82.1*	*1.5*
Installed, but little or no detail	*0.04967*	*83.0*	*1.5*
Installed sidewall insulation	0.34738	132.8	3.1
Installed, but only partial detail	*0.15913*	*94*	*3.9*
Installed, but little or no detail	*0.07273*	*149*	*3.8*
Insulated ducts	0.09928	95.0	2.1
Repaired ducts	0.20257	119.1	1.6
Installed a new central air unit	0.79103	300.2	-
Installed a central air unit, but little or no detail	*0.020274*	*234.7*	-
Installed a new furnace	-	-	2.9
Installed a new heat pump	0.32038	705.5	-
Installed heat pump, but little or no detail	*0.30722*	*591.36*	-
Mean Total Savings, if all measures installed	**2.18243**	**2,339.7**	**34.58**

Table 70. Summary of Mean Savings for All Recommendations Taken by Those Not Receiving Kits

	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
Lowered the temperature in winter			
Daytime savings	-	297.9	4.7
Nighttime savings	-	138.1	1.8
Purchased and installed CFLs	0.00612	51	-0.2
Switched to cold water	0.00725	63.5	10.3
Replaced furnace filter	-0.01885	-41.18	-0.01
Closed off fireplace	0.00067	2.4	0.0
Stopped heating unused rooms	0.07881	119.7	1.2
Window Shrink	0.01293	21.2	0.3
Insulated water heater	0.00486	42.6	3.4
Manages draperies	-	66.6	3.0
Cleaned baseboards	-	7.2	-
Installed attic insulation	0.05006	90.2	1.4
Installed, but only partial detail	*0.06886*	133.31	1.7
Installed, but little or no detail	*0.06927*	142.95	1.7
Installed sidewall insulation	0.07561	90.2	3.6
Installed, but only partial detail	*0.08025*	*218.9*	*3.4*
Installed, but little or no detail	*0.07999*	*208.9*	*3.5*
Insulated ducts	0.06431	160.1	2.0

Repaired ducts	0.08429	176.7	1.0
Installed a new central air unit	1.22887	295.1	-
Installed a central air unit, but little or no detail	*0.21814*	254.9	-
Installed a new furnace	-	-	3.0
Installed a new heat pump	1.32199	736.0	-
Installed heat pump, but little or no detail	*0.32881*	625.4	-
Mean Total Savings, if all measures installed	**2.91692**	**2,317.32**	**35.49**

Savings Distributions

There are substantial risks associated with relying on self-reported behavioral changes, because the foundation of the savings estimates are based solely on the participant's responses, with no means to verify that the respondent has installed the kit's measures or has actually taken the recommendation provided in the Personalized Energy Report. There are two main sources of bias with these types of surveys that directly impact the conclusions drawn from the responses. These sources of bias are Self-Selection Bias and False Response Bias. There is also an issue regarding the accuracy of the baseline energy use conditions used by the evaluation contractor to estimate savings in that many of these conditions need to be based on assumptions rather than on measurements. These three conditions significantly impact the evaluation contractor's ability to provide accurate estimates of energy impact. These issues are discussed in more detail in the following paragraphs.

Self-Selection Bias

The survey was sent to 5,401 PER Program participants – 3,562 customers that did not receive the kit, and 1,839 customers that did receive the Energy Efficiency Starter Kit. The data collection efforts resulted in 1,879 responses from PER participants who only received the PER (response rate = 52.8%), and 741 responses (response rate = 40.3%) from Kentucky PER participants who received the Energy Efficiency Kit. The people that filled out and returned the survey are the participants that are more likely to install measures from the Energy Efficiency Kit and consider taking actions based on the recommendations from the Personalized Energy Report. That is, they self-selected themselves to return the survey because they have a higher interest in the subject matter than the people who did not. These individuals also will often respond to a survey in order to let it be known that they did the right thing, and that they are taking steps to be more energy efficient. The customers that did not return the survey are more likely to have a lower interest in the subject matter, and are less likely to take actions. Thus, the people who returned the survey are not the typical participant, but rather are the participant that is more likely to take actions. With 47.2% of the PER group and 59.7% of the Kit group not responding, we are setting the self-selection bias used to estimate the potential range of impacts at half of the non-response rate. As a result, all estimated energy impact estimates will be discounted 29.9% for customers that received the Energy Efficiency Kit and the Personalized Energy Report, and 23.6% for those that only received the Personalized Energy Report. All impact estimates will be discounted by this percentage in order to calculate the low end of the range of savings estimates for each measure and recommendation. This adjustment approach is subjective, and is not based on the evaluation literature or on completed research within the energy program evaluation field. Within the energy program evaluation field there is a substantial lack of research indicating the range of self-selection bias associated with energy efficiency programs. As a result, the authors of this study elected to apply a significant self-selection bias factor in order to be conservative in our estimates of program impacts. Setting the factor at half of the non-response rate is based on professional conservative judgment from conducting surveys and metering studies of energy efficiency programs for over 28 years and interacting with the evaluation community regarding these rates,

but we can point to no research that objectively assesses if this level of self-selection bias is too high or too low.

False Response Bias

False Response Bias is a problem with many self-reporting surveys. The participants respond not with the truth, but with the socially acceptable response. In short, they give the answer that they think is the *right answer* about what measures they installed or what actions they have taken as a result of the Personalized Energy Report. False response bias is typically not a large adjustment, depending on the controversy around the subject being discussed. False response bias adjustments typically range from a low of two or three percent to a high of 15 percent depending on the topic and the population being tested. The False Response Bias for this assessment was set at from a low of 10% to a high of 50% because of a specific rational relating to the conditions that act to increase or decrease this estimated average rate. A 10 % to 50% discount is be applied to each PER recommended measure impact estimate to calculate the low-end of the range of savings estimates for each measure and recommendation.

Baseline Energy Use Assumptions

When a mail survey is used to conduct an evaluation, the evaluation contractors are unsure of the actual conditions in the home that have experienced a change. For example, while a new showerhead may have been installed, it is impossible to estimate precise savings unless the flow rates and use conditions associated with the previous showerhead are well understood. For this study we established our baseline assumptions based on the survey results and our past research and experience with programs and program evaluations that have taken measurement of baseline conditions. We have also used housing-type computer models to estimate baseline conditions and behaviors. As a result, we are not adjusting the baseline conditions applied in this study, but rather using the survey results, the literature, our past research and field experience to set baseline conditions. However, because these are not program-participant measured baseline conditions, it is important to let the reader know that the baselines used in this study are estimated.

Methodology

The level of discounting used to determine the ranges for each of the measures and recommendations can be found in the table below. The self-selection bias discount factor for all measures and recommendations for the Kentucky PER is 29.9% for customers that received the Energy Efficiency Kit and the Personalized Energy Report, and 23.6% for those that only received the Personalized Energy Report.

Measure	False Response Bias	Other Discounting and Notes
CFLs	10%	Used ranges for wattage of bulb removed (as opposed to most common wattage in range) and hours of use for the lamp (as opposed to the mean of the range).
Weatherstripping	10%	
Outlet gaskets	10%	
Window shrink kit	10%	Adjusted square footage of window: if customer

		indicated "small" window, sq ft reduced by 1/3; if "average" or "large", sq ft reduced by ½.
Showerhead	20%	Used 2.75 gpm for base showerhead (as opposed to 3.1 gpm) to get the low range.
Aerators	20%	Removed the savings from cases in which there was already an aerator installed for the low estimates.

Recommendation	False Response Bias	Other Discounting and Notes
CFLs	50%	Used ranges for wattage of bulb removed (as opposed to most common wattage in range) and hours of use for the lamp (as opposed to the mean of the range). Used ranges for wattage of CFL installed. For high range, used 15 CFL replacements when respondent indicated they replaced 10+ bulbs.
Clean baseboards	50%	
Close off fireplace	50%	
Install new central air unit	50%	Low end of savings obtained by further cutting savings by half under the assumption that half of new installations were normal replacement instead of early replacement.
Install new furnace	50%	Low end of savings obtained by further cutting savings by half under the assumption that half of new installations were normal replacement instead of early replacement.
Install a new refrigerator	50%	Used 1700 for base.
Install a new heat pump	50%	Low end of savings obtained by further cutting savings by half under the assumption that half of new installations were normal replacement instead of early replacement.
Install attic insulation	50%	For partial installation, used a range of 25% coverage instead of 50%. Used a low range of 225 square feet per room.
Install sidewall insulation	50%	Removed savings for those that indicated that they installed 7-12" or 13"+ of sidewall insulation. Used a low range of 225 square feet per room. Halved the fraction used in calculating wall area as a fraction of floor area.
Install window shrink kits	50%	Adjusted square footage of window: if customer indicated "small" window, sq ft reduced by 1/3; if "average" or "large", sq ft reduced by ½.
Insulate or repair ducts	50%	Savings cut in half based on having less insulation than before and lower leakage rates.
Insulate water heater	50%	UA table modified to reflect a 1" blanket. Also used a lower set point of 120 degrees.
Lower temperature in winter	50%	
Manage draperies	50%	Reduced the savings by ½ for 2/3 of the windows to account for direction of window.
Replace furnace filter	50%	
Stop heating unused rooms	50%	Further reduced savings by 20% because of the inability to completely shut off a room, and the conductive losses through the uninsulated walls.

Switch to cold water for laundry	50%	

Savings Estimates

Each of the Kit measures and PER recommendations are recalculated here in order to provide reasonable ranges of energy savings associated with each item. The tables below provide the low and high estimates for each of the measures and recommendations provided to the Indiana participants. Savings estimates are provided for only those participants who indicated that they installed the measure. For recommendations, savings are provided for only those who indicated that they took the action, and provided full details on follow-up questions on the survey.

Table 71. Kentucky Kit Participants' Range of Kilowatt Savings

Measure	Total kW Savings		Mean kW Savings (per install)	
	Low	High	Low	High
15-watt CFL	1.928	5.243	0.00295	0.00802
20-watt CFL	1.867	5.166	0.00316	0.00876
Weatherstripping	0.327	0.683	0.00126	0.00264
Outlet gaskets	0.768	1.850	0.00210	0.00505
Window shrink kit	0.737	2.286	0.00730	0.02263
Showerhead	1.759	4.053	0.00377	0.00868
Bathroom aerator	0.020	0.035	0.00005	0.00009
Kitchen aerator	0.014	0.025	0.00004	0.00007

Table 72. Kentucky Kit Participants' Range of Kilowatt-Hour Savings

Measure	Total kWh Savings		Mean kWh Savings (per install)	
	Low	High	Low	High
15-watt CFL	19,966	88,829	30.5	135.8
20-watt CFL	18,737	82,917	31.8	140.5
Weatherstripping	853	2,231	3.3	8.6
Outlet gaskets	2,629	6,351	7.2	17.4
Window shrink kit	1,279	3,957	12.7	39.2
Showerhead	16,048	36,983	34.4	79.2
Bathroom aerator	1,513	2,651	3.8	6.7
Kitchen aerator	1,168	2,083	3.2	5.7

Table 73. Kentucky Kit Participants' Range of Therm Savings

Measure	Total Therm Savings		Mean Therm Savings (per install)	
	Low	High	Low	High
15-watt CFL	-31.7	-141.3	0.0	-0.2
20-watt CFL	-29.5	-130.8	-0.1	-0.2
Weatherstripping	19.7	51.3	0.1	0.2
Outlet gaskets	533.3	126.4	1.5	0.3
Window shrink kit	14.5	44.9	0.1	0.4
Showerhead	1,624.4	3,724.6	3.5	8.0
Bathroom aerator	85.7	149.5	0.2	0.4

Kitchen aerator	75.5	134.6	0.2	0.4

Table 74. Kentucky Kit Participants' Range of Kilowatt Savings for Recommendations

Recommendation	Total kW Savings		Mean kW Savings (per install)	
	Low	High	Low	High
CFLs	25.255	45.505	0.06426	0.11579
Clean baseboards	-	-	-	-
Close off fireplace	0.642	0.898	0.00336	0.00470
Install new central air unit	12.865	73.408	0.79103	1.26566
Install new furnace	-	-	-	-
Install a new heat pump	5.126	29.242	0.32038	1.82763
Install attic insulation	25.107	40.171	0.10165	0.16264
Install sidewall insulation	6.948	11.116	0.34738	0.55580
Install window shrink kits	2.127	3.832	0.03128	0.05635
Insulate ducts	4.071	6.513	0.09928	0.15885
Repair ducts	7.495	11.992	0.20257	0.32411
Insulate water heater	1.134	2.044	0.01112	0.02004
Lower temp in winter - day	-	-	-	-
Lower temp in winter - night	-	-	-	-
Manage draperies	-	-	-	-
Replace furnace filter	-2.240	-2.240	-0.01779	-0.01779
Stop heating unused rooms	86.448	86.448	0.21345	0.21345
Switch to cold water for laundry	5.582	8.931	0.01446	0.02314

Table 75. Kentucky Kit Participants' Range of Kilowatt-Hour Savings for Recommendations

Recommendation	Total kWh Savings		Mean kWh Savings (per install)	
	Low	High	Low	High
CFLs	151396	640,140	385.2	1628.9
Clean baseboards	40	115	8.0	23.0
Close off fireplace	1103	3,277	5.8	17.2
Install new central air unit	17411	99,349	300.2	1712.9
Install new furnace	-	-	-	-
Install a new heat pump	11288	64,407	705.5	4025.4
Install attic insulation	15843	67,490	64.1	273.2
Install sidewall insulation	2656	22,796	132.8	1139.8
Install window shrink kits	1018	5,795	15.0	85.2
Insulate ducts	3896	22,228	95.0	542.1
Repair ducts	4408	25,155	119.1	679.9
Insulate water heater	3282	17,904	32.2	175.5
Lower temp in winter - day	121733	347,312	200.2	571.2
Lower temp in winter - night	56733	161,864	93.3	266.2
Manage draperies	36371	43,960	61.8	74.6
Replace furnace filter	-3,934	-3,934	-36.1	-36.1

Stop heating unused rooms	35061	125,041	86.6	308.7
Switch to cold water for laundry	27404	78,186	71.0	202.6

Table 76. Kentucky Kit Participants' Range of Therm Savings for Recommendations

Recommendation	Total Therm Savings		Mean Therm Savings (per install)	
	Low	High	Low	High
CFLs	-67.2	-980	-0.2	-2.5
Clean baseboards	-	-	-	-
Close off fireplace	20.7	68	0.1	0.4
Install new central air unit	-	-	-	-
Install new furnace	381.9	2,178	2.9	16.6
Install a new heat pump	-	-	-	-
Install attic insulation	267.5	1,159	1.1	4.7
Install sidewall insulation	61.9	554	3.1	27.7
Install window shrink kits	18.9	106	0.3	1.6
Insulate ducts	88.1	504	2.1	12.3
Repair ducts	58.1	333	1.6	9.0
Insulate water heater	354.1	1,868	3.5	18.3
Lower temp in winter - day	2727.0	7,781	4.5	12.8
Lower temp in winter - night	1080.0	3,080	1.8	5.1
Manage draperies	1641.0	2,145	2.8	3.6
Replace furnace filter	-21	-21	-0.1	-0.1
Stop heating unused rooms	437.0	1,560	1.1	3.9
Switch to cold water for laundry	3875.6	11,057	10.0	28.6

Table 77. Kentucky No Kit Participants' Range of Kilowatt Savings for Recommendations

Recommendation	Total kW Savings		Mean kW Savings (per install)	
	Low	High	Low	High
CFLs	5.503	47.649	0.00612	0.05300
Clean baseboards	-	-	-	-
Close off fireplace	0.340	0.891	0.00067	0.00175
Install new central air unit	26.778	140.328	0.22887	1.19938
Install new furnace	-	-	-	-
Install a new heat pump	10.626	55.632	0.32199	1.68582
Install attic insulation	31.440	123.745	0.05006	0.19705
Install sidewall insulation	5.746	50.692	0.07561	0.66700
Install window shrink kits	2.147	11.163	0.01293	0.06725
Insulate ducts	6.688	35.017	0.06431	0.33670
Repair ducts	7.754	40.600	0.08429	0.44130
Insulate water heater	1.288	6.303	0.00486	0.02378
Lower temp in winter - day	-	-	-	-
Lower temp in winter - night	-	-	-	-
Manage draperies	-	-	-	-
Replace furnace filter	-0.880	-1.520	-0.0185	-0.00332
Stop heating unused rooms	81.334	266.144	0.07881	0.25789
Switch to cold water for laundry	7.159	18.741	0.00725	0.01899

Table 78. Kentucky No Kit Participants' Range of Kilowatt-Hour Savings for Recommendations

Recommendation	Total kWh Savings		Mean kWh Savings (per install)	
	Low	High	Low	High
CFLs	45,864	1,132,047	51	1259.2
Clean baseboards	51	133	7.2	19.0
Close off fireplace	1201	3,142	2.4	6.2
Install new central air unit	34523	180,749	295.1	1544.9
Install new furnace	-	-	-	-
Install a new heat pump	24289	127,167	736.0	3853.5
Install attic insulation	56639	222,542	90.2	354.4
Install sidewall insulation	13714	105,277	180.4	1385.2
Install window shrink kits	3516	18,294	21.2	110.2
Insulate ducts	16648	87,162	160.1	838.1
Repair ducts	16255	85,106	176.7	925.1
Insulate water heater	11278	55,215	42.6	208.4
Lower temp in winter - day	464354	1,215,587	297.9	779.7
Lower temp in winter - night	96373	563,414	138.1	361.4
Manage draperies	96373	756,481	66.6	523.2
Replace furnace filter	-4594	-4,594	-3.4	-10.0
Stop heating unused rooms	123535	404,237	119.7	391.7
Switch to cold water for laundry	62702	164,141	63.5	166.3

Table 79. Kentucky No Kit Participants' Range of Therm Savings for Recommendations

Recommendation	Total Therm Savings		Mean Therm Savings (per install)	
	Low	High	Low	High
CFLs	-136.0	-1,852.9	-0.2	-2.1
Clean baseboards	-	-	-	-
Close off fireplace	22.5	58.9	0.0	0.1
Install new central air unit	-	-	-	-
Install new furnace	841.3	4,404.8	3.0	15.8
Install a new heat pump	-	-	-	-
Install attic insulation	857.4	3,389.7	1.4	5.4
Install sidewall insulation	276.3	2,121.1	3.6	27.9
Install window shrink kits	48.9	253.6	0.3	1.5
Insulate ducts	210.1	1,100.1	2.0	10.6
Repair ducts	94.1	492.7	1.0	5.4
Insulate water heater	901.4	4,358.4	3.4	16.4
Lower temp in winter - day	7255.2	18,992.8	4.7	12.2
Lower temp in winter - night	2778.1	7,272.6	1.8	4.7
Manage draperies	4371.6	34,315.0	3.0	23.7
Replace furnace filter	5.5	16.0	0.0	0.0
Stop heating unused rooms	1270.4	4,157.0	1.2	4.0
Switch to cold water for laundry	10210.6	26,729.3	10.3	27.1

Appendix A: PER and Energy Efficiency Kit Survey

Please answer the questions in this survey by darkening the circles next to the responses associated with each question using blue or black ink. For example ○ is fully filled in when it looks like this: ●

Duke Energy

QUESTIONS FOR KIT MATERIAL USE

The first set of questions ask about the materials you received in the Energy Efficiency Kit mailed to you from Duke Energy. This kit included a number of items such as a showerhead, aerators, compact fluorescent light bulbs and other items. Please provide your response to each of the following questions about the materials you received in the kit.

15-WATT MINI COMPACT FLORESCENT LIGHT (CFL)

1. Have you installed the 15-watt CFL bulb in a light fixture? ○ Yes ○ No ○ Don't know

If yes...

2. How many watts was the old bulb you took out? ○ ≥45 ○ 45-30 ○ 31-99 ○ 100≥
3. On average, how many hours per day do you use this bulb? ○ <1 ○ 1-2 ○ 3-4 ○ 5-10 ○ 11-12 ○ 13-24

20-WATT MINI COMPACT FLORESCENT LIGHT

1. Have you installed the 20-watt CFL bulb in a light fixture? ○ Yes ○ No ○ Don't know

If yes...

2. How many watts was the old bulb you took out? ○ ≥45 ○ 45-30 ○ 31-99 ○ 100≥
3. On average, how many hours per day do you use this bulb? ○ <1 ○ 1-2 ○ 3-4 ○ 5-10 ○ 11-12 ○ 13-24

CLOSED CELL WEATHER-STRIPPING – 17 FEET

1. Have you installed any of the weather-stripping on your doors or windows or used it to seal cracks? ○ Yes ○ No ○ Don't know
2. If yes, how many feet of the 17 received have you used? ○ 1-5 ○ 6-10 ○ 11-17

WINDOW COVERING SHRINK-FIT STORM WINDOW

1. Have you installed the window shrink-film? ○ Yes ○ No ○ Don't know

If yes...

2. What size would you consider the window on which you used the kit to be? ○ Small ○ Average ○ Large
3. What type of window is it? ○ Single pane ○ Single with storm ○ Double pane

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SHOWERHEAD

1. Have you installed the energy-efficient showerhead? ○ Yes ○ No ○ Don't know

If yes...

2. Typically, how many showers per week are taken using this showerhead? ○ 0-4 ○ 5-10 ○ 11-15 ○ 16-20 ○ 21≥
3. Would you estimate that the amount of water coming through the new showerhead is: ○ Less than the old unit ○ About the same ○ More than the old unit

---

BATHROOM FAUCET AERATOR

1. Have you installed the faucet aerator in your bathroom? ○ Yes ○ No ○ Don't know

If yes...

2. Was there an aerator on the faucet that you had to remove? ○ Yes ○ No ○ Don't know
3. If yes, would you estimate that the amount of water coming through the new aerator is: ○ Less than the old unit ○ About the same, or ○ More than the old unit

KITCHEN FAUCET AERATOR

1. Have you installed the faucet aerator in your kitchen? ○ Yes ○ No ○ Don't know

If yes...

2. Was there an aerator on the faucet that you had to remove? ○ Yes ○ No ○ Don't know
3. If yes, would you estimate that the amount of water coming through the new aerator is: ○ Less than the old unit ○ About the same ○ More than the old unit

WALL PLUG OUTLET AND SWITCH INSULATORS

1. Have you installed the insulating gaskets on any outlet boxes or wall switches? ○ Yes ○ No ○ Don't know
2. If yes, how many have you installed? ○ 1-2 ○ 3-5 ○ 6-8

REPORT RECOMMENDATIONS

This set of questions ask about the actions you have taken or plan to take based on the recommendations that were included on your Personalized Energy Report. These questions are only about things that you have done after receiving your report.

LOWERED THE TEMPERATURE IN THE HOME DURING THE WINTER

1. Have you lowered the temperature of your home to save money or energy during the winter months?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. How many degrees have you lowered the temperature at night? ○ 1-3 ○ 4-6 ○ 7-10 ○ 11+
3. How many degrees have you lowered the temperature during the day? ○ 1-3 ○ 4-6 ○ 7-10 ○ 11+

PURCHASED AND INSTALLED COMPACT FLORESCENT LIGHTS (CFLS)

1. Have you purchased and used additional compact fluorescent lightbulbs in your home? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. How many CFLs have you purchased and installed since receiving the report? ○ 1-2 ○ 3-5 ○ 6-9 ○ 10+
3. On average, what wattage bulb did you remove from the fixture before you installed the CFL? ○ <41 ○ 41-70 ○ 71-99 ○ 100+
4. Considering all CFL locations and uses, on average, how many hours per day do you use these bulbs?

○ <1 ○ 1-2 ○ 3-4 ○ 5-9 ○ 10-12 ○ 13-24

WASHED LAUNDRY IN COLD WATER

1. Have you switched from using hot water to do your laundry instead of cold water? ○ Yes ○ No but plan to do this ○ No ○ Don't know
2. If yes, how many loads of laundry do you do per week? ○ 1-2 ○ 3-4 ○ 5-6 ○ 7-8 ○ 9-10 ○ 11-12 ○ 13+

REPLACED FURNACE FILTERS

1. Have you replaced your furnace filter? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. How often do you now change the filter? ○ Less than once a year ○ Once a year ○ Twice a year ○ More than twice a year ○ Don't know
3. How often did you change your filter prior to receiving the personalized energy report? ○ Less than once a year ○ Once a year ○ Twice a year ○ More than twice a year ○ Don't know

TURNED OFF HEAT IN UNUSED ROOMS

1. Have you closed the heating vents or covered the heat outlets in unused rooms? ○ Yes ○ No but plan to do this ○ No ○ Don't know
2. If yes, how many rooms do you close/cover? ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6+

INSTALLED WINDOW COVERING SHRINK-FIT STORM WINDOWS

1. Have you purchased and installed any plastic wrap-type window kits that cover the entire window to help keep the cold out?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. How many windows have you covered with these kits? ○ 1-3 ○ 4-7 ○ 8-10 ○ 11+
3. On average, what size would you consider the window on which you used the kits to be? ○ Small ○ Average ○ Large
4. What type of window is it? ○ Single pane ○ Single with storm ○ Double pane

INSULATED HOT WATER HEATER TANK

1. Have you insulated your hot water tank? ○ Yes ○ No but plan to do this ○ No ○ Don't know
2. If yes, how many gallons of water does your tank hold? ○ 30 ○ 50 ○ 60 ○ 75 ○ 80+ ○ Don't know

KEEP DRAPERIES OPEN ON SUNNY DAYS AND CLOSED AT NIGHT

1. Do you manage your window coverings and draperies so that they are open when the sun is shining in and closed at other times?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, how many windows do you manage the coverings to save energy? ○ 1-3 ○ 4-7 ○ 8-12 ○ 13+

CLEANED ELECTRIC BASEBOARD HEATING REGISTERS OF DUST

1. For electrically heating homes, have you cleaned any of the baseboards?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, how many baseboards have you cleaned? ○ 1-3 ○ 4-6 ○ 7-10 ○ 11+

INSULATED THE CEILING OR ATTIC

1. Have you had your attic insulated? ○ Yes ○ No but plan to do this ○ No ○ Don't know
2. Did you insulate part of the ceiling or attic? ○ Part of ceiling ○ Entire ceiling
3. What type of insulation did you add? ○ Fiberglass ○ Cellulose ○ Foam ○ Other
4. How many inches of thickness did you add? ○ 1-2 ○ 3-4 ○ 5-6 ○ 7-8 ○ 9-10 ○ 11+
5. How close was the insulation before you added more? ○ 1-2 ○ 3-4 ○ 5-6 ○ 7-8 ○ 9-10 ○ 11+

INSULATED SIDEWALLS OF HOME

1. Have you had the sidewalls of your home insulated since you received your Personalized Energy Report?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. How many walls did you have insulated? ○ 1 ○ 2 ○ 3 ○ 4+
3. What type of insulation did you add? ○ Fiberglass ○ Cellulose ○ Foam ○ Other
4. How many inches of thickness did you add? ○ 1-3 ○ 4-6 ○ 7-12 ○ 13+

CLOSED-OFF OR SEAL-UP THE FIREPLACE

1. Have you stopped using a fireplace to reduce the heat loss going up the chimney during the winter?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. Have you closed-off or sealed the fireplace to reduce the heat loss?

○ Yes ○ No but plan to do this ○ No ○ Don't know

INSULATED OR REPAIRED HEATING OR AIR CONDITIONING DUCTS

1. Have you insulated any of your heating or cooling ducts that deliver air to the rooms of the home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Are these ducts located in a heated or unheated part of the home?

○ Unheated area ○ Heated area ○ Don't know

3. Have you repaired or fixed holes in any of your heating or cooling ducts that deliver air to the rooms of the home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

INSTALLED NEW CENTRAL AIR CONDITIONING

1. Have you installed a new central air conditioning unit in your home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Is the air conditioner a high efficiency unit (>= 13 SEER) or a standard efficiency unit (< 13 SEER)? ○ High efficiency ○ Standard ○ Don't know

3. What is the SEER number for your unit? ○ < 11 ○ 12 ○ 13 ○ 14+ ○ Don't know

---

INSTALLED A NEW NATURAL GAS OR PROPANE FURNACE

1. Have you installed a new natural gas or propane furnace in your home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, is the furnace a high efficiency unit in which the exhaust exits a plastic pipe coming through the side of the home, or does the exhaust go up a chimney or flue similar to a standard efficiency unit? ○ Plastic pipe ○ Chimney or flue ○ Don't know

---

INSTALLED NEW HEAT PUMP

1. Have you installed a new heat pump in your home? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Is the heat pump a high efficiency unit (>= 13 SEER) or a standard efficiency unit (< 13)? ○ High efficiency ○ Standard ○ Don't know

3. What is the SEER number for your unit? ○ < 11 ○ 12 ○ 13 ○ 14+ ○ Don't know

---

INSTALLED NEW REFRIGERATOR

1. Have you purchased a new refrigerator? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Is the refrigerator Energy Star compliant? ○ Yes ○ No ○ Don't know

3. Are you keeping your old refrigerator plugged in as a backup? ○ Yes ○ No ○ Don't know

---

THE DUKE ENERGY WEB SITE

1. Have you visited the Duke Energy Web site that is referenced in your Personalized Energy Report to identify additional ways to save energy in your home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, did you find this Web site helpful? ○ Yes ○ Somewhat ○ No

Appendix B: PER Survey

Please answer the questions in this survey by darkening the circles next to the responses associated with each question using blue or black ink. For example ○ is fully filled in when it looks like this: ●

Duke Energy

REPORT RECOMMENDATIONS

This set of questions ask about the actions you have taken or plan to take based on the recommendations that were included in your Personalized Energy Report. These questions are only about things that you have done after receiving your report.

LOWERED THE TEMPERATURE IN THE HOME DURING THE WINTER

1. Have you lowered the temperature of your home to save money or energy during the winter months?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. How many degrees have you lowered the temperature at night? ○ 1-3 ○ 4-6 ○ 7-10 ○ 11+

3. How many degrees have you lowered the temperature during the day? ○ 1-3 ○ 4-6 ○ 7-10 ○ 11+

PURCHASED AND INSTALLED COMPACT FLORESCENT LIGHTS (CFLs)

1. Have you purchased and used additional compact fluorescent (CFL) bulbs in your home? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. How many CFLs have you purchased and installed since reading the report? ○ 1-2 ○ 3-5 ○ 6-9 ○ 10+

3. On average, what wattage bulb did you remove from the fixture before you installed the CFL? ○ ≤44 ○ 45-70 ○ 71-99 ○ 100+

4. Considering all CFL locations and uses, on average, how many hours per day do you use these bulbs?

○ ≤1 ○ 1-2 ○ 3-4 ○ 5-9 ○ 10-12 ○ 13-24

WASHED LAUNDRY IN COLD WATER

1. Have you switched from using hot water to do your laundry instead of cold water? ○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, how many loads of laundry do you do per week? ○ 1-2 ○ 3-4 ○ 5-6 ○ 7-9 ○ 9-10 ○ 11-12 ○ 13+

REPLACED FURNACE FILTERS

1. Have you replaced your furnace filter? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. How often do you now change the filter? ○ Less than once a year ○ Once a year ○ Twice a year
○ More than twice a year ○ Don't know

3. How often did you change your filter prior to reading the personalized energy report? ○ Less than once a year ○ Once a year
○ Twice a year ○ More than twice a year ○ Don't know

TURNED OFF HEAT IN UNUSED ROOMS

1. Have you closed the heating vents or otherwise shut off heat in unused rooms? ○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, how many rooms do you now heat in the winter? ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6+

INSTALLED WINDOW COVERING OR RIGID-FIT STORM WINDOWS

1. Have you purchased and installed any plastic wrap-type window kits that cover the entire window to help keep the cold out?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes, ...

2. How many windows have you covered with these kits? ○ 1-3 ○ 4-7 ○ 8-10 ○ 11+

3. On average, what size would you consider the window on which you used the kits to be? ○ Small ○ Average ○ Large

4. What type of window is it? ○ Single pane ○ Single with storm ○ Double pane

INSULATED HOT WATER HEATER TANK

1. Have you insulated your hot water tank? ○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, how many gallons of water does your tank hold? ○ 30 ○ 50 ○ 60 ○ 75 ○ 80+ ○ Don't know

KEEP DRAPERIES OPEN ON SUNNY DAYS AND CLOSED AT NIGHT

1. Do you manage your window coverings and draperies so that they are open when the sun is shining in and closed at other times?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, how many windows do you manage the coverings to save energy? ○ 1-3 ○ 4-7 ○ 8-12 ○ 13+

CLEANED ELECTRIC BASEBOARD HEATING REGISTERS OF DUST

1. For electrically heating homes, have you cleaned any of the baseboards?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, how many baseboards have you cleaned? ○ 1-3 ○ 4-6 ○ 7-10 ○ 11+

INSULATED THE CEILING OR ATTIC

1. Have you had your attic insulated? ○ Yes ○ No but plan to do this ○ No ○ Don't know

2. Did you insulate part of the ceiling or attic? ○ Part of ceiling ○ Entire ceiling

3. What type of insulation did you add? ○ Fiberglass ○ Cellulose ○ Foam ○ Other

4. How many inches of thickness did you add? ○ 1-3 ○ 3-4 ○ 5-6 ○ 7-8 ○ 9-10 ○ 11+

5. How thick was the insulation before you added more? ○ 1-3 ○ 3-4 ○ 5-6 ○ 7-8 ○ 9-10 ○ 11+

INSULATED SIDE WALLS OF HOME

1. Have you had the sidewalls of your home insulated since you received your Personalized Energy Report?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. How many walls did you have insulated? ○ 1 ○ 2 ○ 3 ○ 4+

3. What type of insulation did you add? ○ Fiberglass ○ Cellulose ○ Foam ○ Other

4. How many inches of thickness did you add? ○ 1-3 ○ 4-6 ○ 7-12 ○ 13+

CLOSED-OFF OR SEAL-UP THE FIREPLACE

1. Have you stopped using a fireplace to reduce the heat loss going up the chimney during the winter?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. Have you closed-off or sealed the fireplace to reduce the heat loss?

○ Yes ○ No but plan to do this ○ No ○ Don't know

INSULATED OR REPAIRED HEATING OR AIR CONDITIONING DUCTS

1. Have you insulated any of your heating or cooling ducts that deliver air to the rooms of the home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Are these ducts located in a heated or unheated part of the home?

○ Unheated area ○ Heated area ○ Don't know

3. Have you repaired or sealed leaks in any of your heating or cooling ducts that deliver air to the rooms of the home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

INSTALLED NEW CENTRAL AIR CONDITIONING

1. Have you installed a new central air conditioning unit in your home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Is the air conditioner a high efficiency unit (>= 13 SEER) or a standard efficiency unit (< 13 SEER)? ○ High efficiency ○ Standard ○ Don't know

3. What is the SEER number for your unit? ○ <11 ○ 12 ○ 13 ○ 14+ ○ Don't know

INSTALLED A NEW NATURAL GAS OR PROPANE FURNACE

1. Have you installed a new natural gas or propane furnace in your home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, is the furnace a high efficiency unit in which the exhaust exits a plastic pipe coming through the side of the home, or does the exhaust go up a chimney or flue similar to a standard efficiency unit? ○ Plastic pipe ○ Chimney or flue ○ Don't know

INSTALLED NEW HEAT PUMP

1. Have you installed a new heat pump in your home? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Is the heat pump a high efficiency unit (>= 13 SEER) or a standard efficiency unit (< 13)? ○ High efficiency ○ Standard ○ Don't know

3. What is the SEER number for your unit? ○ <11 ○ 12 ○ 13 ○ 14+ ○ Don't know

INSTALLED NEW REFRIGERATOR

1. Have you purchased a new refrigerator? ○ Yes ○ No but plan to do this ○ No ○ Don't know

If yes...

2. Is the refrigerator Energy Star compliant? ○ Yes ○ No ○ Don't know

3. Are you keeping your old refrigerator plugged in as a backup? ○ Yes ○ No ○ Don't know

THE DUKE ENERGY WEB SITE

1. Have you visited the Duke Energy Web site that is referenced in your Personalized Energy Report to identify additional ways to save energy in your home?

○ Yes ○ No but plan to do this ○ No ○ Don't know

2. If yes, did you find this Web site helpful? ○ Yes ○ Somewhat ○ No

Appendix C: Impact Algorithms Used

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW_S = \text{units} \times \left[\frac{(Watts \times DF_s)_{base} - (Watts \times DF_s)_{ee}}{1000} \right] \times CF_S \times (1 + HVAC_{d,\,s})$$

Gross Annual Energy Savings

$$\Delta kWh = \text{units} \times \left[\frac{(Watts \times DF)_{base} - (Watts \times DF)_{ee}}{1000} \right] \times FLH \times (1 + HVAC_c)$$

$$\Delta therm = \Delta kWh \times HVAC_g$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
$\Delta therm$	= gross annual therm interaction
units	= number of units installed under the program
$Watts_{ee}$	= connected (nameplate) load of energy-efficient unit
$Watts_{base}$	= connected (nameplate) load of baseline unit(s) displaced
FLH	= full-load operating hours (based on connected load)
DF	= demand diversity factor
CF	= coincidence factor
$HVAC_c$	= HVAC system interaction factor for annual electricity consumption
$HVAC_d$	= HVAC system interaction factor for demand
$HVAC_g$	= HVAC system interaction factor for annual gas consumption

15 W CFL Measure

$Watts_{ee}$ = 15, which is the input power of program supplied CFL

$Watts_{base}$ - calculated from survey responses as shown below:

Wattage of bulb removed	$Watts_{base}$	Notes
<= 44	40	Most popular size < 44 W
45 - 70	60	Lumen equivalent of 15 W CFL
71 - 99	75	Most popular size in range
> = 100	100	Most popular size in range

FLH - calculated from survey responses as shown below:

Hours of use per day	FLH	Notes
<1	183	Average value over range
1-2	548	Average value over range
3-4	1278	Average value over range
5-10	2738	Average value over range
11-12	4198	Average value over range
13-24	6753	Average value over range

DF = 1.0 and CF = 0.10

The coincidence factor for this analysis was taken as the average of the coincidence factors estimated by PG&E and SCE for residential CFL program peak demand savings. The PG&E and SCE coincidence factors are combined factors that consider both coincidence and diversity, thus the diversity factor for this analysis was set to 1.0

$HVAC_C$ - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Covington, KY

Heating Fuel	Heating System	Cooling System	HVACc	HVACg
Other	Any except Heat Pump	Any except Heat Pump	0	0
Any	Heat Pump	Heat Pump	-0.16	0
Gas Propane Oil	Central Furnace	None	0	-0.0021
		Room/Window	0.079	-0.0021
		Central AC	0.079	-0.0021
	Other	None	0	-0.0021
		Room/Window	0.079	-0.0021
		Central AC	0.079	-0.0021
Electricity	Central furnace	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0
	Electric baseboard	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0
	Other	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0

$HVAC_d$ - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Covington, KY

Cooling System	HVACd
None	0
Room/Window	.17
Central AC	.17
Heat Pump	.17

20W CFL Measure

$Watts_{ee}$ = 20, which is the input power of program supplied CFL
$Watts_{base}$ - calculated from survey responses as shown below:

Wattage of bulb removed	$Watts_{base}$	Notes
<= 44	40	Most popular size < 44 W
45 - 70	60	Most popular size in range
71 - 99	75	Lumen equivalent of 20 W CFL
> = 100	100	Most popular size in range

Weatherstripping, Outlet Gaskets, and Fireplace Closure

Gross Summer Coincident Demand Savings

$\Delta kW_S = units \times (\Delta cfm/unit) \times (kW / cfm) \times DF_S \times CF_S$

Gross Annual Energy Savings

$\Delta kWh = units \times (\Delta cfm/unit) \times (kWh / cfm)$

$\Delta therm = units \times (\Delta cfm / unit) \times (therm / cfm)$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings

units = number of buildings sealed under the program
Δcfm/unit = unit infiltration airflow rate (ft^3/min) reduction for each measure
DF = demand diversity factor = 0.8
CF = coincidence factor = 1.0
kW/cfm = demand savings per unit cfm reduction
kWh/cfm = electricity savings per unit cfm reduction
therm/cfm = gas savings per unit cfm reduction

Unit cfm savings per measure

The cfm reductions for each measure were estimated from equivalent leakage area (ELA) change data taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001). The equivalent leakage area changes were converted to infiltration rate changes using the Sherman-Grimsrud equation:

$$Q = ELA \times \sqrt{A \times \Delta T + B \times v^2}$$

where:

A = stack coefficient (ft^3/min-in^4-°F)
= 0.015 for one-story house
ΔT = average indoor/outdoor temperature difference over the time interval of interest (°F)
B = wind coefficient (ft^3/min-in^4-mph^2)
= 0.0065 (moderate shielding)
v = average wind speed over the time interval of interest measured at a local weather station at a height of 20 ft (mph)

The location specific data are shown below:

Location	Average outdoor temp	Average indoor/outdoor temp difference	Average wind speed (mph)	Specific infiltration rate (cfm/in^2)
Covington	33	35	22	1.92

Measure ELA impact and cfm reductions are as follows:

Measure	Unit	ELA change (in^2/unit)	ΔCfm/unit (KY)
Outlet gaskets	Each	0.357	0.69
Weather strip	Foot	0.089	0.17
Fireplace	Each	1.86	3.57

Unit energy and demand savings

The energy and peak demand impacts of reducing infiltration rates were calculated from infiltration rate parametric studies conducted using the DOE-2 residential building prototype models, as described at the end of this Appendix. The savings per cfm reduction by heating and cooling system type are shown below:

Heating Fuel	Heating System	Cooling System	kWh/cfm	kW/cfm	therm/cfm
Other	Any except Heat Pump	Any except Heat Pump	1.14	0.00000	0.000
Any	Heat Pump	Heat Pump	12.85	0.00248	0.000
Gas Propane Oil	Central Furnace	None	0	0	0.124
		Room/Window	1.14	0.00000	0.124
		Central AC	1.14	0.00000	0.124
	Other	None	0	0	0.124
		Room/Window	1.14	0.00000	0.124
		Central AC	1.14	0.00000	0.124
Electricity	Central furnace	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000
	Electric baseboard	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000
	Other	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000

Window Shrink Kit

Gross Summer Coincident Demand Savings
ΔkW_S = no. windows ×SF/window × (ΔkW/SF) × DF_S × CF_S

Gross Annual Energy Savings
ΔkWh = no. windows ×SF/window × (ΔkWh/SF)

Δtherm = no. windows ×SF/window × (Δtherm/SF)

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
No windows = quantity of windows treated with window film from survey

SF/window = window square feet based on window size
DF = demand diversity factor
CF = coincidence factor
ΔkW/SF `= electricity demand savings per square foot of window treated
ΔkWh/SF `= electricity consumption savings per square foot of window treated
Δtherm/SF `= gas consumption savings per square foot of window treated

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Window area assumptions (per window):

Window Type	Size (SF)
Small	9
Average	18
Large	30

Unit energy and demand savings data

The unit energy savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic simulation assumptions for window U-value and solar heat gain coefficient (SHGC) were taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001), and are described below:

	Without window film		**With window film**	
Window type	**U-value (Btu/hr-SF-°F)**	**SHGC**	**U-value (Btu/hr-SF-°F)**	**SHGC**
Single	1.27	0.86	0.81	0.76
Single with storm	0.81	0.76	0.67	0.68
Double	0.81	0.76	0.67	0.68

The unit energy savings depend on the heating fuel, heating system, cooling system and window type:

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Window	**ΔkWh/SF**	**ΔkW/SF**	**Δtherm/SF**

type			
All	0	0	0

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0.795	0.000853	0
Single with storm	0.566	0.000498	0
Double	0.566	0.000498	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	4.757	0.001280	0.000
Single with storm	1.621	0.000711	0.000
Double	1.621	0.000711	0.000

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0	0	0.039
Single with storm	0	0	0.011
Double	0	0	0.011

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0.795	0.000853	0.039
Single with storm	0.566	0.000498	0.011
Double	0.566	0.000498	0.011

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	8.748	0.004979	0.000
Single with storm	2.431	0.001351	0.000
Double	2.431	0.001351	0.000

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	9.335	0.005690	0.000
Single with storm	2.940	0.001849	0.000
Double	2.940	0.001849	0.000

Low-Flow Showerhead

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413_s} \times DF_x \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413} \times 365$$

$$\Delta therm = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{365}{100000}$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of units installed under the program

GPD_{base} = daily hot water consumption before installation
GPD_{ee} = daily hot water consumption after flow reducing measure installation
ΔT = average difference between entering cold water temperature and the shower use temperature
DF = demand diversity factor for electric water heating
CF = coincidence factor
8.33 = conversion factor (Btu/gal-°F)
3413 = conversion factor (Btu/kWh)
24 = conversion factor (hr/day)
365 = conversion factor (days/yr)
100000 = conversion factor (Btu/therm)

Showerhead

GPD_{base} = showers/week / 7 x 3.1 gpm x 5 minutes/shower

GPD_{ee} = showers/week / 7 x 1.5 gpm x 5 minutes/shower

ΔT

City	Average cold water temperature	Shower use temperature	Average ΔT
Covington	53.9°F	100°F	46.1°F

Water heater efficiency

Combustion efficiency for residential gas water heater = 0.70

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Faucet Aerators

This measure used the Efficiency Vermont deemed savings (Efficiency Vermont, 2003) adjusted for entering water temperature:

Demand Savings
$\Delta kW = 0.0171 \text{ kW} \times \Delta T / \Delta T_{VT} \times DF \times CF$

Energy Savings
$\Delta kWh_i = 57\ kWh \times \Delta T / \Delta T_{VT}$
$\Delta therms = 2.0 \times \Delta T / \Delta T_{VT\,i}$

City	Average cold water temperature	Hot water use temperature	Average ΔT
Covington	53.9°F	100°F	46.1°F
Burlington VT	44.5	100°F	55.5

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Lowering the Temperature in Winter

Gross Annual Energy Savings
ΔkWh = (ΔkWh/unit)

Δtherm = (Δtherm/unit

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
DF	= demand diversity factor
CF	= coincidence factor
ΔkWunit	`= electricity demand savings per dwelling
ΔkWh/SF	`= electricity consumption savings per dwelling
Δtherm/SF	`= gas consumption savings dwelling

Unit energy savings data

The unit energy savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic assumptions used in the simulations are shown below:

Setback strategy	Setback schedule	Setback temperature
Night 1-3	10 pm to 5 am 7 days per week	68°F
Night 4-6		65°F
Night 7-10		61.5°F

Night 11+		59°F
Day 1-3	5 am to 10 pm 7 days per week	68°F
Day 4-6		65°F
Day 7-10		61.5°F
Day 11+		59°F

The baseline heating setpoint is assumed to be 70°F with no setback.

The unit energy savings depend on the heating fuel, heating system, cooling system and setback strategy. Since this is a heating season measure, there are no summer peak demand savings.

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Setback strategy	ΔkWh/unit	Δtherm/unit
All	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

Setback strategy	ΔkWh/unit	Δtherm/unit
Night 1-3	58	0
Night 4-6	107	0
Night 7-10	138	0
Night 11+	149	0
Day 1-3	80	0
Day 4-6	159	0
Day 7-10	204	0
Day 11+	232	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

Setback strategy	ΔkWh/unit	Δtherm/unit
Night 1-3	386	0.0
Night 4-6	1,114	0.0
Night 7-10	2,080	0.0
Night 11+	2,767	0.0

Day 1-3	951	0.0
Day 4-6	2,518	0.0
Day 7-10	4,394	0.0
Day 11+	5,715	0.0

Heating Fuel — Gas, propane or oil
Heating System — Any except Heat Pump
Cooling System — None

Setback strategy	ΔkWh/unit	Δtherm/unit
Night 1-3	0.0	4.0
Night 4-6	0.0	10.0
Night 7-10	0.0	16.0
Night 11+	0.0	19.8
Day 1-3	0.0	8.5
Day 4-6	0.0	20.5
Day 7-10	0.0	33.3
Day 11+	0.0	41.3

Heating Fuel — Gas, propane or oil
Heating System — Any except Heat Pump
Cooling System — Room/Window or Central AC

Setback strategy	ΔkWh/unit	Δtherm/unit
Night 1-3	58	4.0
Night 4-6	107	10.0
Night 7-10	138	16.0
Night 11+	149	19.8
Day 1-3	80	8.5
Day 4-6	159	20.5
Day 7-10	204	33.3
Day 11+	232	41.3

Heating Fuel — Electricity
Heating System — Any except Heat Pump
Cooling System — None

Setback strategy	ΔkWh/unit	Δtherm/unit
Night 1-3	918	0.0
Night 4-6	2,164	0.0
Night 7-10	3,390	0.0
Night 11+	4,095	0.0

Day 1-3	1,863	0.0
Day 4-6	4,419	0.0
Day 7-10	7,030	0.0
Day 11+	8,615	0.0

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

Setback strategy	ΔkWh/unit	Δtherm/unit
Night 1-3	957	0.0
Night 4-6	2,228	0.0
Night 7-10	3,467	0.0
Night 11+	4,171	0.0
Day 1-3	1,903	0.0
Day 4-6	4,492	0.0
Day 7-10	7,100	0.0
Day 11+	8,686	0.0

Using Cold Water for Laundry

The energy and demand savings for this measure were taken from the Efficiency Vermont Technical Reference Manual (Efficiency Vermont, 2001), based on the savings per load and the number of loads reported by the survey respondents.

	Gas	Electric	
Loads/wk	therm/yr	kWh/yr	kW
1-2	13.2	166	0.019
3-4	30.8	388	0.044
5-6	48.3	609	0.070
7-8	65.9	830	0.095
9-10	83.5	1052	0.120
11-12	101.0	1273	0.145
13+	114.2	1439	0.164

Replacing Furnace Filter

Gross Summer Coincident Demand Savings

$\Delta kW_S = (kW/unit_{pre} - kW/unit_{post}) \times DF_S \times CF_S$

Gross Annual Energy Savings

$\Delta kWh = (kWh/unit_{pre} - kWh/unit_{post})$

$\Delta therm = (therm/unit_{pre} - therm/unit_{post})$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
DF	= demand diversity factor
CF	= coincidence factor
$kWunit_{pre}$	= HVAC electricity demand per dwelling based on pre report filter change frequency
$kWunit_{post}$	= HVAC electricity demand per dwelling based on post report filter change frequency
$kWh/unit_{pre}$	= HVAC electricity consumption per dwelling based on pre report filter change frequency
$kWh/unit_{post}$	= HVAC electricity consumption per dwelling based on post report filter change frequency
$therm/unit_{pre}$	= HVAC gas consumption per dwelling based on pre report filter change frequency
$therm/unit_{post}$	= HVAC gas consumption per dwelling based on post report filter change frequency

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Unit energy and demand data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The analysis assumes that furnace filter change outs result in a 5% savings relative to an un-maintained system. The 5% overall savings were allocated to the survey responses as follows:

Filter change frequency	Percent savings
< 1/yr	0%
1x / yr	1.7%
2x / yr	3.3%
> 2x / yr	5%

Data depend on the heating fuel, heating system, cooling system type and the pre and post filter change frequency

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Filter change frequency	kWh	kW	therm
all	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Central AC

Filter change frequency	kWh	kW	therm
< 1/yr	4,453	5.2	0
1x / yr	4,375	5.1	0
2x / yr	4,302	5.0	0
> 2x / yr	4,231	4.9	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

Filter change frequency	kWh	kW	therm
< 1/yr	21,793	11.7	0
1x / yr	21,410	11.5	0
2x / yr	21,054	11.3	0
> 2x / yr	20,704	11.1	0

Heating Fuel	Gas, propane or oil
Heating System	Furnace
Cooling System	None

Filter change frequency	kWh	kW	therm
< 1/yr	0	0	148

1x / yr	0	0	146
2x / yr	0	0	143
> 2x / yr	0	0	141

Heating Fuel Gas, propane or oil
Heating System Furnace
Cooling System Central AC

Filter change frequency	kWh	kW	therm
< 1/yr	4,453	5.2	148
1x / yr	4,375	5.1	146
2x / yr	4,302	5.0	143
> 2x / yr	4,231	4.9	141

Heating Fuel Electricity
Heating System Furnace
Cooling System None

Filter change frequency	kWh	kW	therm
< 1/yr	31,073	19.5	0
1x / yr	30,527	19.2	0
2x / yr	30,020	18.8	0
> 2x / yr	29,520	18.5	0

Heating Fuel Electricity
Heating System Furnace
Cooling System Central AC

Filter change frequency	kWh	kW	therm
< 1/yr	34,936	24.3	0
1x / yr	34,322	23.9	0
2x / yr	33,752	23.5	0
> 2x / yr	33,190	23.1	0

Stopping Heating Unused Rooms

Gross Summer Coincident Demand Savings
$\Delta kW_S = (\Delta kW/unit) \times DF_S \times CF_S$

Gross Annual Energy Savings
$\Delta kWh = (\Delta kWh/unit)$

$\Delta therm = (\Delta therm/unit$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
DF	= demand diversity factor
CF	= coincidence factor
ΔkWunit	`= electricity demand savings per dwelling
ΔkWh/SF	`= electricity consumption savings per dwelling
Δtherm/SF	`= gas consumption savings dwelling

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The analysis assumes that each room is 220 SF in size. Savings data depend on the heating fuel, heating system, cooling system and duct treatment

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Number of rooms	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel Other

Heating System	Any except Heat Pump
Cooling System	Central AC

Number of rooms	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1	80	0.09	0
2	161	0.19	0
3	241	0.28	0
4	321	0.37	0
5	401	0.47	0
6+	482	0.56	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

Number of rooms	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1	393	0.21	0
2	786	0.42	0
3	1,179	0.63	0
4	1,571	0.84	0
5	1,964	1.05	0
6+	2,357	1.26	0

Heating Fuel	Gas, propane or oil
Heating System	Furnace
Cooling System	None

Number of rooms	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1	0	0	3
2	0	0	5
3	0	0	8
4	0	0	11
5	0	0	13
6+	0	0	16

Heating Fuel	Gas, propane or oil
Heating System	Furnace

Cooling System Central AC

Number of rooms	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1	80	0.09	3
2	161	0.19	5
3	241	0.28	8
4	321	0.37	11
5	401	0.47	13
6+	482	0.56	16

Heating Fuel Electricity
Heating System Furnace
Cooling System None

Number of rooms	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1	560	0.35	0
2	1,120	0.70	0
3	1,680	1.05	0
4	2,241	1.41	0
5	2,801	1.76	0
6+	3,361	2.11	0

Heating Fuel Electricity
Heating System Furnace
Cooling System Central AC

Number of rooms	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1	630	0.44	0
2	1,260	0.88	0
3	1,889	1.31	0
4	2,519	1.75	0
5	3,149	2.19	0
6+	3,779	2.63	0

Insulated Water Heater

Gross Summer Coincident Demand Savings

$$\Delta kW_S = \text{units} \times \frac{(UA_{base} - UA_{ee}) \times \Delta T_s}{3413} \times DF_s \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{3413} \times 8760$$

$$\Delta therm = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{8760}{100000}$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of water heaters installed under the program
UA_{base}	= overall heat transfer coefficient of base water heater (Btu/hr-°F)
UA_{ee}	= overall heat transfer coefficient of improved water heater (Btu/hr-°F)
ΔT	= temperature difference between the tank and the ambient air (°F)
DF	= demand diversity factor
CF	= coincidence factor
3413	= conversion factor (Btu/kWh)
8760	= conversion factor (hr/yr)
100000	= conversion factor (Btu/therm)
$\eta_{waterheater}$	= water heater efficiency

Water heater tank UA

Water heater size (gal)	Electric		Gas	
	UAbase	UAee	UAbase	UAee
30	3.84	1.69	4.21	1.76
50	4.67	1.83	5.13	1.91
60	4.13	2.06	4.54	2.14
75	5.00	2.42	5.50	2.52
80+	5.72	2.53	6.28	2.64

ΔT = 140°F water setpoint temp – 65°F room temp = 75°F

DF = 1.0
CF= 1.0
$\eta_{waterheater}$ = 0.7

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential water heaters meeting standby losses.

Manage Draperies

Gross Summer Coincident Demand Savings
ΔkW_S = windows × (ΔkW/window) × DF_S × CF_S

Gross Annual Energy Savings
ΔkWh = windows × (ΔkWh/ window)

Δtherm = windows × (Δtherm/ window)

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
Windows	= number of windows managed
DF	= demand diversity factor
CF	= coincidence factor
ΔkW/ window	`= electricity demand savings per window
ΔkWh/window	`= electricity consumption savings per window
Δtherm/window	`= gas consumption savings per window

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The analysis assumes drapes open during daylight hours on south facing windows only. The savings depend on the heating fuel, heating system, cooling system and number of windows managed.

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Any or none

Number of windows	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

Number of windows	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1-3	99	0	0
4-7	274	0	0
8-12	497	0	0
13+	647	0	0

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	Any or none

Number of windows	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1-3	0	0	3
4-7	0	0	5
8-12	0	0	8
13+	0	0	11

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Any or none

Number of windows	ΔkWh/unit	ΔkW/unit	Δtherm/unit
1-3	164	0	0
4-7	451	0	0
8-12	821	0	0
13+	1067	0	0

Cleaned Electric Baseboards

Savings are based on reduced heat losses from back of electric baseboard unit through insulated wall to the outside. Cleaning unit is assumed to reduce the average temperature inside the unit from 115°F to 90°F. Heat losses are estimated based on an R-11 wall and 40°F outside temperature. Each unit is assumed to be 8 ft long. Heat loss reductions are estimated to be 0.13% of the baseboard rated input, resulting in 4.25 kWh per baseboard unit cleaned. Apply only when heating fuel = electric and heating system type = baseboard. No kW savings.

Attic Insulation

Gross Summer Coincident Demand Savings
$\Delta kW_S = SF \times (kW/SF_{base} - kW/SF_{ee}) \times DF_S \times CF_S$

Gross Annual Energy Savings
$\Delta kWh = SF \times (kWh/SF_{base} - kWh/SF_{ee})$

$\Delta therm = SF \times (therm/SF_{base} - therm/SF_{ee})$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
SF	= insulation square feet installed
DF	= demand diversity factor
CF	= coincidence factor
kW/SF	`= electricity demand per square foot of insulation installed
kWh/SF	`= electricity consumption per square foot of insulation installed
therm/SF	`= gas consumption per square foot of insulation installed

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Insulation square foot assumptions:

Average house size from site data (Carolinas), or estimated from number of rooms (Kentucky)

Size of house = number of rooms * 330 SF/room

Average ceiling area = house size / 1.2

If partial insulation, then reduce ceiling area by 50%

R value assumptions

Rbase:

Base thickness	R_{base}
2	7
4	14
6	21
8	28
10	35

Assumes existing insulation is fiberglass or cellulose, at R-3.5 per inch. This assumption addresses insulation R-value only. The R-value assumptions for other materials within the ceiling construction are embedded in the simulation model.

Ree

The R-value of the wall with added insulation depends on base thickness, added insulation thickness and insulation type: Fiberglass, cellulose and "other" insulation is assumed to have an R-value of 3.5 per inch. Foam insulation is assumed to have an R-value of 5.6 per inch.

Base thickness	Added thickness	Ree	
		fiberglass, cellulose or other	Foam
2	2	14.00	18.20
	4	21.00	29.40
	6	28.00	40.60
	8	35.00	51.80
	10	42.00	63.00
	12	49.00	74.20
4	2	21.00	25.20
	4	28.00	36.40
	6	35.00	47.60
	8	42.00	58.80
	10	49.00	70.00
	12	56.00	81.20
6	2	28.00	32.20
	4	35.00	43.40
	6	42.00	54.60

	8	49.00	65.80
	10	56.00	77.00
	12	63.00	88.20
	2	35.00	39.20
	4	42.00	50.40
	6	49.00	61.60
	8	56.00	72.80
	10	63.00	84.00
8	12	70.00	95.20
	2	42.00	46.20
	4	49.00	57.40
	6	56.00	68.60
	8	63.00	79.80
	10	70.00	91.00
10	12	77.00	102.20
	2	49.00	53.20
	4	56.00	64.40
	6	63.00	75.60
	8	70.00	86.80
	10	77.00	98.00
12	12	84.00	109.20

Unit energy and demand data

The unit energy savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The unit energy and demand savings depend on the heating fuel, heating system, cooling system type and Rvalue

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF

7	1.339	0.00157	0
14	1.272	0.00149	0
21	1.245	0.00145	0
28	1.231	0.00143	0
35	1.220	0.00142	0
42	1.214	0.00141	0
49	1.210	0.00141	0
56	1.206	0.00140	0
63	1.203	0.00140	0
70	1.201	0.00140	0
77	1.200	0.00140	0
84	1.196	0.00139	0
109	1.194	0.00139	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

R-value	kWh/SF	kW/SF	therm/SF
7	6.550	0.00387	0.00000
14	6.121	0.00378	0.00000
21	5.937	0.00374	0.00000
28	5.833	0.00371	0.00000
35	5.768	0.00370	0.00000
42	5.724	0.00368	0.00000
49	5.689	0.00368	0.00000
56	5.665	0.00367	0.00000
63	5.644	0.00366	0.00000
70	5.628	0.00366	0.00000
77	5.616	0.00366	0.00000
84	5.605	0.00366	0.00000
109	5.576	0.00365	0.00000

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
7	0	0	0.04418
14	0	0	0.04058
21	0	0	0.03908
28	0	0	0.03828
35	0	0	0.03768

42	0	0	0.03738
49	0	0	0.03708
56	0	0	0.03688
63	0	0	0.03668
70	0	0	0.03658
77	0	0	0.03648
84	0	0	0.03638
109	0	0	0.03618

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	1.339	0.00157	0.04418
14	1.272	0.00149	0.04058
21	1.245	0.00145	0.03908
28	1.231	0.00143	0.03828
35	1.220	0.00142	0.03768
42	1.214	0.00141	0.03738
49	1.210	0.00141	0.03708
56	1.206	0.00140	0.03688
63	1.203	0.00140	0.03668
70	1.201	0.00140	0.03658
77	1.200	0.00140	0.03648
84	1.196	0.00139	0.03638
109	1.194	0.00139	0.03618

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
7	9.063	0.00501	0.00000
14	8.254	0.00463	0.00000
21	7.915	0.00447	0.00000
28	7.728	0.00439	0.00000
35	7.610	0.00432	0.00000
42	7.528	0.00429	0.00000
49	7.468	0.00426	0.00000

56	7.423	0.00424	0.00000
63	7.387	0.00422	0.00000
70	7.358	0.00421	0.00000
77	7.334	0.00420	0.00000
84	7.313	0.00419	0.00000
109	7.262	0.00417	0.00000

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	10.184	0.00646	0.00000
14	9.327	0.00601	0.00000
21	8.969	0.00581	0.00000
28	8.773	0.00571	0.00000
35	8.645	0.00564	0.00000
42	8.560	0.00560	0.00000
49	8.497	0.00557	0.00000
56	8.448	0.00554	0.00000
63	8.410	0.00552	0.00000
70	8.380	0.00551	0.00000
77	8.356	0.00550	0.00000
84	8.331	0.00548	0.00000
109	8.279	0.00546	0.00000

Sidewall Insulation

Gross Summer Coincident Demand Savings

$\Delta kW_S = SF \times (kW/SF_{base} - kW/SF_{ee}) \times DF_S \times CF_S$

Gross Annual Energy Savings

$\Delta kWh = SF \times (kWh/SF_{base} - kWh/SF_{ee})$

$\Delta therm = SF \times (therm/SF_{base} - therm/SF_{ee})$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings

SF = insulation square feet installed
DF = demand diversity factor
CF = coincidence factor
kW/SF `= electricity demand per square foot of insulation installed
kWh/SF `= electricity consumption per square foot of insulation installed
therm/SF `= gas consumption per square foot of insulation installed

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Insulation square foot assumptions:

Average house size from site data (Carolinas), or estimated from number of rooms (KY)

Size of house = number of rooms * 330 SF/room

Number of walls	Wall area as a fraction of floor area
1	0.26
2	0.52
3	0.72
4+	0.92

R value assumptions

Rbase:

Base thickness	R_{base}
0	0.91

The base case assumes an uninsulated wall with 3.5 inch air gap. This assumption addresses "insulation" R-value only. The R-value assumptions for other materials within the wall construction are embedded in the simulation model.

Ree

The insulated wall R-value depends on added insulation thickness and insulation type. Fiberglass, cellulose and "other" insulation is assumed to have an R-value of 3.5 per inch. Foam insulation is assumed to have an R-value of 5.6 per inch.

Added thickness	Ree	
	fiberglass, cellulose or other	Foam
1-3	7.9	12.1
4-6	18.4	28.9
7-12	30.7	48.5
13+	46.4	73.7

Unit energy and demand data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The unit energy and demand savings depend on the heating fuel, heating system, cooling system type and wall Rvalue:

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	2.361	0.00273	0
7.9	2.046	0.00238	0
18.4	1.950	0.00227	0
30.7	1.908	0.00224	0
46.4	1.887	0.00220	0
12.1	1.988	0.00230	0
28.9	1.917	0.00224	0
48.5	1.886	0.00220	0
73.7	1.874	0.00220	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

R-value	kWh/SF	kW/SF	therm/SF

0.91	12.078	0.00655	0.00000
7.9	9.865	0.00605	0.00000
18.4	9.160	0.00588	0.00000
30.7	8.892	0.00581	0.00000
46.4	8.734	0.00578	0.00000
12.1	9.477	0.00597	0.00000
28.9	8.918	0.00583	0.00000
48.5	8.721	0.00578	0.00000
73.7	8.620	0.00575	0.00000

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
0.91	0	0	0.08530
7.9	0	0	0.06565
18.4	0	0	0.05974
30.7	0	0	0.05751
46.4	0	0	0.05623
12.1	0	0	0.06230
28.9	0	0	0.05767
48.5	0	0	0.05623
73.7	0	0	0.05543

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	2.361	0.00273	0.08530
7.9	2.046	0.00238	0.06565
18.4	1.950	0.00227	0.05974
30.7	1.908	0.00224	0.05751
46.4	1.887	0.00220	0.05623
12.1	1.988	0.00230	0.06230
28.9	1.917	0.00224	0.05767
48.5	1.886	0.00220	0.05623
73.7	1.874	0.00220	0.05543

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
0.91	17.807	0.00963	0
7.9	13.354	0.00749	0
18.4	12.045	0.00685	0
30.7	11.552	0.00663	0
46.4	11.277	0.00650	0
12.1	12.616	0.00712	0
28.9	11.599	0.00665	0
48.5	11.254	0.00649	0
73.7	11.075	0.00641	0

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	12.078	0.00655	0.00000
7.9	9.865	0.00605	0.00000
18.4	9.160	0.00588	0.00000
30.7	8.892	0.00581	0.00000
46.4	8.734	0.00578	0.00000
12.1	9.477	0.00597	0.00000
28.9	8.918	0.00583	0.00000
48.5	8.721	0.00578	0.00000
73.7	8.620	0.00575	0.00000

Duct Insulation and Repair

Gross Summer Coincident Demand Savings
$\Delta kW_S = (\Delta kW/unit) \times DF_S \times CF_S \times LF$

Gross Annual Energy Savings
$\Delta kWh = (\Delta kWh/unit) \times LF$

$\Delta therm = (\Delta therm/unit) \times LF$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
DF = demand diversity factor
CF = coincidence factor
LF = location factor
ΔkWunit `= electricity demand savings per dwelling
ΔkWh/SF `= electricity consumption savings per dwelling
Δtherm/SF `= gas consumption savings dwelling

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential air conditioners and heat pumps in summer peaking utilities.

The location factors used are as follows:

Heated Area	Unheated Area	DK/No Response
0	1	.43

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic assumptions are listed below:

Assumption	Pre treatment	Post treatment	Notes
Duct insulation	Uninsulated	R-19	Consistent with Smart Saver program requirements
Duct sealing	26% leakage	8% leakage	Duct leakage assumptions used in CA for Title 24 and utility program design. Evenly distributed between supply and return

The unit energy and demand savings depend on the heating fuel, heating system, cooling system and duct treatment as follows:

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	384	0.10	0
Seal	466	0.25	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	1,520	0.48	0.0
Seal	2,422	0.78	0.0

Heating Fuel Gas, propane or oil
Heating System Furnace
Cooling System None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	0.0	0.0	17.3
Seal	0.0	0.0	16.5

Heating Fuel Gas, propane or oil
Heating System Furnace
Cooling System Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	384	0.10	17.3
Seal	466	0.25	16.5

Heating Fuel	Electricity
Heating System	Furnace
Cooling System	None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	3,917	3.13	0.0
Seal	3,798	2.98	0.0

Heating Fuel	Electricity
Heating System	Furnace
Cooling System	Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	4,285	3.18	0.0
Seal	4,211	3.18	0.0

Installed a New AC or Heat Pump

Gross Summer Coincident Demand Savings
$\Delta kW_S = (\Delta kW/unit) \times DF_S \times CF_S$

Gross Annual Energy Savings
$\Delta kWh = (\Delta kWh/unit)$

$\Delta therm = (\Delta therm/unit$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
DF	= demand diversity factor
CF	= coincidence factor
ΔkWunit	`= electricity demand savings per dwelling
ΔkWh/SF	`= electricity consumption savings per dwelling
Δtherm/SF	`= gas consumption savings dwelling

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential air conditioners and heat pumps in summer peaking utilities.

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. Unit energy savings are based on replacement of an existing SEER 8.5 air conditioner or heat pump. The unit energy and demand savings depend on the heating fuel, heating system, cooling system and replacement efficiency.

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	2,941	1.36	0
12	2,941	1.36	0
13	5,294	2.45	0
14+	6,496	2.98	0

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0.0	0.0	0

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

0

Heating Fuel Electricity
Heating System Any except Heat Pump
Cooling System None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0.0	0.0	0

Heating Fuel Electricity
Heating System Any except Heat Pump
Cooling System Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

Installed a New Furnace

Gross Annual Energy Savings
Δtherm = (Δtherm/unit)

where:

Δtherm/SF `= gas consumption savings dwelling

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic assumptions are listed below:

Furnace Type	AFUE
Baseline	0.78
Standard efficiency (metal flue pipe) replacement	0.80
Condensing furnace (plastic flue pipe) replacement	0.90

The unit energy and demand savings depend on the heating fuel, heating system type, and replacement furnace type:

Heating Fuel	Gas, propane or oil
Heating System	Furnace

Replacement efficiency	Δtherm/unit
Standard (metal pipe)	3.0
Condensing (plastic pipe)	18.8

Otherwise 0

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable

average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 1.

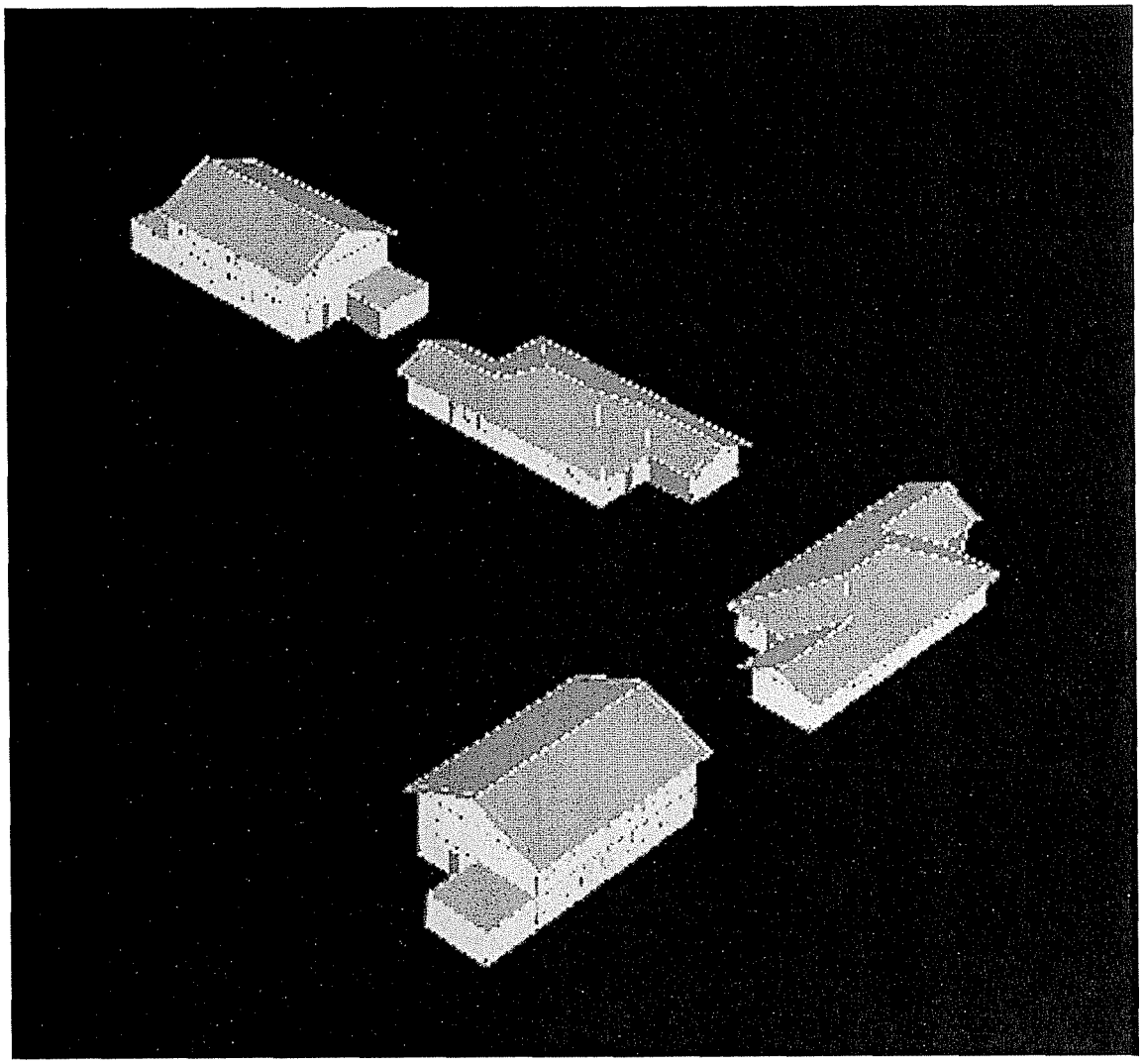

Figure 1. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF average

Characteristic	Value
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F
Duct location	Attic (unconditioned space)
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	26%; evenly distributed between supply and return
Cooling season	Charlotte – April 17 to October 6 Covington
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

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Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix D: Housing Characteristics

Type of home

	Kentucky Kits			Kentucky No Kits		
	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Detached single-family	654	88.26%	88.26%	1681	89.46%	89.46%
Manufactured/Modular home	23	3.10%	3.10%	56	2.98%	2.98%
Condominium	41	5.53%	5.53%	111	5.91%	5.91%
Duplex/2-family	14	1.89%	1.89%	23	1.22%	1.22%
Multi-family (3 or more units)	9	1.21%	1.21%	8	0.43%	0.43%
Total	741	100.00%	100.00%	1879	100.00%	100.00%

Year home was built

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Don't Know	5	0.67%	0.67%	16	0.85%	0.85%
Before 1959	227	30.63%	30.63%	548	29.16%	29.16%
1960-1979	177	23.89%	23.89%	514	27.35%	27.35%
1980-1989	83	11.20%	11.20%	183	9.74%	9.74%
1990-1997	103	13.90%	13.90%	269	14.32%	14.32%
1998-2000	65	8.77%	8.77%	157	8.36%	8.36%
2001-2006	81	10.93%	10.93%	192	10.22%	10.22%
Total	741	100.00%	100.00%	1879	100.00%	100.00%

Number of rooms in home (excluding bathrooms)

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Don't Know	3	0.40%	0.40%	8	0.43%	0.43%
1-3	11	1.48%	1.48%	34	1.81%	1.81%
4	40	5.40%	5.40%	91	4.84%	4.84%
5	111	14.98%	14.98%	279	14.85%	14.85%
6	145	19.57%	19.57%	377	20.06%	20.06%
7	158	21.32%	21.32%	426	22.67%	22.67%
8	131	17.68%	17.68%	305	16.23%	16.23%
9	68	9.18%	9.18%	156	8.30%	8.30%
10+	74	9.99%	9.99%	203	10.80%	10.80%
Total	741	100.00%	100.00%	1879	100.00%	100.00%

Number of occupants

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Don't Know	1	0.13%	0.13%	4	0.21%	0.21%
1	131	17.68%	17.68%	387	20.60%	20.60%
2	359	48.45%	48.45%	928	49.39%	49.39%
3	114	15.38%	15.38%	256	13.62%	13.62%
4	86	11.61%	11.61%	205	10.91%	10.91%
5	35	4.72%	4.72%	62	3.30%	3.30%
6	11	1.48%	1.48%	29	1.54%	1.54%
7	2	0.27%	0.27%	5	0.27%	0.27%
8+	2	0.27%	0.27%	3	0.16%	0.16%
Total	741	100.00%	100.00%	1879	100.00%	100.00%

Heating fuel

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
electric	139	18.76%	18.86%	415	22.09%	22.12%
natural gas	524	70.72%	71.10%	1312	69.82%	69.94%
oil	2	0.27%	0.27%	4	0.21%	0.21%
propane	4	0.54%	0.54%	5	0.27%	0.27%
other	68	9.18%	9.23%	140	7.45%	7.46%
Total	737	99.46%	100.00%	1876	99.84%	100.00%
No Response	4	0.54%		3	0.16%	
Total	741	100.00%		1879	100.00%	

Heating system

	Kentucky Kits			Kentucky No Kits		
	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Central furnace	600	80.97%	81.74%	1555	82.76%	83.11%
Electric baseboard	7	0.94%	0.95%	11	0.59%	0.59%
Other	49	6.61%	6.68%	114	6.07%	6.09%
Heat pump	78	10.53%	10.63%	191	10.16%	10.21%
Total	734	99.06%	100.00%	1871	99.57%	100.00%
No Response	7	0.94%		8	0.43%	
Total	741	100.00%		1879	100.00%	

Age of furnace

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Don't Know	21	2.83%	2.83%	68	3.62%	3.62%
0-4	213	28.74%	28.74%	491	26.13%	26.13%
5-9	220	29.69%	29.69%	548	29.16%	29.16%
10-14	124	16.73%	16.73%	383	20.38%	20.38%
15+	163	22.00%	22.00%	389	20.70%	20.70%
Total	741	100.00%	100.00%	1879	100.00%	100.00%

Type of cooling system

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Central air conditioning	595	80.30%	80.84%	1524	81.11%	81.45%
Room window unit	43	5.80%	5.84%	107	5.69%	5.72%
Central and room	12	1.62%	1.63%	22	1.17%	1.18%
Heat pump	78	10.53%	10.60%	191	10.16%	10.21%
None	8	1.08%	1.09%	27	1.44%	1.44%
Total	736	99.33%	100.00%	1871	99.57%	100.00%
No Response	5	0.67%		8	0.43%	
Total	741	100.00%		1879	100.00%	

Age of cooling system

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Don't Know	30	4.05%	4.05%	104	5.53%	5.53%
0-4	235	31.71%	31.71%	517	27.51%	27.51%
5-9	243	32.79%	32.79%	607	32.30%	32.30%
10-14	127	17.14%	17.14%	382	20.33%	20.33%
15+	106	14.30%	14.30%	269	14.32%	14.32%
Total	741	100.00%	100.00%	1879	100.00%	100.00%

Water heater fuel

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Electric	246	33.20%	33.47%	596	31.72%	31.92%
Natural gas	482	65.05%	65.58%	1252	66.63%	67.06%
Other	7	0.94%	0.95%	19	1.01%	1.02%
Total	735	99.19%	100.00%	1867	99.36%	100.00%
No Response	6	0.81%		12	0.64%	
Total	741	100.00%		1879	100.00%	

Water heater age

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Don't Know	7	0.94%	0.94%	20	1.06%	1.06%
0-4	291	39.27%	39.27%	704	37.47%	37.47%
5-9	305	41.16%	41.16%	746	39.70%	39.70%
10-14	112	15.11%	15.11%	321	17.08%	17.08%
15+	26	3.51%	3.51%	88	4.68%	4.68%
Total	741	100.00%	100.00%	1879	100.00%	100.00%

Stove fuel

	Kentucky Kits			Kentucky No Kits		
	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Electric	556	75.03%	75.75%	1437	76.48%	76.76%
Natural gas	165	22.27%	22.48%	410	21.82%	21.90%
Other	13	1.75%	1.77%	25	1.33%	1.34%
Total	734	99.06%	100.00%	1872	99.63%	100.00%
No Response	7	0.94%		7	0.37%	
	741	100.00%		1879	100.00%	

Oven fuel

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Electric	513	69.23%	78.20%	1315	69.98%	79.12%
Natural gas	135	18.22%	20.58%	324	17.24%	19.49%
Other	8	1.08%	1.22%	23	1.22%	1.38%
Total	656	88.53%	100.00%	1662	88.45%	100.00%
No Response	85	11.47%		217	11.55%	
Total	741	100.00%		1879	100.00%	

Dryer fuel

	Frequency	Percent	Valid Percent	Frequency	Percent	Valid Percent
Electric	604	81.51%	82.18%	1504	80.04%	80.38%
Natural gas	114	15.38%	15.51%	336	17.88%	17.96%
No clothes dryer	17	2.29%	2.31%	31	1.65%	1.66%
Total	735	99.19%	100.00%	1871	99.57%	100.00%
No Response	6	0.81%		8	0.43%	
Total	741	100.00%		1879	100.00%	